FIRST ISLANDERS

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Prehistory and Human Migration in Island Southeast Asia

Peter Bellwood

With invited contributions by (in order of appearance)
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Marc Oxenham, Truman Simanjuntak, Mariko Yamagata,
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For my wife Claudia Morris, who has supported me in writing this book with her love and her considerable editorial skills.

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I wish also to thank the many Wiley editorial staff members who helped bring this book to fruition, especially former Wiley editor Mark Graney who sent me the contract in September 2015, copy editor Joanna Pyke who flushed out all the little gremlins in the text, current Wiley editor Tanya McMullin in the Oxford office, and production editor Vimali Joseph and project editor Manish Luthra in the Chennai office.

Finally, I must also emphasize the increasing contributions made to understanding the human past in Island Southeast Asia by indigenous archaeological researchers in Taiwan, Vietnam, the Philippines, and Indonesia. My bookshelves literally sag under the weight of their productions in the Chinese, Vietnamese, and Indonesian languages (and of course in English from the Philippines). Many archaeologists from these countries have studied their archaeology to MA and PhD level with me at the Australian National University in Canberra. I hope that this book can contribute something towards an understanding of the past of Island Southeast Asia by the indigenous populations of the region, scholars, and general public alike. Pride in one's ancestors, if handled with good sense, can hopefully fuel a desire to understand other people's ancestors and to bring some peace to a troubled world.

Chapter 1
Introducing *First Islanders*

The islands of Southeast Asia – Sumatra to the Moluccas, Taiwan to Timor (Figure 1.1) – present prehistorians with a unique opportunity to study some of the earliest recorded interactions between humanity and the oceans. This region has witnessed some remarkable changes in geographical configuration throughout the past 1.5 million years, throughout both an extinct hominin and an extant *Homo sapiens* presence. Land bridges have alternated with coastal submergence and tectonic activity has created some of the greatest volcanic eruptions in earth history, together with very rapid rates of crustal movement. An amazingly diverse variety of tropical wildlife (including humans!) has passed to and fro, some across land bridges and some across one of the most significant biogeographical divides on earth, which many of us know as the "Wallace Line." This delineates the western edge of the Wallacea region of biogeographers, which extends from Borneo and Bali across to the continental shelf of New Guinea and Australia. Because of its multiple sea passages, Wallacea has always separated the Asian and Australian continents, ensuring that cattle and pigs never met kangaroos and wombats until humans started to interfere with their natural distributions.

In terms of ocean travel, hominins reached the island of Flores across at least two sea passages around 1 million years ago, or perhaps before. Modern human ancestors crossed multiple sea passages to reach Australia and New Guinea at least 50,000 years ago. Within the past 5000 years these islands have fueled the genesis of the greatest maritime migration in human prehistory, that of the Austronesian-speaking peoples, who made absolutely incredible canoe voyages to reach places such as Guam, Madagascar, Easter Island, New Zealand, Hawaiʻi, and even South America. These voyages occurred over a period of more than 4000 years, dating between 3000 BCE and 1250 CE if we begin in Neolithic Taiwan and end with the Maori settlement of New Zealand, but the sheer achievement demands great respect from all humanity and indeed was the main attraction that persuaded me to migrate from England to New Zealand in 1967, in order to study Polynesian origins and archaeology (Bellwood 1978a, 1978b, 1987).

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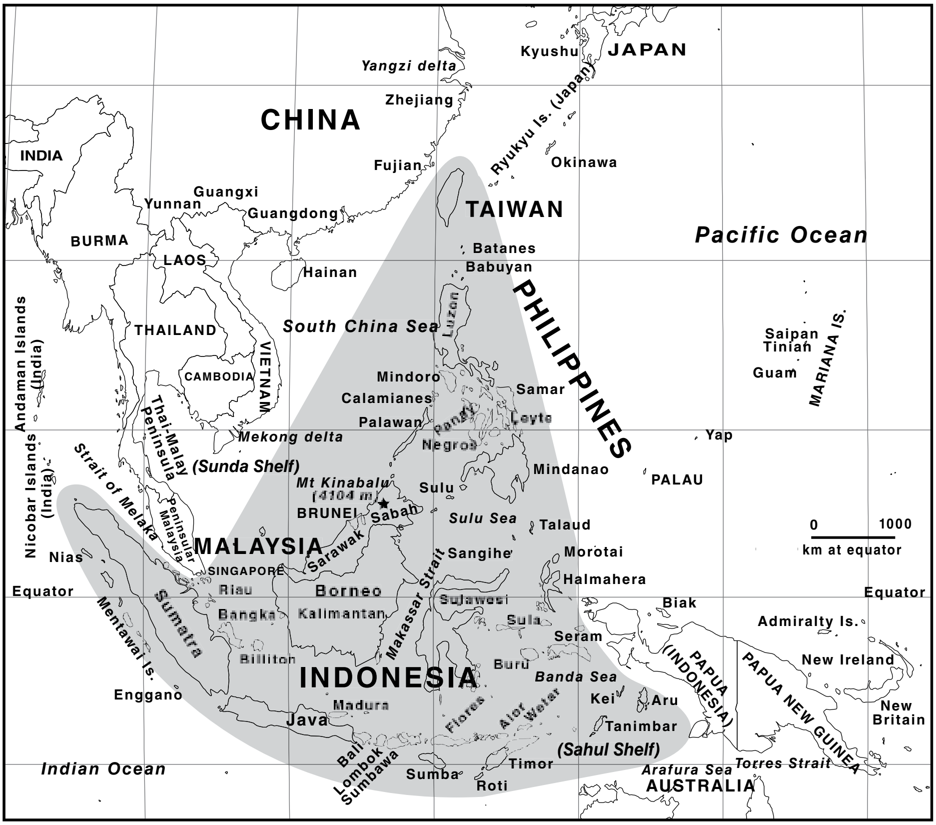

Figure 1.1 The basic geography and definition (shaded area) of Island Southeast Asia in its regional setting. Source: base map by Multimedia Services, ANU; details added by the author.

During my career as an archaeologist, I have to admit that I have always found the ancestries and migrations of human populations, whether still living, or extinct and deep in the past, to be amongst the most interesting aspects of human prehistory. This book, therefore, presents a multidisciplinary reconstruction of the biological and cultural migrations of the inhabitants of Island Southeast Asia during the past 1.5 million years, finishing on the eve of the early historical Indic and Islamic kingdoms and religions between 500 and 1500 CE. With its focus on migration, this book links with my three other recent Wiley-Blackwell books – *First Farmers* (2005), *First Migrants* (2013), and *The Global Prehistory of Human Migration* (ed. 2015). For *First Islanders* the geographical canvas is far smaller, although I must on occasion extend my investigations as far away as the Yangzi Valley, Mainland Southeast Asia, Australia, and the islands of Oceania in order to put everything into its proper perspective.

I have also traveled a great deal in Island Southeast Asia during my career, as no doubt will have many readers of this book, and one fundamental observation never ceases to interest me. The seasoned traveler in Island Southeast Asia will be impressed by the panoply of ancient Hindu and Buddhist temples in Java, by the cultural achievements of Hinduism in Bali, by the modern vibrancy of Islam in most regions of

Indonesia and Malaysia, and by the extensive influence of Christianity in the Philippines and parts of eastern Indonesia. These cultural and religious traditions were, and still are, very different in many ways from those of prehistoric times. They were external to Southeast Asia in origin, and even if the outsider religions sometimes became admixed with indigenous beliefs they still reflected the penetration of Southeast Asia by the cultural and religious interests of far-away societies. With this in mind, it is remarkable to me that the modern Island Southeast Asian peoples themselves, in their biology and languages, are entirely indigenous and have been so since long before the age of international trade and empires. These people do not speak languages derived from Sanskrit, Arabic, Spanish, or Dutch, and have never done so, despite a borrowing of large numbers of often specialized vocabulary items from these external linguistic sources. They carry indigenous DNA, apart from some minor immigration of genes, mostly on the male side, during historical times.

Anyone who has read Alfred Crosby's *Ecological Imperialism* (1986) will realize why this situation exists. The indigenous populations of Island Southeast Asia were already numerous and densely settled 2000 years ago, living in a tropical landscape that was unsuitable for more westerly Eurasian settlers with their Fertile Crescent domesticated crops and animals. They were also protected by a suite of diseases that literally stopped many would-be invaders from temperate lands dead in their tracks. Unlike their less fortunate cousins in the heavily colonized regions of the Americas and Australasia, Island Southeast Asians lived sufficiently close to the teeming populations of Eurasia to be only lightly affected by the diseases of immigrants, to which they had reasonable levels of immunity. Instead, their own tropical diseases often turned the tables in the other direction, as any visit to an early European cemetery in the region will probably reveal.

In other words, the peoples of Island Southeast Asia, in terms of biological and linguistic genesis, were essentially in existence almost as they are now by at least 2000 years ago. Since that time there has been a great deal of population admixture over the whole of Island Southeast Asia, as is to be expected given the lively history of the region in trade, commerce, and sea-borne interaction. But were we to travel with a time machine across the region in 500 BCE, the faces that would hopefully smile at us as we landed on each island would look essentially much as they do today.

This Book

The predecessor of this book, entitled *Prehistory of the Indo-Malaysian Archipelago*, was first published in 1985 by Academic Press in Sydney. A revised edition was published in 1997 by the University of Hawai'i Press in Honolulu, and translated into Bahasa Indonesia as *Prasejarah Kepulauan Indo-Malaysia* by PT Gramedia Pustaka Utama in Jakarta in 2000. In 2007, the ANU E Press (now ANU Press) republished the revised edition as a third edition, but with only a new preface – the remainder of the text was reprinted exactly as it was in 1997. This third edition remains in print, available for free download at http://press.anu.edu.au/titles/prehistory-of-the-indo-malaysian-archipelago/, and it continues to reflect the state of knowledge about the region in the mid-1990s. What you are about to read here is a new book that builds upon the foundation of *Prehistory of the Indo-Malaysian Archipelago*, rewritten and updated with a new title and a new chapter organization.

Why a new book? The answer is basically that *Prehistory of the Indo-Malaysian Archipelago* is now out of date and simple revision of the existing structure is no longer sufficient. The time has come for a new perspective, not just from me, but also from a number of my colleagues who specialize in areas of research that are becoming ever more complex and prolific, such that a single individual can no longer keep on top of absolutely everything. For instance, here are some important aspects of Island Southeast Asian prehistory that have undergone fundamental change in terms of both data and interpretation since the text of the second edition of *Prehistory of the Indo-Malaysian Archipelago* was submitted to the publisher in 1995:

1. The Pleistocene biogeography of Island Southeast Asia is better understood now than 20 years ago, especially in terms of the glacial–postglacial fluctuations in sea level, temperature, and rainfall during the past 100,000 years. Much new research has, of course, been driven by the current world concern with the dangers posed by the El Niño climatic phenomenon and by anthropogenic global warming.
2. As far as new discoveries in the Southeast Asian fossil record are concerned, we can point to the 2003 and 2016 publications of the bones of a new hominin species from Flores island in eastern Indonesia, the tiny *Homo floresiensis*, as well as to other small archaic hominin remains dating from almost 70,000 years ago from northern Luzon in the Philippines. There have also been considerable strides in the craniometric analysis and absolute dating of many early modern human (*Homo sapiens*) remains from Late Pleistocene contexts.
3. It is now generally agreed by geneticists, biological anthropologists, and archaeologists alike that ancestral *Homo sapiens* did not evolve "multiregionally" all over the Old World, but evolved in and spread out of Africa between 100,000 and 50,000 years ago. For instance, few today would favor continuous multiregional evolution from *Homo erectus* in Java into the modern indigenous populations of Indonesia and Australia/New Guinea. There was, however, some degree of admixture between modern humans and archaic (and now-extinct) hominin species, such as Neanderthals in western Eurasia and so-called "Denisovans" in Southeast Asia. None of this was at all clear in 1995, although even then I tended to favor an "Out of Africa" rather than multiregional scenario for the origins of *Homo sapiens* in Eurasia.
4. There have been absolutely fundamental advances in the past decade in understanding the biochemistry of the human genome, both modern and ancient. In 1995, little could be stated from genetics about deeper human history beyond the level of mitochondrial DNA, blood groups and serum proteins, since whole genome and ancient DNA studies were simply not available at that time. Today, geneticists can scan and compare whole human genomes and even extract DNA from 300,000-year-old

skeletal remains (in Europe, but not yet in Southeast Asia!). The advances in genetic knowledge about population origins and ancestries have been astonishing, and are coming to dominate international publication venues.

5. The most recent statistical analyses of craniofacial variables in prehistoric cemetery populations are also of tremendous importance and allow us to witness the arrival of an Asian Neolithic genetic and phenotypic population throughout much of Island Southeast Asia, commencing about 3500 BCE in Taiwan. This population admixed with the preceding Australo-Papuan populations who were dominant to as far north as southern China and Taiwan prior to the Neolithic. The results are still visible today in many populations in southern and eastern Indonesia.
6. There have been major advances in recent years in understanding the beginnings of rice and millet agriculture in central China and the consequent spreads of Neolithic farming economies and human populations with rice, pigs, and dogs into southern China, Taiwan, the Philippines, and Vietnam. There have also been major archaeological research projects in Taiwan, the Philippines, and Indonesia that provide much clearer dating and directionality for the whole Neolithic migration process.
7. In collaboration with several of my colleagues who have contributed their invited perspectives to the following chapters, evidence is provided in support of a very important Neolithic movement through Taiwan into the Philippines, carrying Austronesian languages and Neolithic material culture, including the cultivation of rice. This commenced sometime between 2500 and 2000 BCE and passed through the Batanes Islands into northern Luzon. Although this "Out of Taiwan" hypothesis still has critics, in my view none provide a coherent multidisciplinary case for any other *major* hypothesis to explain the ancestry of early Austronesian-speaking populations. While the Out of Taiwan hypothesis was clearly stated in *Prehistory of the Indo-Malaysian Archipelago*, the multidisciplinary evidence in favor of it has now become overwhelming.
8. In various stages between 2200 BCE and 1200 CE, ancestral Austronesian-speaking peoples undertook further migrations across a vast area of the earth's surface. They settled throughout the Philippines and Indonesia, in all of the Pacific Islands beyond the Solomons, and westwards into Peninsular Malaysia, Vietnam, and Madagascar. Accordingly, it is possible to add new observations on the first truly long-distance voyagers in world prehistory, for instance the ancestral Chamorro population of the Mariana Islands and the people who produced Lapita pottery in Island Melanesia and western Polynesia. The movement from the Philippines to the Marianas around 1500 BCE marked the beginnings of Austronesian long-distance seafaring, in this case perhaps across 2300 km of open sea. The Lapita movement around 900 BCE from Island Melanesia into western Polynesia, by populations now known to be of Asian Neolithic genetic ancestry, continued this expansion process and eventually led to the settlement of the furthest-flung islands on the earth's surface.
9. Although New Guinea is not dealt with in detail in this book since it is not considered a part of Island Southeast Asia, major advances in understanding the

archaeological record of the New Guinea Highlands reveal this area to have been an indigenous source of a food-producing economy in the mid-Holocene, with potential repercussions in the prehistory of eastern Island Southeast Asia and Island Melanesia.

10. There have been major advances in post-Neolithic archaeology in Island Southeast Asia, especially concerning the exchange of Taiwan nephrite ear ornaments across and around the South China Sea. New understanding has also developed of Indian contact-era archaeology through the excavation of settlements dating to around 2000 years ago in southern Thailand and Bali, and of the impact, by around 500 BCE, of bronze-working traditions of Mainland Southeast Asian origin on the indigenous Early Metal Age societies of western Indonesia. The Early Metal Age also witnessed the migrations out of Island Southeast Asia (especially Borneo) of ancestral Chams to Vietnam, Malays to Peninsular Malaysia, and Malagasy to Madagascar. Interestingly, Taiwan at this time continued to interact mainly with other regions of Southeast Asia, rather than with Qin and Han Dynasty China.

This new book differs from its predecessors in my decision to ask many of my colleagues to add short chapters, under their own names as authors, describing their disciplinary perspectives on specific aspects of Island Southeast Asian prehistory. The total field covered by this book has now grown very large and the rate of publication increases continually, not just in quantity but also in degree of complexity. The time has come for collaboration between disciplinary specialists, and while I can read and understand what scholars in disciplines outside my own field (archaeology) have to say, I feel more comfortable if they also appear in person and in support. I do not wish to suggest that all will agree entirely with my views, since research in a field of the humanities such as human prehistory cannot proceed very far if everyone agrees in total unison. But I also know that our views are mostly in accord.

I should also add that in *First Islanders* I have replaced the term "Indo-Malaysian Archipelago" with "Island Southeast Asia." The former, while undoubtedly still valid and mellifluous, can give a wrong impression that this book is concerned only with Indonesia and Malaysia, thus leaving out Taiwan and the Philippines. Another difference between this book and *Prehistory of the Indo-Malaysian Archipelago* is that the latter still contains additional sections on the ethnography of the modern inhabitants (Chapter 5), on the Hoabinhian lithic industries of southern Thailand and Peninsular Malaysia (part of Chapter 6), as well as on the Neolithic of the Malay Peninsula (Chapter 8). I consider these sections still to be reasonably up to date and they have not been imported into *First Islanders*, which is focused more deeply on Island Southeast Asia *per se* rather than the Malay Peninsula, and on prehistory prior to 500 CE as reconstructed from the disciplines of archaeology, linguistics, genetics, and biological anthropology. *First Islanders* also has a stronger focus on human migration than did *Prehistory of the Indo-Malaysian Archipelago*.

A Note on Dating Terminology

Chronological statements in this book are always based on solar years, expressed as "years ago" for the Pleistocene and early Holocene (11,700 to 8200 years ago for the latter), and thereafter BCE (Before Common Era) and CE (Common Era, i.e., after AD 1) for the middle and late Holocene. Dates in millions of years ago are abbreviated to **mya**, and in thousands of years ago to **kya**. In a broad-scale review such as this, there is no need to refer to individual uncalibrated laboratory radiocarbon determinations.

The terms Pleistocene and Holocene refer to geological epochs. The former spanned the period from 2.58 mya to 11.7 kya, the latter date marking the end of the Younger Dryas brief return to glacial climatic conditions (Head et al. 2015). The Holocene has spanned the past 11,700 years (or roughly 10,000 uncalibrated radiocarbon years) and is still unfolding. It commenced with the establishment of current interglacial climatic conditions across the world after the Younger Dryas, and has witnessed the rise of humanity from a universal baseline of hunting and gathering through food production to statehood and global domination. The Pleistocene was preceded by the Pliocene, within which the earliest recorded stages of human evolution occurred in Africa.

The Pleistocene is divided into three periods of unequal length: Early Pleistocene from 2.58 mya to the Brunhes-Matuyama paleomagnetic reversal at 790 kya, Middle Pleistocene from 790 kya to the beginning of the last interglacial at 130 kya, and Late Pleistocene from 130 kya to the beginning of the Holocene at 11.7 kya. The Late Pleistocene contained the penultimate interglacial and final glacial periods, a time of massive change in global environments in which anatomically and behaviorally modern humans were propelled into prominence, and other more archaic hominin species in Indonesia, such as *Homo erectus* and *Homo floresiensis*, finally succumbed to extinction.

A Note on Archaeological Terminology

The basic structure of this book still revolves around the technological phase, or "age," system that has underpinned Eurasian (but not American!) archaeology since the nineteenth century. I make no apologies for this, but stress that clear definition is necessary from the outset, especially when we are discussing the evolving products of human technology (stone, bone, shell, pottery, metal, glass, etc.). There are four fundamental technological phases across the Southeast Asian region, overlapping in date and cultural content, but each also marked by one or more new marker combinations or appearances.[1]

Paleolithic. In Island Southeast Asia, the Paleolithic continued from the first Pleistocene appearance of stone tools in Java and Flores to the regional beginnings of the Neolithic, the latter between 3500 BCE in Taiwan and 1500/1300 BCE in southern and eastern Indonesia. In general, the Paleolithic was characterized by flaked and unground stone, bone, or shell tools, but in its terminal Pleistocene phases and into the Holocene there were a number of additions to the basic Paleolithic repertoire in Island Southeast Asia. These included edge-ground stone tools (Niah Cave, Sarawak), bifacial points (Sabah), ground shell tools (Philippines, southeastern Indonesia, and Timor-Leste), and microliths and backed flakes/blades (South Sulawesi). Further afield, the world's oldest examples of edge-grinding are reported from Japan (Izuho and Kaifu 2015) and tropical northern Australia (Geneste et al. 2012), dating back to around 38 kya. The Paleolithic was the long time span when both archaic hominins and early modern humans appeared in Island Southeast Asia, although the secondary elaborations just listed belong to a time when archaic hominins were extinct and only modern humans existed.

Para-Neolithic. This term Para-Neolithic[2] is used for a specific set of sites in southern China, northern Vietnam, and possibly Peninsula Malaysia that are defined by continuing hunter-gatherer economies and Paleolithic technology, but with the additions of *both* fully polished and symmetrically beveled stone axes, usually hammer-dressed from river pebbles, *and* simple vine-rolled or cord-marked pottery with gently inflected rather than angular rim and body contours. The presence of both of these artifact categories means that this phase deserves a special recognition. These Para-Neolithic sites belong to the early and middle Holocene and were located on the southern fringes of the contemporary central Chinese Neolithic, which commenced around 7000 BC. No examples are yet reported from Island Southeast Asia. The Para-Neolithic sites of China and Vietnam are discussed further in chapters 4 and 5, partly because of their carefully analyzed human burials with their implications for population history in Island Southeast Asia.

Neolithic. The Neolithic in Southeast Asia is defined by a presence of domesticated animals and crops, polished stone uni-beveled adzes (as opposed to axes) and body ornaments, and pottery of complex shape and decorative style (slipped, stamped, incised, with angled or inflected body contours and rims). One must bear in mind that very few tropical sites in Island Southeast Asia have paleobotanical records, so dogmatic statements to the effect that food production did or did not exist in specific archaeological circumstances are to be avoided. However, food production in general is an essential element of the Neolithic definition and its presence in Island Southeast Asia is strongly supported by Austronesian comparative linguistic data and increasing numbers of archaeobotanical analyses, especially in Taiwan and the northern Philippines. The Neolithic was also a period of major demographic growth according to archaeological and cranial/genetic data, the latter documenting the immigration of a population from southern China and Taiwan with Asian Neolithic as opposed to Australo-Papuan craniometric and genetic affinities. The Neolithic in Southeast Asia is associated with the first large-scale open-air settlements of village type, and Neolithic burials were mostly extended supine or placed in large earthenware jars, often with pots or body ornaments as grave goods, unlike their tightly folded Paleolithic and Para-Neolithic predecessors.

Early Metal Age. The Early Metal Age, or "Paleometallic" in much Indonesian literature, is marked by the appearances of copper, bronze, and iron, with the oldest items of copper/bronze dating to about 600–500 BCE in southern Sumatra and iron perhaps a little later. Bronze appeared slightly before 1000 BC in Vietnam and Thailand, thus definitely earlier than iron, and bronze was present even earlier (by 2000–1500 BCE) in central China. The Early Metal Age is also associated with the first evidence of contact with traders from the growing Hindu and Buddhist civilizations of Gangetic and eastern peninsular India, with Sri Lanka. In Taiwan, the Early Metal Age commenced around 400 BCE, surprisingly with almost all attested cultural contacts with Island Southeast Asia to the south rather than with contemporary dynastic China.

The period after 400 CE is essentially **Early Historical**, focusing on early trading networks involving China and India, located in regions such as the Red and Mekong river deltas, the Malay Peninsula, Sumatra, and Java. By 500 CE, inscriptions in Sanskrit and Austronesian languages, together with the first temples dedicated to Indic religions such as Hinduism and Buddhism, were beginning to appear across the region from Burma to eastern Borneo. This book is not concerned in detail with the Early Historical period or its art history, except for its roots in the indigenous societies of the preceding Early Metal Age.

The reader will note that I have not attempted to put rigid chronological boundaries around the above archaeological ages, simply because the pace of new discovery, with so many new radiocarbon dates being published all the time, makes absolute precision rather an elusive concept. Furthermore, in recent millennia we see gradients in the dating of shifts between ages, for instance into the Neolithic, as we move across geographical space. Absolute chronology is of enormous importance in specific instances of understanding how peoples and cultures have evolved through time, but imposition of a region-wide chronology for no specific purpose is unwise.

Pronunciation and Place-names

In Indonesian place-names the "c" is pronounced "ch" as in English "church," "ng" is pronounced as in "singer," and "ngg" as in "finger." The common place-name elements *gua* (cave or rock shelter), *liang* (aperture or cave), *gunung* (mountain), *bukit* (hill), *tengkorak* (skeleton), *tulang* (bone), *angin* (wind), *sungai* (river), *batu* (rock), and *kota* (town) are all in the modern Bahasa Indonesia and Malay vocabularies. Chinese place-names are all in *pinyin* Romanization for both China and Taiwan. Vietnamese place-names are rendered without diacritical (tone and vowel) marks.

Notes

1. Naturally, in preparing this edition I have thought deeply about the possibility of replacing this phase sequence with another classification, but any such classification will always involve a presence of human behavioral concepts that are often very hard to verify from the archaeological record. For instance, Indonesian archaeologists (e.g., Soejono 1984) have for many years used a three-part descriptive terminology that relates directly to aspects of behavior. This commences with *masa berburu dan mengumpulkan makanan* (age of hunting and food collection), with simple and extended (*sederhana* and *lanjut*) phases that correspond

to the single-phase Paleolithic as defined here. It then progresses into *masa bercocok-tanam* (age of planting, or Neolithic), and finishes with *masa perundagian* (age of craftsmanship, or Early Metal Age). Use of such a system does not in my view solve the problem of classifying the hundreds of undated sites in Island Southeast Asia that lack diagnostic artifacts or economic evidence, any more than does the system advocated here. I suggest we keep the *status quo*.

2. I am using the Oxford Dictionary definition of the prefix para-, meaning "beside" (as in "paramilitary"), or "beyond" (as in "paranormal").

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Chapter 2
Island Southeast Asia as a Canvas for Human Migration

For the purposes of this book, Island Southeast Asia includes Taiwan, the Philippines, Brunei and the Sarawak and Sabah provinces of East Malaysia (northern Borneo), and all of the islands of Indonesia to the west of New Guinea (Figure 1.1). Adjacent regions to the west and north that will also require extended comment in the following chapters include the Thai-Malaysian Peninsula, Vietnam, southern Thailand, and southern China below the Yangzi River. To the east lies the Greater Australian continent comprising Australia and New Guinea (with its two political divisions of Indonesian Papua and independent Papua New Guinea). Beyond New Guinea lie the islands of the Pacific Ocean, or Oceania.

Island Southeast Asia thus extends from about 25° north latitude (northern tip of Taiwan) to 11° south (Sumba and Timor) and from the western tip of Sumatra to the Moluccas in the east. The region is about 4200 km long from west to east and a similar distance from north to south. It now supports 400 million humans who live on about 2.5 million km^2 of dry land, of which about 75% is located in Indonesia. During Pleistocene periods of glacial low sea level and continental shelf emergence, the area of land exposed above the sea in Island Southeast Asia increased to a maximum of 4.5 million km^2, although the length of exploitable coastline actually decreased under these conditions to as low as one half of the present length (Dunn and Dunn 1977).

The islands of this region differ greatly in size. Borneo[1] covers 750,000 km^2 (only slightly smaller than New Guinea, at 785,000 km^2). Sumatra comes next with 475,000 km^2, then Sulawesi (180,000 km^2) and Java (139,000 km^2). The Philippines occupy 300,000 km^2 of land in total, but because of their tectonic history, with seabed subduction from both west and east (Figure 2.1), these islands form a uniquely compact archipelago organized around a chain of small inland seas. In many ways, the Philippines can be regarded as a single landmass for archaeological analysis. Taiwan, located off the coast of southern China but until the seventeenth century ethnically and linguistically a part of Island Southeast Asia, covers 36,000 km^2.

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

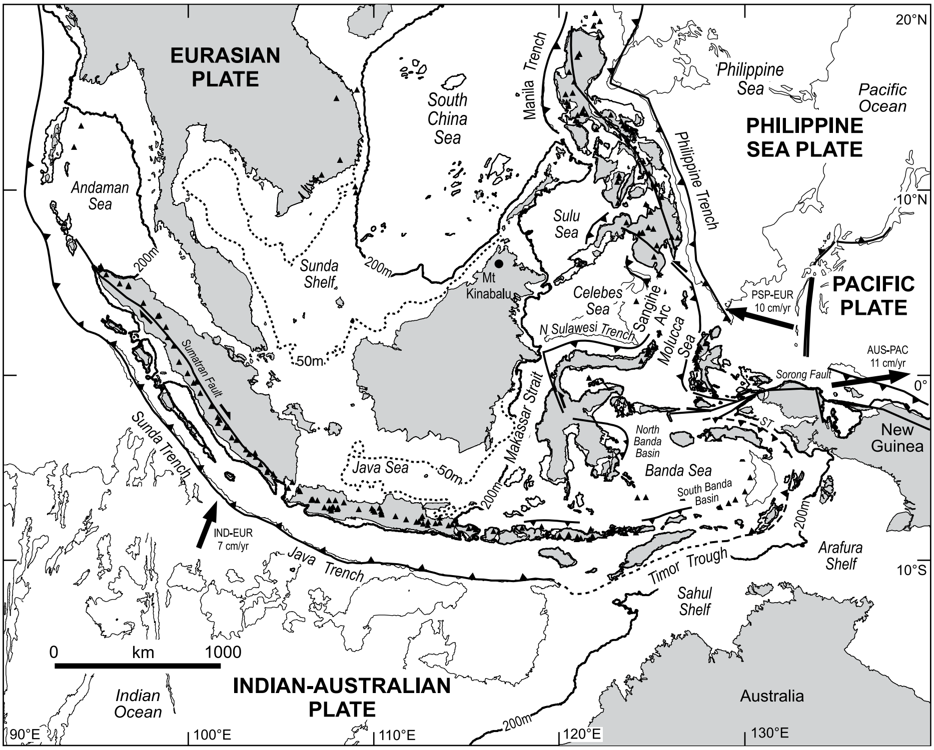

Figure 2.1 Structural map of Southeast Asia and Australasia showing the main lines of continental plate subduction (in the direction of the arrows, sliding downwards beneath the landmasses), the Sunda and Sahul shelves (delimited by the 200 m bathymetric contour), and the volcanic arcs. The 50 m bathymetric contour is also shown as a dotted line for the main portions of Sundaland, since coastlines would have approximated this shape between glacial and interglacial maxima during much of the Pleistocene. Volcanoes are shown as black triangles. Source: base map courtesy of Robert Hall (2012: Figure 3.1) and The Systematics Association, modified slightly by the author.

The Shelves and Basins

The islands of western Indonesia are in general larger than those of eastern Indonesia and the reasons for this lie in the structure of the archipelago. The Southeast Asian islands, "the remarkable festoon of islands that swing around the equator in the East Indies" (Umbgrove 1949), fall into three fundamental structural divisions (Figure 2.2). The first, forming a direct extension of the Asian mainland, comprises the Sunda continental shelf – the ancient and stable "Sundaland." The second, the Pliocene and Pleistocene Sunda–Banda volcanic arc, is attached to the Indian Ocean edge of the Sunda shelf and extends eastwards beyond it into Nusa Tenggara (the Lesser Sundas) and the southern Moluccas. The third consists of the Sangihe, Philippine, and Halmahera volcanic arcs, with their extensions northwards

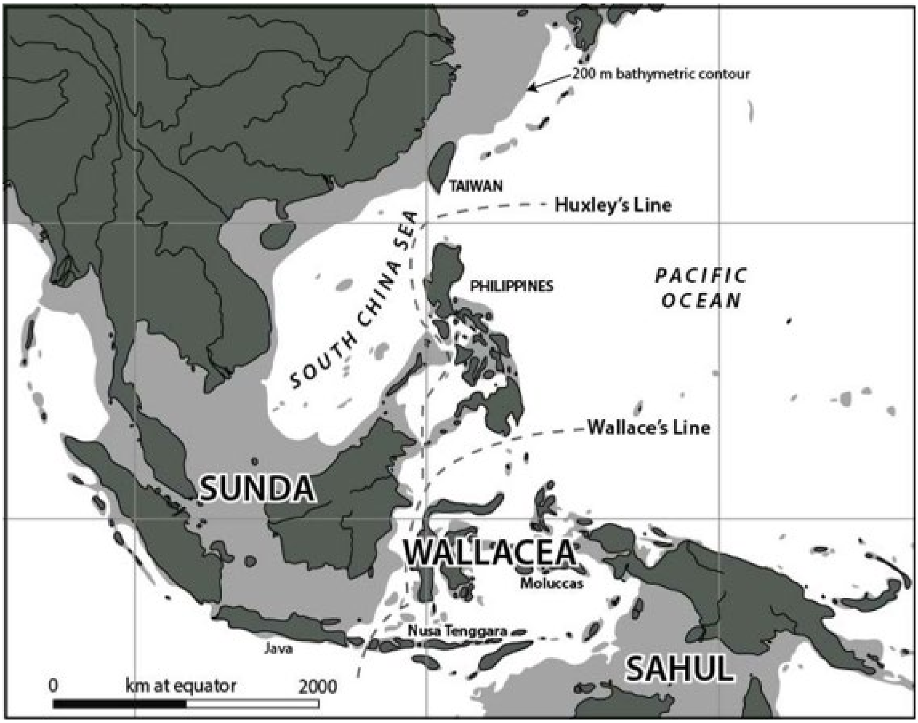

Figure 2.2 Major biogeographical divisions and boundary lines within Island Southeast Asia, especially Sundaland, Wallacea, and Sahul, shown at an absolute maximum bathymetric contour of −200 m, which was never actually attained during the Pleistocene. Separate Philippine land masses (too complex and close together to show in this map) during glacial periods of maximum low sea level (−120 m) would have included (a) Luzon; (b) Mindanao, Samar, Leyte, and Bohol; (c) Panay, Negros, and Cebu; (d) Palawan; (e) Sulu; (f) Mindoro (after Croft et al. 2006: Figure 1; Robles 2013). Source: base map by Multimedia Services, ANU; details added by the author.

towards Taiwan and Japan. These volcanic arcs are shown in the form of individual volcanoes (black triangles) in Figure 2.1.

The Sunda shelf proper supports the largest area of shallow submerged continental edge in the world, built around an old and fairly stable Mesozoic core that has had little recent volcanic activity. Much of the shelf lies beneath the sediments of the South China and Java seas as a virtual peneplain worn down by erosion. Present land areas that rise directly from the old partly submerged shelf core include the Thai-Malaysian Peninsula, Borneo, and the northern coastal lowlands of Sumatra, Java, and Bali.

The volcanoes of the Sunda–Banda arc were formed by crustal subduction of the Indo-Australian plate along the Indian Ocean rim of the Sunda shelf and beyond it to the east. They form the highland spines of Sumatra, Java, and Nusa Tenggara and are visually one of the most remarkable volcanic mountain systems in the world.

The arc is actually expressed as two separate island chains, the inner and higher one being volcanic and the outer and lower one consisting of uplifted sediments (including widespread coral limestones) without active volcanoes. The inner chain includes 82 active volcanoes that extend in a curve from Sumatra through Java and into Nusa Tenggara. Outside this arc lies a deep marine trench, beyond which rise the non-volcanic outer arc islands off the western coast of Sumatra (Nias, Simeulue, Mentawai, and Enggano), as well as the southeastern islands of Sumba, Timor, and Tanimbar. The Sunda–Banda arc is still in active construction as demonstrated by very frequent volcanic eruptions, such as Tambora in 1815 and Krakatoa in 1883, and earthquakes, including that which produced the Indian Ocean tsunami of 2004.

The Sangihe, Philippine, and Halmahera volcanic arcs are of Pacific basin origin, having originally moved westwards since 20 mya from original positions north of New Guinea. They are similar to but much smaller than the Sunda–Banda arc, and other such arcs continue northward around the western Pacific rim to form a "Ring of Fire" through the Ryukyu Islands, Japan, and the Aleutians.

General accounts of the formation through geological time of the Island Southeast Asian region have been given by many geologists and earth scientists and a number of reconstructions with animated colored maps have been published by geologist Robert Hall (2002, 2012, 2013). In recent years it has become clear that Sundaland has a complex geological history, being composed not just of successive volcanic arcs but also of numerous continental fragments, including some from Australia, forged together through subduction, crustal rafting, and volcanic arc formation at different times since the Triassic (250–200 mya). Much of the present shape of Sundaland also reflects an increased rate of plate subduction and tectonic activity during and since the Eocene, starting around 45 mya (Hall 2013).

One interesting aspect of all of this continental movement is that it has allowed some degree of mixing of very different floras and faunas through geological time, the faunas coming from separate Asian placental and Australasian marsupial evolutionary origins. The northward drift of Australia has been occurring at a rate of about 80 km per million years since this landmass began its migration from Gondwanaland early in the Tertiary. The eventual result was that some outer crustal fragments that split off the Australian continent began to collide with the Sunda–Banda arc and the eastern part of Sulawesi. The geological structure of the Wallacean region of Indonesia is therefore particularly complex, with the Australasian plate contributing portions of the two eastern arms of Sulawesi, plus Timor, Seram, Buru, and the Sula Islands. Western Sulawesi apparently became separated from eastern Borneo and moved eastwards during the Eocene, around 45 mya. The island began to approach its present composite and complex shape with major uplift and collision with the Australasian crustal fragments during the Pliocene. As a result, Sulawesi has a unique endemic fauna of both placental and marsupial mammals.

Whatever the underlying geological forces, the Southeast Asian archipelago had attained much of its present basic shape by the time hominins[2] first arrived, around 1.8–1.2 mya, although some regions such as eastern Java and some smaller Sunda–Banda islands might have been still emerging at that time. In terms of human and biotic developments, the three major structural divisions just described can be rearranged into three west to east biogeographical divisions of much more direct relevance for human prehistory. These are Sundaland in the west, Wallacea in the middle, and the separate Sahul continent to the east (Figure 2.2).

Sundaland

Sundaland comprises the regions on or attached to the present Sunda shelf – the Thai-Malaysian Peninsula, Sumatra, Java, Borneo, and other small groups such as the Riau and Lingga Islands. Palawan is normally considered a part of Sundaland but its mammal fauna also has phylogenetic affinities with those of the Oceanic islands that form the main Philippines, including Luzon and Mindanao (Esseltyn et al. 2010). The eastern edge of Sundaland is marked by Huxley's Line of biogeographers, not to be confused with its better-known antecedent the Wallace Line, which its creator Alfred Russel Wallace drew in 1869 to the south of the Philippines (Wallace 1962:8–9; he termed it the "Division of Indo-Malayan & Austro-Malayan Regions"). Huxley's Line runs between Bali and Lombok, Borneo and Sulawesi, Borneo and the Sulu Archipelago, then east of the Calamianes and Palawan, and finally off into the Pacific between Luzon and Taiwan.

Much of Sundaland is now covered by shallow sea, but varying extensions would have been exposed as dry land by low sea levels for long periods during successive Pleistocene glaciations, especially at the peak of the last glaciation (or LGM – last glacial maximum) at about 28–18 kya, when no less than 2 million extra km^2 emerged as dry land from the shallow beds of the South China and Java seas. Drowned river channels and sediments in the beds of these seas show this long-term exposure and erosion very clearly.

Wallacea

The term "Wallacea" was first introduced into the zoogeographical literature by Dickerson (1928). He defined the region as that between Huxley's Line in the west and Weber's Line in eastern Indonesia, the latter marking a balance in species numbers between the Oriental and Australasian faunas. In this book, however, I will adopt a definition more relevant for human prehistory. Wallacea includes all those islands lying between the continental shelves of Sunda to the west and Sahul to the east, including Nusa Tenggara from Lombok eastwards to Timor, Timor-Leste, Sulawesi, the Moluccas including Tanimbar and Kei, and the Philippines with Sulu but not Palawan (which formed a long northeasterly peninsula of Sundaland). The islands of Wallacea all share one important factor – they were never land-bridged continuously (as far as we know) to any of the larger land masses to their west or east. Humans and other terrestrial animals had always to cross ocean gaps to reach and pass through them.

Wallacea has evolved as a zone of enormous crustal instability and now exists as a number of islands separated by deep ocean basins, particularly the Sulu, Sulawesi, and

Banda seas, the whole formed by rapid processes of uplift and down-faulting. Some of the enclosed seas have particularly impressive features. For instance, the Sulu Sea is 4633 m deep and yet is totally enclosed by high ridges that never sink more than 380 m below sea level. This means that the temperature of this sea remains fairly even from top to bottom, without the rapid cooling with depth found in the great oceans (Molengraaff 1921). The islands of Wallacea rise from the seabed ridges of the region and the rate of uplift has been very rapid in places; corals of presumed Pleistocene date have been reported from an altitude of 1500 m in Timor, and many islands have series of raised coral coastal terraces. Subsidence can, of course, be just as rapid, and corals of similar age have been found to depths of 1600 m on the bed of the Seram Sea.

Sahul

The Sahul shelf forms a shallow, drowned, and tectonically stable link between the Australian continent and the massive island of New Guinea – it is thus the Australasian equivalent of the Sunda shelf. The term "Sahulland" may be used to denote the New Guinea-Australian land masses (with the Aru Islands and Tasmania) when both were joined together during periods of low sea level. Environmental changes in northern Sahulland, particularly during the later Pleistocene and Holocene, are of particular significance for an understanding of similar events in Island Southeast Asia, although Sahulland is not included within Island Southeast Asia for the purposes of this book.

The Island Southeast Asian Environment

Climate

As the whole of Island Southeast Asia lies well within the tropics, temperatures are uniformly hot and vary little throughout the day or from season to season. The only major variation in temperature occurs with altitude (average temperature drops 1 °C every 160 m), but even on the highest peak in Southeast Asia, Mt Kinabalu in Sabah at 4100 m, the temperature never gets colder than an occasional night-time frost. The only permanent glaciers occur to the east in New Guinea, but only 8 km^2 of the total 785,000 km^2 of this island are so covered.

The crucial climatic variable across the region is rainfall, and for general purposes it is useful to recognize two distinct zones – equatorial and monsoonal (Figure 2.3):

1. The equatorial zone, where rain occurs all year round, lies within approximately 5° north and south of the equator. Most regions do have two slight rainfall peaks with the movement of the Intertropical Convergence Zone, but for practical purposes the rainfall is frequent, heavy, and reliable and the evergreen rainforest grows luxuriantly in constantly damp or wet soils. Peninsular Malaysia, Sumatra, western Java, Borneo, central Sulawesi, the southern and eastern Philippines, and parts of the Moluccas fall generally in this zone, as does most of New Guinea, albeit with temperature fall-off with altitude.

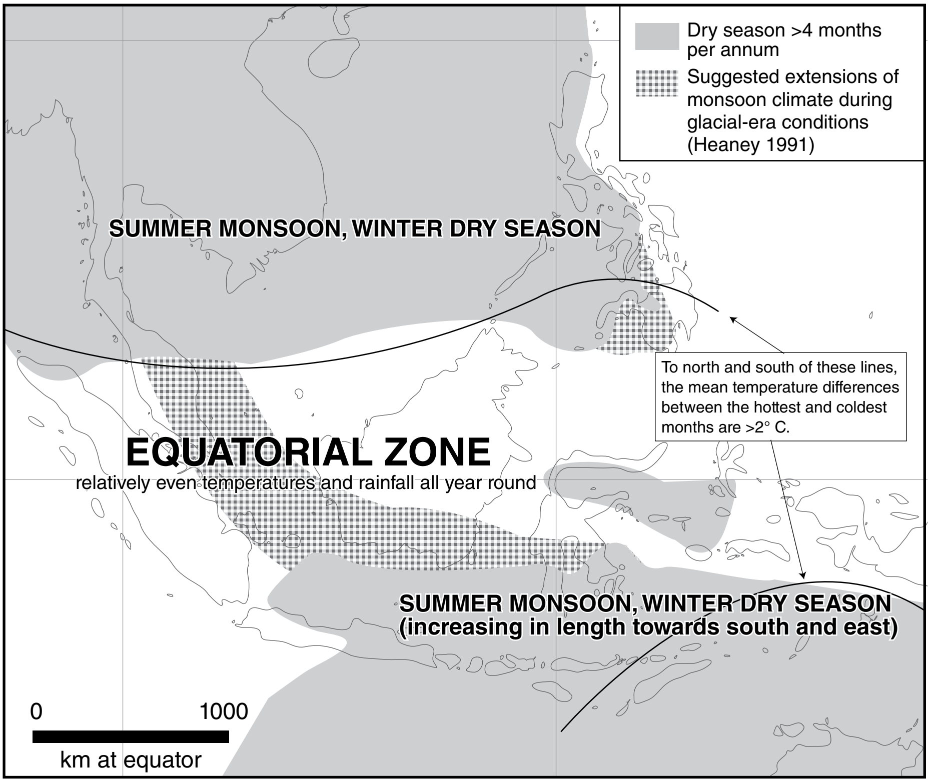

Figure 2.3 Climatic regimes and dry-season distribution in Island Southeast Asia. Source: base map by Multimedia Services, ANU; details added by the author.

2. The monsoonal zone extends beyond the equatorial zone, beyond 5° north and south of the equator, and is characterized by clearly differentiated summer wet seasons and winter dry seasons, the latter between 2.5 and 7.5 months in length. Within Southeast Asia this monsoonal zone includes the mainland north of the Malay Peninsula, the western and northern Philippines, southern Sulawesi, and the Sunda–Banda arc islands from central Java eastwards. The monsoonal zone ultimately fades into the temperate monsoonal climates of China and the deserts of central Asia and Australia. Monsoon forests tend to be more open than equatorial ones and to have a deciduous tendency during the peak of the dry season.

To explain these rainfall variations, a major feature of global air circulation concerns a constant exchange of air which flows as winds between the equator and the Poles. In the tropics, warm air is constantly rising and flowing poleward at intermediate altitudes. It cools, sinks in the fringing tropical latitudes at about 20–30° north and south and flows equatorward again as the trade or monsoon winds. The trade winds in the open Pacific, where there is no interference from large land masses, blow from the northeast in the northern hemisphere and from the southeast in the southern as a result of the earth's east to west rotation. The region where these two sets of trade winds converge and where air convection is strongest is termed the Intertropical Convergence Zone. This zone is not fixed in position but moves seasonally to north and south of the equator according to temperatures in the continental interiors of Asia and Australia.

Because of their large sizes, these two continents are responsible for modifications to the trade winds in their vicinities, giving rise to what are known as the monsoons. In January the Asian interior is cold, the Australian interior hot. The resulting pressure gradient outward from Asia deflects the Intertropical Convergence Zone southwards into the southern part of Indonesia and the northern tip of Australia (to about 10–12° south). These areas then receive their rainy seasons (southern summer), because the front is a constant formation zone of depressions and squalls and the northern hemisphere trade winds are sucked as monsoon winds southwards across the equator, bringing additional moisture from the seas that they cross.

Conversely, in the northern summer (July), the front is pushed much further to the north (up to 32° north) because Asia, as a much larger continent, has greater influence on global climate than Australia. Mainland Southeast Asia and the Philippines then get their wet seasons. The equatorial regions proper tend to have a double rainfall peak because the front passes over them twice in each year. The extended trade winds in Island Southeast Asia thus become the monsoons, which are usually named after their predominant directions.

These climatic variations are of great importance for recent prehistory and postulated changes in them were also of great importance in the Pleistocene, especially with respect to the history and changing extent of the Sundaland equatorial rainforest. Typhoons and hurricanes also form in the monsoonal zone and are common in the northern Philippines and Taiwan, where they blow in from the Pacific Ocean, and likewise in the southern hemisphere in northern Australia and the southern islands of Melanesia. They are almost unheard of in the equatorial latitudes of Indonesia and Malaysia, although current global warming appears to be pulling some equatorward into the latitude of the southern Philippines.

Landforms and Soils

Humans, animals, and plants depend not only on climate for their existence, but also on the nature of the ground upon which they live. In Island Southeast Asia there are some very important variations in landforms and soils which lie at the base of the enormous differences in population density seen today between islands such as Java and Borneo. It is apparent that they were equally important in prehistoric times.

The main soils of the equatorial ever-wet region are yellow to red leached lateritic clays that are rich in iron and aluminum, acidic, and generally low in plant nutrients and organic matter. They do, indeed, support dense and luxuriant forests, but these are products of long evolution whereby 50–80% of the nutrients are accumulated in the biomass and constantly recycled in the upper layers of the soil as vegetation grows, dies, and decays. Once these forests are cleared the cycle is broken, as the nutrients simply leach away through the exposed soil, often with disastrous results.

These lateritic soils are generally characteristic of the equatorial and non-volcanic lowlands of Sumatra, the Malay Peninsula, Borneo, Sulawesi, and southern New Guinea. Today, they support low populations because they are fairly infertile, unsuited in traditional cultivation systems to anything but shifting agriculture, and difficult for reasons of structure and excessive rainfall to bring under irrigated and terraced rice. Furthermore, the forest itself is normally always wet, hard to clear and burn with simple equipment, and subject to rapid regrowth of weeds and secondary vegetation. In addition, many low-lying Sunda Shelf coastal regions of the Malay Peninsula, eastern Sumatra, and southern and western Borneo have extensive areas of lowland peat soil, very difficult for any traditional food-producing economy apart from sago management.

The soil patterns change, however, when we move into the Philippines and southeastern Indonesia, from central Java through Nusa Tenggara. Here, the soil can be sometimes enriched by the fertile outpourings of the many volcanoes, particularly where the products are chemically of basic rather than acidic composition, as they are in central and eastern Java, Bali, Lombok, and the Minahasa Peninsula of northern Sulawesi. Most (but not all) of the Sumatran volcanoes are more acidic in this respect and consequently produce soils less favorable for agriculture.

This volcanic replenishment means that the normal tropical trends of leaching and nutrient loss in soils are constantly reversed when eruptions occur. The resulting volcanic ashes are often firm and ideally suited for purposes of rice terrace construction, as any visitor to Bali or eastern Java will observe (Fig. 8.7). This lucky combination does not cease here, for these regions, like the western Philippines, have a climate with a definite dry season which lessens the rate of soil leaching and also promotes a partially deciduous and more open vegetation, an easier target for clearance by agricultural societies than the ever-wet equatorial rainforest. However, this monsoon vegetation is fragile when subjected to clearance and degraded lands in these regions tend to degenerate to extensive grasslands, particularly where droughts are common.

The results of these differences in soil fertility are very visible today because regions where wet rice is grown in paddy fields surrounded by small banks (*sawah* in Bahasa Indonesia), fed by both artificial irrigation and monsoon rainfall, tend to be concentrated on alluvial and deltaic soils in major river valleys and along coastal plains, or in regions of fertile volcanic soil. Modern wet rice cultivation is therefore of tremendous importance in regions such as Java and Bali, South Sulawesi, parts of the Philippines, and in other favored coastal and riverine pockets elsewhere (Huke 1982). However, the major portions of the large islands of Sumatra, Borneo, and Sulawesi were (and still are) mostly under less productive shifting cultivation.

These differences were very clearly pointed out for Indonesia by Mohr in 1945. From a census taken in 1930 he was able to show that Java and Madura had average densities at that time of over 300 persons per km^2, Bali and Lombok about 175, Sulawesi 22, Indonesian Borneo 4, and West New Guinea only 0.73. These figures, even if now outdated (Java has a density of over 1100 persons per km^2 today and Luzon over 500), still tell an important tale. Although the high Javanese densities reflected in part the Dutch introduction of intensive agricultural techniques after 1830, including permanent dry-field cultivation, Mohr was still able to show convincingly how high population densities in Indonesia depended on a triple combination of basic volcanic soils, non-excessive rainfall with a good dry season for cereal ripening and harvest, and rice cultivation in permanent irrigated fields. He concluded: "In the Netherlands Indies the population density is a function of the nature of the soil and this is a function of the presence of active volcanoes" (Mohr 1945:262).

However, as we will see in Chapter 7, many of the lowland alluvial areas that support so much wet rice cultivation today simply did not exist above sea level when agriculture was introduced into Island Southeast Asia between 5000 and 3500 years ago. At that time, sea levels were slightly higher than now and coastlines were extensively drowned. The sea washed directly against coastal foothills, especially along the steep coastlines of Wallacea, and the lower courses of rivers were turned into deep estuaries.[3] This means that many of the lowland riverine, deltaic, and coastal plain regions of Mainland as well as Island Southeast Asia that we see covered in such a beautiful patchwork of wet rice fields today were not part of the Neolithic landscape.

The Floras of Island Southeast Asia

Island Southeast Asia forms part of the "Malesia" of botanists. In its ever-wet equatorial regions, the evergreen mixed dipterocarp rainforest forms the most complex terrestrial ecosystem in the world (Walker 1980:21). Botanists are always eager to quote impressive statistics about this vegetation. Within Malesia, about 10% of all the plant species, 25% of the genera, and over 50% of the families in the world are represented. Over 25,000 species of flowering plants occur in the region, with 11,000 on Borneo alone. Associated with this variety is a rarity of extensive stands of single tree species and extreme spatial variation is the rule. No fewer than 780 tree species have been recorded from a single 10 hectare plot in northern Sarawak (Hanbury-Tenison 1980), and a 1 hectare forest plot at Belalong in Brunei contained 550 trees in 43 families, represented by 231 different species (Cranbrook and Edwards 1994:103).

This equatorial rainforest is characteristic of the lowland regions along the equator that lack dry seasons, but in eastern Java, Nusa Tenggara, the southern tips of Sulawesi, and the western Philippines the longer dry season has favored more open monsoon forests with a deciduous tendency, characterized by stands of casuarina, sandalwood, and eucalypts. In western Java, southern Sumatra, and northern Peninsular Malaysia there is a shorter three- to five-week dry season that also encourages some elements of this type of forest. Local ecological variations cross-cut the major climatic patterns to create such specialized ecosystems as the coastal mangrove and swamp forests, the limestone forests, and the high mountain moss forests.

From a human prehistoric perspective, it is the broad distinction between the equatorial and the monsoon forests that is likely to be of the greatest significance on a large scale. Monsoon forests support larger population densities than equatorial forests, and offer easier routes for migration. Modern plant geography also reflects the geological history of the Indonesian region, in that the floras of Sundaland are of Asian origin and rich in species, a reflection of the frequency of dryland connections across the subcontinent in the past. The floras of Wallacea, on the other hand, have fewer species, higher proportions of endemics, and a larger Australian element. Wallacea may be regarded as a transition zone between two ancient continental areas with quite different floras.

Faunal and Biogeographical Boundaries

The differences between Sundaland and Wallacea in terms of flora are also reflected in the distribution of animal species, particularly the large mammals that have a fairly prolific fossil record. Basically, Sundaland has an Asian placental mammal fauna that includes many species ranging in size from elephants and rhinos downwards. Peninsular Malaysia, for instance, has 203 species of land mammals (Cranbrook and Edwards 1994:79). Wallacea, on the other hand, has fewer species than Sunda and a greater proportion of endemics, with an increasing Australasian marsupial element in Sulawesi and further east.

The sluggishness or absence of faunal dispersal across Huxley's Line into the eastern part of the archipelago is clearly of importance for understanding prehistoric human dispersal. There have been no Wallacean land bridges of anything more than a very ephemeral and local nature within the past 2 million years, an observation underlined by biogeographical as well as geological considerations. Of placental mammals, only rats and bats are distributed from Sunda right through to Sahul, and of marsupials a number have spread naturally from New Guinea into the Moluccas (Flannery 1995). But only marsupial phalangers (cuscuses) ever reached Sulawesi and Timor, in the former case by prehuman crustal rafting and in the latter by human translocation. Both wallabies and bandicoots were once present in Halmahera and adjacent islands in the northern Moluccas, very close to New Guinea, before their apparent extirpation in Neolithic times or later. However, it is unclear whether these animals were introduced by humans or if they reached these islands by natural means.

Discussions of the significance of Huxley's Line have been numerous, with ample disagreement about how to subdivide the Wallacean region in zoogeographical terms (Simpson 1977; Esseltyn et al. 2010). The line works quite well for freshwater fish, mammals, and birds (in that order), but is less decisive for insects and plants. It also works well between Borneo and Sulawesi, but the Philippine (especially Palawan) and Nusa Tenggara boundaries are hazy. Although Oriental bird faunas drop off sharply down the Nusa Tenggara chain from Java, the reasons may be more to do with changing ecology than the mere presence of sea passages. Furthermore, there is no sharp break in plant distribution down the Nusa Tenggara chain, although the break is sharper between Borneo and Sulawesi. In general, however, it is best to regard Wallacea as a zone of transition rather than as a zone of total barriers.

As we will see, the biogeographical divide of the Huxley/Wallace Line was also important in early hominin dispersals, although some clearly managed to cross it.

With the arrival of modern humans and especially seaborne Neolithic populations it diminished in significance.

The Cyclical Changes of the Pleistocene

Having discussed elements of the natural environment of Island Southeast Asia as it is today, I turn now to examine variations in climate, land–sea distributions, land bridges, floras, and faunas during the Pleistocene epoch. The first hominins and modern humans entered Island Southeast Asia during this epoch, one of dramatic geomorphological and climatic change.

The Pleistocene Epoch: Definition and Chronology

Concerning overall chronology, the boundary between the Pliocene and Pleistocene epochs has been dated in the past according to three criteria: the onset of mid-latitude glaciation, changes in marine faunas, and changes in terrestrial faunas. The Quaternary period (Pleistocene and Holocene epochs) and the present cycle of mid-latitude glaciation started about 2.5 mya and earlier cycles of glaciation can be traced back into the Tertiary. In *Prehistory of the Indo-Malaysian Archipelago* the Plio-Pleistocene boundary was set at 1.6 to 1.8 mya with the appearance of the Calabrian mollusk fauna in the Mediterranean. Since 2009, this boundary has been extended back to the base of the Quaternary period and dated to 2.58 mya with the appearance of the Gelasian mollusk fauna (Gibbard et al. 2009). The base of the Pleistocene thus now correlates with the commencement of the Quaternary succession of glacials and interglacials.

In the past, before the development of absolute dating methods, it was the tradition to place hominin remains, animal faunas, and stone tool assemblages into a relative chronological framework of Early, Middle, and Late Pleistocene. Today, the Early Pleistocene is agreed to date from 2.58 mya to the Brunhes–Matuyama paleomagnetic reversal at 790 kya. The Middle Pleistocene continued from 790 to 130 kya, and the Late Pleistocene from 130 kya to the beginning of the Holocene at 11.7 kya (Head et al. 2015). The Late Pleistocene thus contained the penultimate interglacial and final glacial periods, a time of massive change in global environments in which anatomically and behaviorally modern *Homo sapiens* left Africa, was propelled into prominence, and other more archaic hominin species finally succumbed to extinction. The Pleistocene was preceded by the Pliocene, within which the earliest recorded stages of human evolution occurred in Africa, although no hominins are yet reported outside Africa as early as this.

The Holocene, the successor to the Pleistocene, commenced with the establishment of current interglacial climatic conditions across the world during the final glacial retreat at the end of the Younger Dryas mini-glaciation (13–11.7 kya). We live in the Holocene now – it has witnessed the rise of complex hunter-gatherer and agricultural societies, civilizations, and the archaeological phases of intensifying cultural evolution which in this book are described as the Para-Neolithic, Neolithic, and Metal Ages.

The Cycles of Glacials and Interglacials

Because of their regular cycles, with glacial maxima falling close to 100,000 years apart, it is now agreed that the major trigger for the successive ice ages was the regular oscillation of the earth's orbit around the sun and the slight movement in its axis of spin, leading to cyclical changes in the amount of insolation received at the earth's surface (Cheng et al. 2016). Other less predictable stimuli perhaps included the formation of large ash clouds from volcanic activity and mountain range formation in middle and high latitudes.

Until the 1960s, Pleistocene climatic cycles were traced mainly from studies of glacial geomorphology in cool temperate latitudes – the tropics remained rather remote and mysterious. However, knowledge has been revolutionized in recent years by the results derived from coring seabed sediments and glaciers, and also from studies of deeply stratified terrestrial mollusk- and pollen-bearing soils and uplifted coral reefs. Sediments in the beds of the oceans contain shells of tiny marine micro-organisms (foraminifera) and ice cores contain trapped ancient water, both yielding oxygen in two isotopic forms: ^{16}O and ^{18}O. During glaciations, the vast quantities of water trapped in the ice sheets immobilized large amounts of ^{16}O, and the cold seas thus became relatively rich in ^{18}O. In interglacials the ratios were reversed. Fluctuations in these ratios have been plotted for the duration of the Pleistocene in many regions of the earth and because they are thought to reflect partly the waxing and waning of continental glaciers they provide excellent evidence for Pleistocene climatic and sea level cycles.

It is now known that there have been about 20 full glacials within the past 2 million years, with the same number of intervening full interglacials, plus periodic intermediate interstadials within the glacials themselves. The glacial to interglacial climatic swings have increased in intensity during the past 1 million years (Figure 2.4) and it has also become apparent that the progression from a glacial into an interglacial period was a far more drawn-out and vacillating affair than the extremely rapid climatic amelioration that occurred after a glacial maximum (Figure 2.4, right-hand diagram). The rather phenomenal rate of climatic amelioration to warmer and wetter conditions at the start of the Holocene was an event unparalleled since the last interglacial commenced around 130 kya. It was undoubtedly a fundamental and highly encouraging event within the subsequent rise of complex human cultures.

World Sea Level Changes During the Pleistocene

Large-scale glaciation implies a lowering of world absolute sea level owing to the immobilization of vast quantities of water in the ice sheets. When the ice melts, sea level will rise. As noted, the oxygen isotope record (Figure 2.4) indicates that there have been 20 major cycles of glacial falling and interglacial rising within the past 2 million years, not to mention interstadial fluctuations. The magnitudes of these fluctuations have always been hard to estimate. The most direct indicators come from observations of drowned shelf topography and the dating of old coastline markers such as uplifted coral reefs and mangrove timbers.

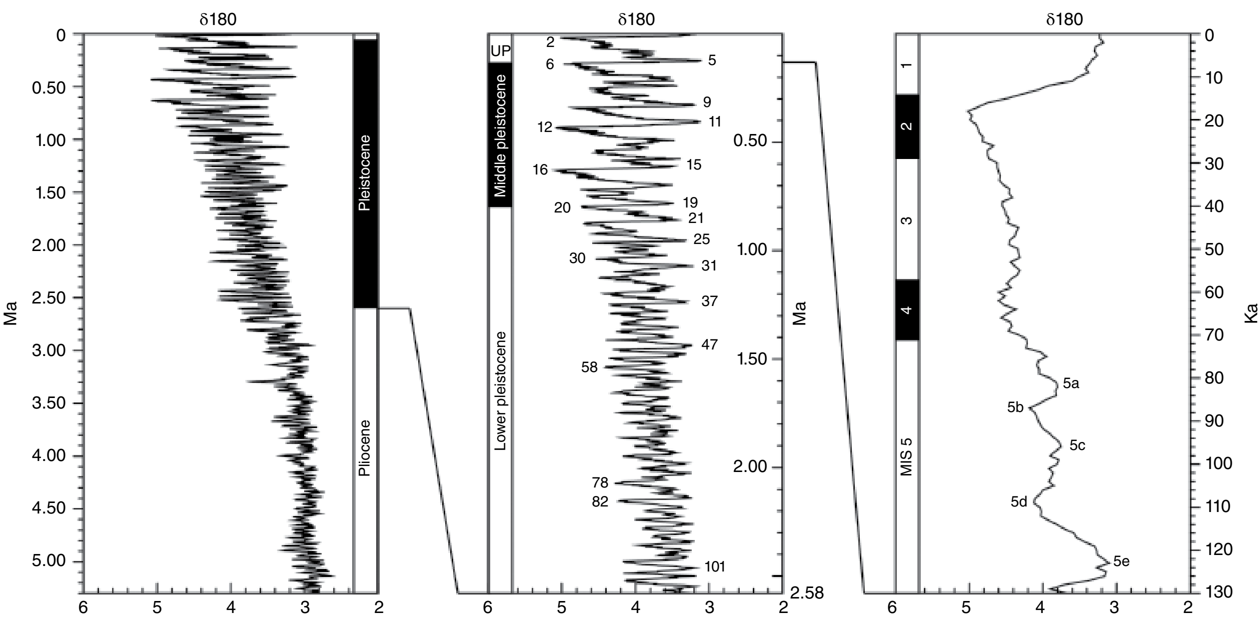

Figure 2.4 Oxygen isotope records reflecting global temperatures at increasing resolutions for the past 5.3 million years (left), the Pleistocene and Holocene (from 2.58 million years ago; center), and the Late Pleistocene and Holocene (from 130,000 years ago; right). Higher temperatures are to the right, lower to the left. Interglacials are identified by uneven numbered marine isotope stages (MIS – the Holocene is MIS 1), glacials by even numbers. Source: Hertler et al. (2015), with original data from Lisiecki and Raymo (2005). Reproduced courtesy of Christine Hertler and Wiley-Blackwell.

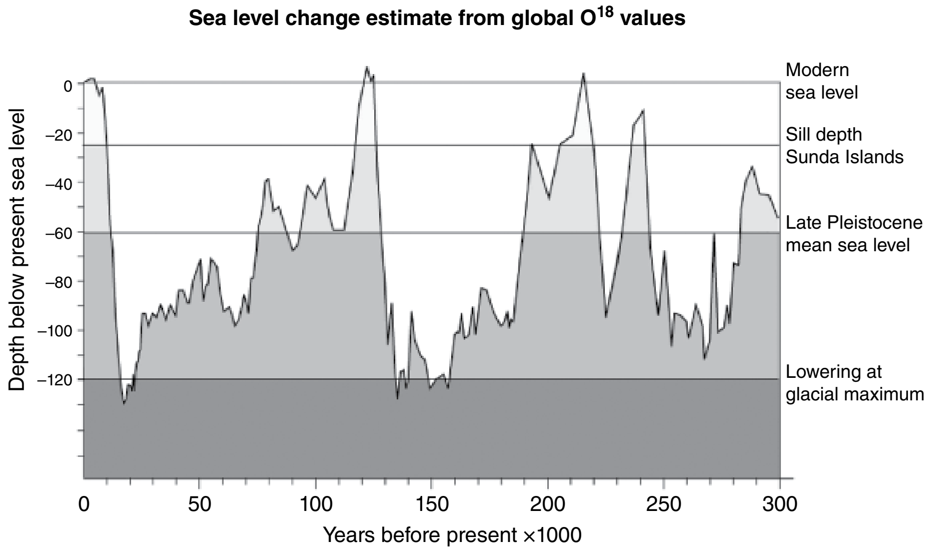

Figure 2.5 Sea level fluctuations of the past 300,000 years, based on the oxygen isotope record of Martinson et al. (1987). Borneo and the Malay Peninsula were joined by dry land at −25 m, Australia and New Guinea at only −12 m. Source: Hope (2005: Figure 2.2). Reproduced with the permission of Oxford University Press and courtesy of Geoffrey Hope.

The calculations are not simple, however, because the earth's surface is not a rigid, unmoving formation washed by fluctuating water levels. It can move in quite a dynamic fashion itself, partly through the mechanism of isostasy, which compensates for the imposition of variable loads such as ice sheets and oceans at changing times and places on its non-rigid surface. In general, water, ice, or sediment loads promote sinking, while relief from such loads will allow slow upward rebound. While isostatic adjustment processes will have operated mainly in the intermittently drowned Sunda and Sahul shelf regions, many of the Wallacean islands are subject to other kinds of tectonic instability and have risen and fallen independently of sea level changes, sometimes at quite rapid rates.

At present, global sea level is at an absolute high compared to those during most of the Pleistocene, a level previously attained during the last interglacial about 125 kya (Figure 2.5). During the LGM between 28 and 18 kya the sea level is widely estimated to have been between 100 and 130 m below that of the present. A high-to-low overall swing of about this magnitude may have occurred approximately every 100,000 years, with occasional perturbations (Spratt and Lisiecki 2015: Figure 2), going back to a million years ago. The swings before a million years ago seem to have been of slightly lower magnitude (Snyder 2016).

When we come to consider more detailed aspects of these fluctuations we find ourselves focusing especially on the past 130,000 years, the Late Pleistocene and Holocene, for which there are obviously more data than for previous cycles. The last interglacial had a fairly short duration between about 130 and 120 kya, when the seas were close to the present absolute level. Following this, sea levels fluctuated many times between relatively high and low points, although none of these intervening highs appear to have attained the level of the present. The implications are that highest stands like that of the present and lowest stands like that of the LGM were relatively short-lived events during the Pleistocene. Average absolute levels would have been between 30 and 90 m below present for much longer periods, as shown clearly in Figure 2.5 and as estimated by the −50 m Sundaland bathymetric contour shown in Figure 2.1. Voris (2000), for instance, estimates that sea levels were at least 40 m below present for 50% of the duration of the Pleistocene and that Sumatra, Java, and Borneo would only have become separate islands when the sea level rose to 25–30 m below present. The Palawan extremity of northeastern Sundaland was separated from Borneo by a much deeper (140 m) channel and was last reached by a land bridge much earlier, probably during a Middle Pleistocene glacial period (Esseltyn et al. 2010; Piper et al. 2011; Robles 2013).

The postglacial sea level rise at times happened very quickly, as can be seen from Figure 2.5, with a rise of 60 m occurring between 11,650 and 7000 years ago caused by catastrophic meltwater release from North America into the Atlantic ocean (Smith et al. 2011). This rise would have led to Sundaland changing rather dramatically from being part of a giant continent (mainland Asia) to becoming a group of separate islands, with the same for Sahul. Some scholars have suggested in recent years that this would have caused episodes of human migration as the rising seas flooded in. I discuss this topic again in Chapter 5, but it is important to note that high sea levels in Island Southeast Asia created increased coastline lengths and more inshore food resources, focused on gentle shelves flooded by warm sea, hence they are unlikely to have promoted out-migration as opposed to local population readjustment. Indeed, a recent archaeological project on Alor Island in eastern Nusa Tenggara (Carro et al. 2015) reveals that people exploited inshore marine resources more frequently during the Holocene than during the terminal Pleistocene, perhaps reflecting the early Holocene stabilization of sea levels and the growth of coral reefs in Wallacea. Subsiding sea levels would have had a more negative impact on food resources owing to exposure of steep and rather barren continental shelf edges, plunging down into deep sea (Chappell 2000).

These fluctuations in sea level are of great potential importance for prehistory, since low levels make islands larger and also tend to produce land bridges, as well as drier climates in exposed continental shelf interiors far from the ocean. As far as land bridges are concerned, shortened sea crossings are particularly important when considering Pleistocene human migration, for instance the first settlement of Australia, and it is of interest that Figure 2.5 shows a low sea level 100 m below the present at about 65 kya. According to some archaeologists, humans first arrived in Australia at about or soon after this time (Hiscock 2008). However, Allen and O'Connell (2014) favor only 50 kya for human arrival in Australia, so the issue is not clear-cut.

One final matter concerns the question of a world sea level slightly above that of the present during the early to middle Holocene, when global temperatures were slightly higher than now (Marcott et al. 2013) and ice sheet volumes correspondingly slightly reduced. There are raised marine deposits in Sundaland which suggest that sea levels about 5000 years ago could have been up to 4.2 m above present (Voris 2000; Sathiamurthy and Voris 2006). The Penghu Islands in Taiwan Strait had a sea level 2.4 m above the present at 4700 years ago (Chen and Liu 1996). A similar high stand can be traced in the Pacific Islands, where sea levels also peaked at +1.6 to 2.6 m around 4000 years ago and then started to drop to the current level about 3000 years ago. At this time, the atolls of Oceania were still mostly below sea level (the Carolines until around 2000 years ago and the Tuamotus until 800 CE), not just because of the higher sea level but also because the living corals needed time to grow upwards to reach the sea surface (Dickinson 2003).

This higher-than-now mid-Holocene sea level causes something of a problem for archaeologists, since the archaeological sites of those populations who lived along tectonically stable Sundaland coastlines in Island Southeast Asia prior to 6000 years ago, indeed at any time back to the last interglacial, will for obvious reasons have become drowned beneath the rising sea or washed away by wave and tidal action. Luckily, however, there are still enough near-coastal sites in these regions, sufficiently far from the sea never to have been drowned (e.g., the Niah Caves in Sarawak), to tell us quite a lot about what was going on.

For regions that were, unlike Sundaland, tectonically *unstable*, Holocene eustatic high stands were perhaps rather irrelevant. Such regions include the southeastern coast of Taiwan, which was rising through subduction during the Holocene at a phenomenal rate of up to 10 m per millennium (Liew et al. 1993), or Timor, which is rising at a possible rate of 1.5 m per millennium (Hope 2005). In southeastern Taiwan, archaeological sites can actually be dated by their heights above sea level, with sites that are 4000 years old being 40 to 50 m above the modern beachline (see Mike Carson's invited contribution in Chapter 7). The story from southeastern Taiwan might be very unusual due to the rapidity of the rise, but it drives home the observation that both sea levels and land surfaces can be subjected to forces that work independently of each other. These can lead to varying rates of rise and fall.

The Consequences of Mid-latitude Glaciation

Most of the prehistory of *Homo sapiens* in Island Southeast Asia has occurred within the Late Pleistocene, an epoch of earth history that contained the rise and fall of the last glaciation with its nadir (the LGM) at around 28–18 kya. During such glacial maxima, ice sheets up to several kilometers thick extended deep into Europe, northwestern Asia, and North America (Siberia was too dry to support large glaciers), reaching the latitudes of modern cities such as Philadelphia and London. During interglacials, conditions returned to something like those of the present. Within the glacials themselves there occurred short warm phases called interstadials, during which conditions ameliorated to intermediate levels. The major interglacials, such as the present Holocene, were relatively short episodes lasting for 10,000 years or so (Figure 2.4). This perhaps means that the future of the Holocene, which has run already for 11,700 years and which is currently being extended by humanly caused global warming, is an important question for all of us.

The major worldwide effects of the Pleistocene glaciations were to lower sea levels and vegetation zones, and reduce temperatures. Carbon dioxide and methane production also dropped, reducing plant growth and greenhouse gas levels in the atmosphere. Winter snowlines fell by up to a kilometer, depending on latitude (Broecker 2000). These changes were of course felt most strongly in the higher latitudes, but they also had major impact in tropical latitudes such as those occupied by Island Southeast Asia and New Guinea. In the intensively studied New Guinea Highlands, ice sheets covered about 2000 km^2 during the LGM (compared to only 8 km^2 now), the snow line fell to 1000 m below its present altitude, the tree line was lowered by about 1500 m, and annual average highland temperatures fell by 6–7 °C (Hope 2005). Some 57,000 km^2 of land below the ice were then under grassland down to a tree line only 2200 m above sea level, as opposed to only 5000 km^2 of grassland now down to a tree line at 4000 m.

The mountains of Island Southeast Asia do not reach such high altitudes as those of New Guinea, but the effects of Pleistocene permanent glaciers are still traceable on the summit of Mt. Kinabalu (4100 m) on Borneo (Flenley and Morley 1978). Any that might once have existed on the high volcanoes of Java and Sumatra will have left no traces owing to subsequent volcanic activity. For LGM highland Taiwan, a drop in annual average temperature of 5–9 °C was suggested by Tsukada (1966), likewise by Newsome and Flenley (1988) for LGM highland Sumatra. LGM estimates for Sundaland locations near sea level tend to fall a little lower, between 2 and 5 °C below present (Verstappen 1975; van der Kaars 1991; Anshari et al. 2004), although an estimate of 5–9 °C is offered for the Niah region in lowland Sarawak during the LGM by Hunt et al. (2012), together with rainfall 30–60% below the present level (Barker 2013:179). It is thus possible that LGM temperatures were generally between 5 and 10 °C below present averages, regardless of altitude.

The surface of Sundaland as an emergent continent during the LGM contains some interesting features. The shallow shelves of the South China and Java seas are incised by a number of fossil river channels. Between Sumatra and western Borneo there are three major ones, termed by Haile (1973) the Anambas, North Sunda (with the Proto-Kapuas as a tributary), and Proto-Lupar valleys (see Bellwood 2007: Figure 1.11). These can be followed in bathymetric charts to the edge of the Sunda shelf at a depth of about 100 m. Two large parallel rivers also ran along the bed of the Java Sea between Java and Borneo toward the Strait of Makassar (Verstappen 1975). Similarities in freshwater fish species between eastern Sumatra and western Borneo indicate that the rivers of these islands were once linked; the Musi of Sumatra and the Kapuas of Borneo in particular were once part of Haile's North Sunda river system. On the other hand, some of these large rivers clearly served as faunal and floral divides of some magnitude. Ashton (1972) has pointed out that dipterocarp forest tree species show some sharp breaks in distribution at the Lupar River in western Borneo, and the former presence of such large rivers between Java and Borneo may have slowed down dispersals between these two islands in the Pleistocene. Large freshwater lakes also occupied the middle of the Gulf of Thailand, the area immediately north of western Java, and much of the Gulf of Carpentaria according to sea bed contours presented by Butlin (1993: maps 8a, 8b).

During the LGM period of Sunda and Sahul shelf exposure above sea level, Island Southeast Asia would probably have had much larger areas of dry-season monsoon forest, causing a shrinkage of the inner core regions of equatorial ever-wet forest in Sundaland and New Guinea. One most intriguing possibility is that there was a "dry-season corridor" at least 150 km wide that ran roughly from northwest to southeast during glacial periods, from southern Thailand across the exposed bed of the South China Sea and through southern Borneo to Java (Heaney 1991). The botanist van Steenis (1961) also observed that several species of Leguminosae and grasses adapted to long dry seasons occur in the northern and southern monsoonal areas of Southeast Asia, with sharp gaps in distribution in equatorial Indonesia at the present time.

The idea of a dry-season corridor to explain such distributions can be said to have taken off with gusto in recent years, despite some cautionary observations.[4] The rough outlines of this corridor as mapped originally by Lawrence Heaney are reproduced in Figure 2.3. However, there are some indications that such a corridor could have been limited in extent, such as an absence of any convincing evidence for Late Pleistocene elephants in Borneo despite their presences on Java and Sumatra. In addition, pollen cores from the northern part of interior Kalimantan (Borneo), together with last glacial animal faunas from the Niah Caves in Sarawak, show that much of the equatorial forest continued to survive, even if LGM temperatures in these locations were lower than now (Medway 1977; Anshari et al. 2004; Hope 2005; Hunt et al. 2012).

The Sahul shelf has produced similar evidence for glacial dryness and an open woodland vegetation, with a considerable restriction of the southward extent of the New Guinea equatorial rainforest. Palynological research on seabed cores by van der Kaars (1989, 1991) indicates that grassland was widespread on the Sahul shelf between 38 and 17 kya. Cave faunas in the Aru Islands (southern Moluccas) on the Sahul Shelf between Australia and New Guinea indicate that dry grassland with a kangaroo fauna gave way around 14 kya to a wetter climate with forest-dwelling wallabies and possums (O'Connor et al. 2005).

In chapters 3 and 5, the impacts of these Pleistocene climatic and environmental fluctuations on the floras and faunas (including hominins and humans) of Island Southeast Asia will be discussed further. Humans migrated as changing environments opened passages for them and impacted upon those new environments in turn as they entered and began to exploit them. However, the impacts of Paleolithic hunter-gatherers were probably rather limited. Southeast Asia witnessed no widespread Late Pleistocene mammal extinctions on the scale of those in Australia or the Americas. It was the food-producing economies of the late Holocene that eventually gave rise to the era of deforestation through agriculture and burning that has lasted into the present, leading to rises in levels of methane and carbon dioxide in the atmosphere that probably commenced with Neolithic food production in Asia more than 5000 years ago (Ruddiman 2015). However, Neolithic population sizes were small compared to the 400 million people who occupy Island Southeast Asia today and it seems impossible to deny that pressures on the environment will increase. As I write this chapter, huge peat fires are burning in much of Borneo, causing major threats to communications and human health. What will come next?

Notes

1. In this book, the term Borneo is used for the whole island, and Kalimantan for the Indonesian portion. The Malaysian parts are Sarawak and Sabah; Brunei is a separate nation.
2. The hominin tribe includes all of us, and our bipedal ancestors and extinct cousins (e.g., Javan *Homo erectus*) in the genera *Homo*, *Australopithecus, Paranthropus, Kenyanthropus*, and *Ardipithecus*. Modern apes join with hominins to form the Hominidae family.
3. Australians will appreciate that such situations would often have resembled Sydney Harbour today. This steep-sided and rocky harbor was not a land of plenty for the first European farmers in the early 1800s, who had to go further inland to the Parramatta River or up the coast to the Hawkesbury River and beyond to find fertile soil.
4. In favor are Meijaard 2003; Bird et al. 2005; Cranbrook 2009; Wurster et al. 2010; Louys and Turner 2012; Boivin et al. 2013; Wurster and Bird 2014. Kershaw et al. 2001 and Cannon et al. 2009 have strong reservations.

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Chapter 3
Homo erectus and *Homo floresiensis*: Archaic Hominins in Island Southeast Asia

Human biological evolution has recently become a very hot topic owing to major advances in the recovery of both ancient and modern DNA and the rapid growth in computing and statistical armory. Ancient DNA has not yet been retrieved from archaic hominins in Southeast Asia or China, although who knows what the near future might bring. In Island Southeast Asia we still rely mainly on fossils and their measurements to light up the evolutionary past. Two sets of hominin remains have made the region famous to the world, these belonging to the archaic species popularly known as "Java man" and "the hobbit," better referred to by their Linnaean names *Homo erectus* and *Homo floresiensis*.

Homo erectus was discovered first. In October 1891, a young Dutchman named Eugène Dubois commenced well over a century of human fossil discovery outside Europe, a century that has witnessed some profound changes in scientific views of human origins. His discovery, a skullcap (or calotte) of apparent human form, was excavated with many other animal bones near the village of Trinil, in a terrace of the Solo River (Bellwood 2007: Plate 1). It belonged to an archaic hominin species that he named *Pithecanthropus erectus*.

Since 1891, many more hominin finds have come to light in Java, especially from another locality called Sangiran, and most recently from the island of Flores in Nusa Tenggara, where the year 2004 saw the publication of the tiny *Homo floresiensis* from Liang Bua Cave. This Flores discovery, together with the much older stone tools and small hominin remains published in 2016 from the Soa basin on Flores, has highlighted a surprisingly early hominin capacity to cross sea gaps more than 1 million years ago. It has also raised a number of phylogenetic and anatomical issues concerning the whole trajectory of hominin evolution outside Africa. This trajectory was clearly not such a unified multiregional route towards modern humans as was once thought.

New paleoanthropological data, not just from Indonesia but from all over the Old World, mean that our understanding of human evolution has changed fundamentally since the last revision of my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 1997), not just through the fossil record but also through the recovery elsewhere in western

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First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

and central Eurasia of ancient DNA from hominin bones. We now know from analyses of ancient autosomal DNA that the many separate species recognized by palaeoanthropologists from their unique osteological characteristics were also capable on a few occasions of interbreeding. Such ancient liaisons occurred between *Homo sapiens* and Neanderthals in western Eurasia, also between *Homo sapiens* and an enigmatic central Asian hominin identified initially from a finger bone in Denisova Cave in the Altai Mountains in Siberia.[1]

This does not mean that species cannot be species any more, but rather that the many species recognized within the genus *Homo*, prior to our own total domination of the world since 40 kya or thereabouts, were not as separate genetically from each other as are cats and dogs. Overlapping lineages rather than fully discrete species might be a more useful concept for human prehistory. Such lineages did not normally admix because of mutual geographical separation, a situation that often lasted for tens or hundreds of millennia at a time. But when migration did occur, especially from one continent to another, bringing into contact again different hominin lineages after long periods of mutual isolation, so human evolution ceased to be simply an ever-diverging family tree.

It is not my purpose here to review the whole field of human evolution (see Bellwood 2013 for my current views, extending back into Africa), but I do intend in this chapter to review the environmental and cultural correlations for the two archaic hominin species in Indonesia – *Homo erectus* and *Homo floresiensis.* Colin Groves and Debbie Argue present more biological detail on these species later in this chapter. From an archaeological perspective it is clearer now than in the mid-1990s that these archaic Southeast Asian hominins made and used tools of stone, bone, and shell, and also butchered animals. Some were also capable of crossing sea passages to reach new islands.

Hominin Antecedents in Africa and Asia

When I was writing the first edition of my *Prehistory of the Indo-Malaysian Archipelago* in the early 1980s, the study of human evolution was going through a phase of "lumping" in which only a relatively small number of species was recognized, each evolving into the next across the whole hominin territory within Africa and Eurasia. This was considered the essence of multiregional evolution. Modern humans were believed to have evolved multiregionally through linking gene flow all over the Old World, from regional archaic hominin species into fully modern *Homo sapiens*. It was widely believed that only one species within the genus *Homo* existed at any one time, running in a general chronological order through the past 2 million years from *Homo habilis*, through *H. erectus* and *H. neanderthalensis*, and eventually to *H. sapiens* (see Bellwood 1985: Chapter 2).

With the publication of the first species-wide survey of modern human mitochondrial DNA (Cann et al. 1987), it became apparent that modern humans (*Homo sapiens*) had a relatively recent African origin within the past 200,000 years, rather than an Old

World multiregional one stretching back everywhere for 2 million years or more. It was also apparent that *Homo sapiens* eventually replaced all earlier hominins, in both Africa and Eurasia. This was rapidly becoming apparent when the second (1997) edition of *Prehistory of the Indo-Malaysian Archipelago* was being prepared. It is now almost universally accepted, despite the issue of minor admixture between archaic and modern humans to which I have already referred.

A potential family tree (no family tree will ever be final!) for archaic hominins and modern humans, bringing in the most important agreed species/lineages and likely dead ends, is given in Figure 3.1. The main conclusions are that there were *at least* three episodes of migration of the genus *Homo* out of Africa, with our own *Homo sapiens* ancestors being part of the most recent one, commencing sometime between 130 and 70 kya. Two earlier migrations occurred roughly at 2 and 1 mya, although there can be no guarantee that these were the only ones. Indeed, there could have been as many migrations out of Africa as there were environmental opportunities to leave that continent via the Sahara and Arabia, perhaps during every Pleistocene episode of inviting interglacial climate when deserts became green. But our current archaeological records simply cannot illuminate such detail.

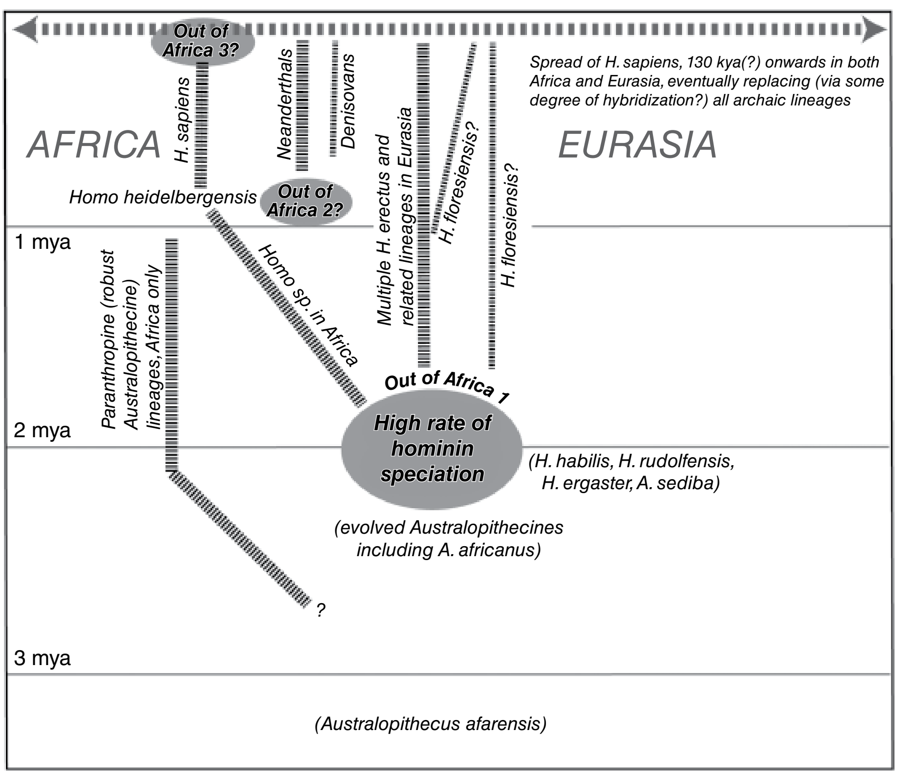

Figure 3.1 A current family tree for hominins, from Australopithecine ancestors to *Homo sapiens*, the only hominin species to have survived until the present. Source: Bellwood (2013: Figure 3.1).

The first out-of-Africa migration is known to us through recent finds at Dmanisi in Georgia, where the discovery of no fewer than five crania of small-bodied and small-brained hominins dated to 1.8 mya gives a firm chronological baseline for the expansion of early *Homo* out of Africa (Lordkipanidze et al. 2013). Dmanisi, in a highly continental location at a latitude more than 40° north of the Equator, tells us that some of the hominins who left Africa around 2 million years ago had an ability to adapt to winter cold like their far-away temperate latitude cousins in South Africa, perhaps also like those who also made stone tools at this time 40° north of the Equator at Nihewan in China (Wei et al. 2015). However, the first inhabitants of lowland tropical Asia and Java did not have to worry about problems with cold weather – they followed warm climates.

The ancestral African hominins who lived during the Pliocene and Early Pleistocene, in both the Australopithecine and succeeding early *Homo* genera, undoubtedly carried in varying times and places the basic physical and cultural roots of all succeeding forms of humanity, including *Homo sapiens*. Early bipedal hominins are presumed to have evolved before 4 mya in tropical eastern and/or southern Africa, in dry and rugged terrain with fairly open parkland vegetation (Winder et al. 2014). Purely biological developments within the genus *Homo* in Africa prior to 2 mya are likely to have been heavily embedded in a matrix that involved reinforcement of a bipedal striding and running posture, increasing hand flexibility and finger-to-thumb opposability (essential for making stone tools), greater cranial capacity (essential for within-group cooperation and eventual language), and the development of the hominin grinding and chewing dentition.

Within Africa itself, during the period of transition to the genus *Homo* around 2.8 to 2.0 mya (DiMaggio et al. 2015) and prior to the first expansion into Eurasia, there is already direct evidence for stone tool use by early hominins. Indeed, new discoveries of stone tools in East Africa are now pushing back the dates beyond 3 mya (Harmand et al. 2015), presumably into the time span of the Australopithecines. Perhaps at this time we can also claim the shadowy development of such important human behavioral concepts as the internally cooperative nuclear family, awareness of kinship with possibly an incest taboo, some form of basic human language, and perhaps also a use of fire for cooking as argued by Richard Wrangham (2009). However, the evidence at such a large time separation from our own world is vague, and a use of fire as early as 2 mya is questioned by Zink and Lieberman (2016), who suggest that archaic hominins instead cut and pounded raw meat and tubers in order to make them palatable, rather than cooking them. As we will see below, large hammer-dressed stone balls are associated with Middle Pleistocene archaeological contexts in central Java and one wonders if these could have been used for such pounding tasks (see Figure 3.7).

Biologically, we are on slightly firmer ground. The fossil record tells us that hominins in Africa were fully bipedal by 2.5 mya and expressed a distinctive cranial shape, marked by prominent brow ridges separated from the rest of the skull by a deep postorbital constriction, a low cranial vault with the greatest width at the base, extremely thick cranial bones and strongly marked muscle attachments, broad and large faces with large teeth and cranial capacities from about 450 to 650 cm^3 (we average about 1350 cm^3 today). The first hominins to arrive in Georgia carried such characteristics and so perhaps did those of China, Java, and Flores. We do not know exactly where the genus *Homo* originated in Africa but geographical common sense dictates that the first hominins to enter Eurasia must have crossed through northeastern Africa, either by going down the Nile Valley and through Sinai or by somehow hopping over the Bab-el-Mandeb Strait, which was always a narrow sea passage. Whether they did this intentionally or not is an interesting question, and one that also pops up with the migration of early hominins to sea-girt Flores around 1 million years ago. The answer, of course, is unknowable, and in my view it always will be, but some of the hypotheticals are considered by Leppard (2015).

Homo erectus in Java

The island of Java (with Bali) was the furthest tropical location from Africa reached by early hominins prior to the settlements of Sulawesi and Flores further to the east. Its periodic isolation by interglacial high sea levels and equatorial rainforest renders the story of its colonization potentially very interesting. As Colin Groves explains later, Java reveals a history of long-term evolution within the species *Homo erectus*, with crania or parts thereof recovered from Early and Middle Pleistocene sediments at Sangiran, Trinil, Sambungmacan, Ngandong, Ngawi, and Mojokerto (Figure 3.2).[2] Trinil, Ngandong, and Mojokerto (find place in 1936 of a cranium of a 5-year-old-child) have been re-excavated recently and new excavations are being undertaken at Pucung in the southeastern region of Sangiran.[3] A newly discovered cranial vault and stone tools from Semedo, located 200 km slightly northwest of Sangiran, is also associated with a Middle Pleistocene fauna (Widianto and Grimaud-Hervé 2014).

Homo erectus in Java is often considered in terms of three successive populations. The oldest comes from Early Pleistocene contexts at Sangiran and possibly from Perning near Mojokerto and dates to before 1 mya. Then comes the "classic" phase of

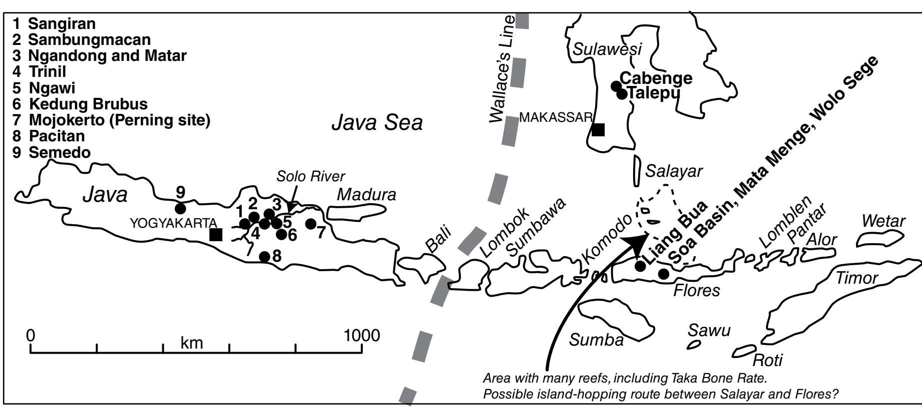

Figure 3.2 Early and Middle Pleistocene sites and localities in Java, South Sulawesi, and Flores. Drawn by the author.

Homo erectus dating from roughly 1 to 0.5 mya in the Middle Pleistocene formations at Sangiran and Trinil. Finally, the youngest remains come from late Middle Pleistocene Solo River terrace locations at Ngandong, Sambungmacan, and Ngawi.

In the large Middle Pleistocene (or "classic") series of remains from Sangiran and Trinil, cranial capacities ranged from about 800 to 1060 cm^3, statures probably ranged up to a maximum of around 160 cm and body weights may have ranged up to 80 kg. These hominins were by this time similar in mass to modern humans, not tiny like those from Dmanisi or Flores. The question of how the tiny hominins of Flores might have originated will be discussed below – ancestral relationships between the oldest hominins of Java and Flores are still poorly understood.

Before considering *Homo erectus* in detail, it is necessary to introduce the Pleistocene faunal sequence in Java and to describe the most significant find places of Sangiran and Ngandong. Beyond the fossil bones themselves, understanding the evolution of *Homo erectus* requires consideration of faunal associations and geological stratigraphy, chronology, and archaeology.

Java – Pleistocene Mammals and Stratigraphy

The island of Java is particularly rich in faunal records for the Pleistocene, owing to the widespread and fortunate occurrence of alluvial and lacustrine stratigraphic sequences that contain tuffs and other datable volcanic materials.[4] Java thus provides a framework for the comparative study of the Pleistocene faunal materials found in the Wallacean Islands that lie beyond Sundaland, especially Luzon, Sulawesi, Flores, and Timor.

In the Early Pleistocene, perhaps around 2.5–2 mya, a mammal fauna with strong South Asian affinities gained a footing in the newly emerging western and central Java. It is known from coastal estuarine deposits and included mastodons and possibly pygmy stegodons (both proboscidean species distantly related to elephants), small hippos, and a giant land tortoise (*Megalochelys* sp.[5]), all species evidently with an ability to swim across short sea gaps. This so-called Satir fauna of Java was then followed by the Ci Saat fauna, which saw the additions of deer, pigs, and another proboscidean species, the larger-sized *Stegodon trigonocephalus* (cf. Figure 3.3). The Ci Saat fauna might also have contained Java's first hominins, particularly at Sangiran in central Java. One presumes that Java was joined as part of Sundaland to the Asian mainland by dry land at this time.

The Javan faunal phases following the Ci Saat bring us forward in time towards 1 million years ago and into a period of Middle and Late Pleistocene glacial to interglacial climatic and sea level fluctuations of increasing magnitude. Any parts of Java already emergent above the sea would have been alternately land-bridged to and sundered from the Asian mainland during the alternating glacials and interglacials, through repetitive cycles each lasting about 100,000 years. Mammals, humans, plants, and other life forms would have taken advantage of the glacial-era land bridges on many occasions, although within our incomplete record it is naturally impossible to see all of the details. Even so, we have to accept that Java was not normally an island but an integral part of a more widely emergent Sundaland (see Figure 2.2). Not only

Figure 3.3 A model of the head and tusks of a *Stegodon florensis*, the dwarfed Middle Pleistocene Flores species. Source: model by Manimal Works, Rotterdam, with scientific input by D. Mol; reproduced courtesy of Remie Bakker.

could mammals have been replenished time and time again by incursions from mainland Asia, so too could *Homo erectus* populations.

This becomes important when we move from the Ci Saat fauna into the following Trinil Hauptknockenschicht (main bone layer) fauna (or Trinil H.K.), excavated by Dubois with his discovery of *Pithecanthropus* at Trinil in 1891. The Trinil H.K. fauna is particularly important because it records the arrival of a large suite of new species into Java, one of which was certainly a fairly advanced form of *Homo erectus*, which possibly replaced the more archaic hominins already present on the island. The new fauna included monkeys (macaques and langurs), bovids (large water buffalo and cattle), rhinos, pigs, a canid, and three genera of deer. Many of these species have poor swimming abilities, a circumstance that supports the existence of a land bridge through Sumatra or across the South China Sea from the Asian mainland. Elephants and apes (gibbons and orangutans) were still absent, but stegodons and hippos continued from the Ci Saat into the Trinil H.K.

The Trinil H.K. developed onwards through two later and successive faunal stages called Kedung Brubus and Ngandong, the latter dating to the end of the Middle Pleistocene, before 130 kya. True elephants of the genus *Elephas* apparently made their first appearance in Java during the Kedung Brubus stage, during which time there might have been another land bridge. The Ngandong fauna marked the final appearance of stegodons and wide-horned buffaloes in Java, but also contained younger *Homo erectus* hominin fossils found in several terrace locations along the Solo River. These terraces were uplifted and rejuvenated late in the Middle Pleistocene by the same tectonic activity that led to the uplift and erosion of the Sangiran Dome itself.

Following the period of the Ngandong fauna and dating between 128 and 118 kya according to luminescence and uranium series dates (Westaway et al. 2007), another sharp change in faunal composition occurred in Java. This reflected the crossing into this island of an interglacial rainforest fauna, as found in the Punung Caves in the Gunung Sewu limestone region southeast of Yogyakarta (Storm and de Vos 2006). The Late Pleistocene Punung fauna contains teeth of *Homo sapiens* (more on them in Chapter 4, since such an early dating for modern humans is controversial), plus the first occurrences of forest-loving animals such as tapirs, bears, gibbons, and orangutans, and continuing presences of pigs, deer, rhinos, bovids, and elephants. The crossing of this fauna to Java occurred when interglacial sea levels were high and the climate warm and wet, yet presumably also at a time when a land bridge still existed from Sumatra or Borneo.

Sangiran

We now examine the stratigraphy of the renowned location of Sangiran, near the city of Solo (Surakarta) in central Java, one of the key hominin fossil find regions in Asia or indeed anywhere in the world. The Sangiran locality (Plate 1) consists of a domed formation of Late Pliocene to Pleistocene marine, swamp, alluvial, and volcanic ash layers, in that general order from base to top. It was uplifted by the tectonic activity that also produced, towards the end of the Middle Pleistocene, the Kendeng hills to the north of Sangiran. The so-called "Sangiran Dome" was then cut open and exposed by the down-cutting Cemoro River and its many small tributaries, all flowing into the much larger Solo River. The crater-like exposure at Sangiran measures approximately 8 by 4 km. Exposed in its rather dissected base are Pliocene marine sediments (Puren Formation), upon which lie the terrestrial Pleistocene Sangiran and Bapang formations that contain the Ci Saat to Kedung Brubus faunal series described above, with over 80 fossilized specimens of crania, mandibles, and teeth of *Homo erectus*.[6]

During Pliocene and Early Pleistocene times the region around Sangiran was still partly under the sea and a long marine strait occupied much of the present Solo Valley. Sangiran seems to have been quite near the coastline and pollen analyses of the Puren marine sediments have indicated the presences of salt-tolerant mangroves, nipa palms, and pandanus trees (Sémah 1982). Above these Pliocene marine deposits come the two major Pleistocene terrestrial formations – the Sangiran (formerly referred to as Pucangan) and the succeeding Bapang (formerly referred to as Kabuh). The Sangiran Formation commenced deposition around 1.9–1.8 mya (Falguères 2001) and is exposed through a total thickness of about 160 m. It comprises mainly swamp sediments with periods of marine and estuarine transgression. Its base has thick marine/estuarine deposits that contain shark teeth and marine and estuarine shells. The pollen analyses support the stratigraphy in suggesting a gradual emergence of the land around Sangiran during this time, when mangroves were slowly replaced by monsoonal vegetation with mainly open country characteristics (savanna, open forest) suited to a long dry season, with patches of rainforest along rivers (Bettis et al. 2009). The upper layers of the Sangiran Formation contain the remains of the earliest hominins in Sangiran.

Above the Sangiran Formation comes the "Grenzbank," a thin calcareous conglomerate and bone-rich bed which appears to contain much Sangiran Formation faunal material redeposited from eroded contexts, including some fragments of robust hominins. Above the Grenzbank, a new sedimentation regime with mainly alluvial rather than lacustrine deposition commenced with the Bapang Formation, up to 60 m thick and the source of most of the Sangiran hominin finds. Pollen from the Bapang layers at Sangiran is still predominantly of non-arboreal type (Gramineae, Cyperaceae), suggesting increasing climatic dryness through time, although some rainforest continued to exist in the wetter valleys. The Middle Pleistocene animal faunas of central Java also support the existence of open conditions with limited forest (Medway 1972; Louys and Meijaard 2010). For instance, some individuals of the large water buffalo species *Bubalus palaeokerabau* had horns stretching to over 2 m wide, hardly suitable for an animal that might wish to penetrate thick rainforest.

As discussed by Colin Groves in his following perspective, all of the Sangiran *Homo erectus* remains have been recovered within a chronostratigraphic zone that extends from the upper part of the Sangiran Formation, through the Grenzbank, into the lower part of the Bapang Formation. Other *Homo erectus* remains come from Trinil and the terraces of the Solo Valley, as well as other locations shown in Figure 3.2. As far as Sangiran itself is concerned, paleomagnetic correlations plotted in Bapang sediments (Hyodo et al. 2011) suggest an age for the Grenzbank and the early stages of the Trinil H.K. fauna of around 900 to 800 kya.[7] Younger radioactive argon ($^{40}Ar/^{39}Ar$) and luminescence dates on geological materials from the original Dubois excavation of the Trinil Hauptknockenschicht suggest that the hominin presence here, associated with utilized bivalve shells, continued until 560–430 kya (Joordens et al. 2015). So a firm date range from at least 1 to 0.5 mya for *Homo erectus* in central Java seems assured, with the Sangiran Formation specimens at Sangiran itself presumably being older.

The dating of the Sangiran Formation, however, is still an issue. In recent years, some authorities have used argon determinations to place the Grenzbank at about 1.5 mya, or at least half a million years before the date range given above.[8] Colin Groves discusses this significant question in more detail below and favors the younger paleomagnetic chronology, partly because some of the argon dates are on volcanic materials that might have been secondarily redeposited. Indeed, Christophe Falguères et al. (2016) discuss a new series of 10 argon and uranium series dates for sediments just above the Grenzbank at Bapang. Although these range between 1.5 and 0.6 mya at the outside, there is a clear concentration between 1.0 and 0.75 mya.

Ngandong

Between 1931 and 1933, Indonesian field assistants employed by the Geological Survey of Indonesia were periodically given the job of excavating a bone-bearing terrace about 20 m above the dry-season level of the Solo River at Ngandong, downstream from Trinil. The whole terrace deposit was about 3 m thick and the animal bones were apparently fairly heavily concentrated in the lower 70 cm of the deposit – about 25,000 were recovered from a 50 by 100 m excavation. Over the two-year period the bone collections eventually yielded no fewer than 12 crania (all lacking bases and faces) and two tibiae of an advanced population of *Homo erectus* (see von Koenigswald 1951, 1956 and Oppenoorth 1932 for eyewitness accounts). It is quite clear that the human skulls at Ngandong were not all found together and von Koenigswald noted the unusual circumstance that teeth, mandibles, and other bones apart from the two tibiae were entirely lacking; such selectivity was not noted amongst the other animal remains. Furthermore, of the 12 skulls only two had parts of their bases surviving, leading von Koenigswald (1951) to postulate that they had been broken open for purposes of brain eating, after which they were used as bowls. The idea of cannibalism was disputed by Jacob (1967, 1972), who pointed out that the skull base is a fragile area subject to natural breakage, although the observation that the human bone sample is taphonomically unusual still remains.

The Ngandong crania were described by Weidenreich just before his death in 1948 (Weidenreich 1951). Most authors today regard them as large-brained (the average of five skulls is 1150 cm^3) and late members of *Homo erectus*. More hominin fragments have been found at Ngandong since the initial discoveries, and possibly four other crania of Ngandong type (perhaps slightly more archaic) come from a roughly contemporary river terrace deposit at Sambungmacan, also on the middle Solo River. In 1987 a new skull, again without facial features, was found at Ngawi (Sartono 1991). All are agreed that the "Solo Man" series is post-Trinil H.K. in the faunal sequence, but beyond this there are major questions that fall loosely under the headings of context, environment, and date.

Concerning the context of the Ngandong remains, it is clear from von Koenigswald's accounts (1951, 1956) that the skulls were dispersed amongst other animal bones in what must once have been a quiet bank of sand and gravel, perhaps on the inside of a river bend. Perhaps they were washed there after being cannibalized in a nearby hunting camp; the presence of articulated vertebral columns of cattle could suggest animal butchery in the vicinity. Indeed, Dennell (2005) has suggested that they were washed into the terrace after a mass drowning event. Others have preferred carnivore kills or suggest that the hominin and mammal remains in the terrace result from completely separate depositional processes (Santa Luca 1980).

Regarding the environment of the Ngandong region we are on firmer ground. The 25,000 animal bones belong to 17 species, of which 12 or 13 are shared with the Trinil fauna, and the major post-Trinil additions appear to be more modern forms of pig and deer.[9] The only wholly extinct genus is *Stegodon*. The fauna as a whole, especially the extinct water buffalo (*Bubalus palaeokerabau*) with horns up to 2.25 m across, hints at a fairly open landscape. The majority of the bones were of deer and cattle (an ancestral banteng), both animals that are more numerous in open landscapes, although they do also occur in small numbers in the dense forests of Sundaland. In addition, one of Oppenoorth's assistants recovered a bone of a crane (*Grus grus*) from deposits considered to be of Ngandong age at a nearby location called Watualang (Wetmore 1940). This bird winters in southern China today and the bone's presence in Java could suggest a cooler climate then than now.

It is with the date of the Ngandong remains that the most difficulty occurs. The fauna is always classed loosely as Middle or Late Pleistocene and the Ngandong terrace deposits certainly postdate the Bapang Formation at Sangiran. However, the fauna is of little help for more precise dating because it is not known when key genera such as *Stegodon* became extinct in Java. In recent years, a large battery of radiometric dating techniques have been applied to volcanic minerals and hominin and animal bones from Ngandong and sites of similar age. They offer a bewildering range, with the latest batch of argon, electron spin resonance, and uranium series dates falling between a rather staggering 550 and possibly 140 kya (Indriati et al. 2011).[10] This at least makes the Ngandong hominins likely to be late Middle Pleistocene and thus in a chronological position to have become extinct with the Late Pleistocene arrival of modern humans in Java.

But is full extinction for *Homo erectus* the final answer? When I was revising *Prehistory of the Indo-Malaysian Archipelago* in the mid-1990s the answer was not so certain; vacillation from one side to the other in terms of continuity versus extinction was the order of the day. Now, 20 years later, the sheer weight of genetic and morphological evidence renders extinction the only likely *ultimate* conclusion for Javan *Homo erectus*. Nevertheless, there is some fuzziness in the concept of extinction. The examples of extinct Neanderthals and Denisovans admixing to a minor degree with modern humans as visible through ancient autosomal DNA analysis, even prior to 100 kya (Kuhlwilm et al. 2016), should make us wonder if similar admixture occurred between *Homo erectus* and modern humans in Java, even if the levels of admixture were extremely small. Since we have no archaic hominin DNA from Island Southeast Asia we cannot yet know, but ancient admixture is certainly possible, especially since the autosomal DNA of some modern Wallaceans, Australians, and Papuans carries traces of very ancient admixture with the rather mysterious Denisovans (Cooper and Stringer 2013).

When Did Hominins Arrive in Java?

Despite difficulties with dating the oldest Sangiran hominins from the Sangiran Formation, a potential start date for hominins in Java should, in theory, be somewhere between 1.8 and 1.2 million years ago, given the 1.8 mya date for the Dmanisi hominins in Georgia and a new claim for stone tools from Nihewan (Hebei) in northern China, dated to between 1.95 and 1.77 mya by magnetostratigraphic correlations (Wei et al. 2015). This is all no doubt frustratingly vague, but such a broad time range currently remains the best compromise and one that is not in disagreement with

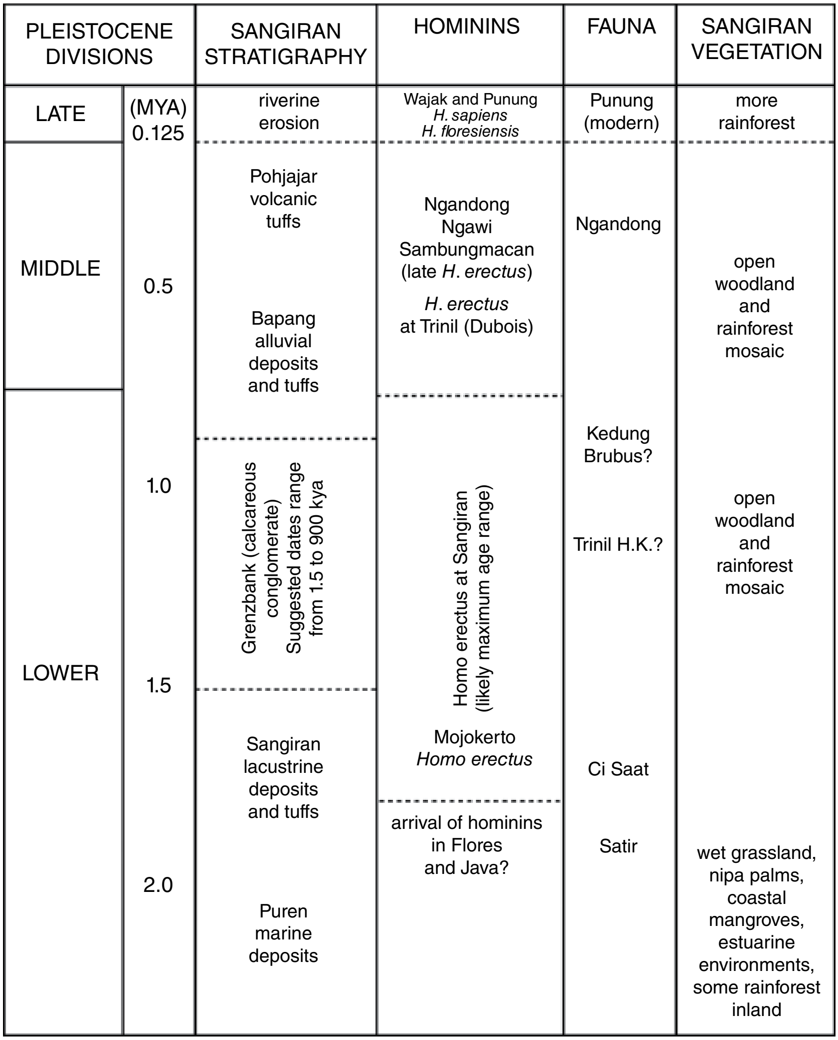

Figure 3.4 The Sangiran stratigraphic and faunal sequence, with approximate hominin date ranges and vegetation correlations. The chronology is a compromise that takes account of both the short (hominins after 1.2 mya) and the long (hominins after 1.8 mya – see text) hypotheses.

hominin cranial morphology (Figure 3.4).[11] In my opinion, any date very much younger than 1.8 mya for Java would have to explain how and why early hominins remained in the vicinity of Georgia and western Asia without any expansion eastwards for more than half a million years through the tropics of Southeast Asia. Equatorial rainforest might have stopped them from reaching Java from the northern hemisphere during interglacials, but, as discussed at the end of Chapter 2, the likelihood that glacial-era dry-season corridors periodically interrupted this rainforest is gaining favor. Hominins, it seems to me, were never slow to respond to a migration stimulus.

An Invited Perspective by Colin Groves

The story is well known: the young Dutchman Eugène Dubois, inspired by the writings of Ernst Haeckel and by hearing him lecture, gets a medical degree and gets himself posted to what was then the Dutch East Indies, where he intends to search for the missing link – and he finds it.

What he actually found, in 1891 and 1892, were a calotte ("skullcap"), a femur, and two molars from Trinil, on the Solo River in Central Java, and a tiny mandibular fragment from Kedung Brubus in East Java (or rather, a gang of Indonesian workers supervised by two Dutch Army sergeants found them). These formed the basis for his description of the new genus and species *Pithecanthropus erectus.* Forty years later (!), he identified three more fragmentary femora from a box of Trinil fossils, then a further one with "Trinil" written on it in the handwriting of one of the Army sergeants, and finally a sixth femoral fragment which, for whatever reason, he thought might have come from Kedung Brubus. The story of this eccentric individual and his fossil discoveries is told by Shipman (2002).

Whether all the material from Trinil came from the same stratigraphic layer has been much discussed. For Dubois, the association of at least the skullcap and femur was crucial: an extremely human femur associated with a much more ape-like skullcap indicated the "upright ape-man," the literal meaning of *Pithecanthropus erectus*. Others have doubted that they really were stratigraphically associated. Bartstra (1983), for example, argued that Dubois' workers had excavated through two distinct layers, the calotte coming from the older one, the femur from the younger. This was supported by Bartsiokas and Day (1993), who found that femur 1 had noticeably higher calcium/phosphorus ratios than the skullcap or the other femora and rediscovered the old excavation plan, which seemed to show a strong slope in the sediments. Therefore, the femur, although found at the same level above the river as the skullcap, came in fact from a higher stratigraphic level. On the other hand, Joordens et al. (2015) have discovered very recently that the CaO/P_2O_5 ratios of the skullcap and all the femora are comparable, hence they are still likely to be of the same approximate age. The identity of the teeth found by Dubois' excavators has also been doubted: are they proto-human or proto-orangutan? A recent study (Smith et al. 2009) has shown conclusively that they really are *Homo* and are maxillary first or second molars.

During the 1930s, G.H.R. von Koenigswald excavated at a nearby site in the Sangiran Dome, where he discovered a number of further fossils, some of which he referred to *Pithecanthropus erectus*, others to a new species, *Pithecanthropus robustus*, and one other to a new genus and species, *Meganthropus palaeojavanicus*. As von Koenigswald was interned in Java by the Japanese during the Second

World War, it fell to his American colleague Franz Weidenreich, to whom he had sent casts, to describe these new taxa on his behalf. Von Koenigswald also excavated at Perning, near Mojokerto in East Java, where he discovered a child's cranial remains, which he made the type of a further species, *Homo modjokertensis* (avoiding use of the generic name *Pithecanthropus* in order not to antagonize the jealous and possessive Dubois). After the war, he described yet a further species, *Pithecanthropus dubius*. If correct, we would have four species of fossil hominin from the Early and/or Middle Pleistocene deposits of Java.

Also during the 1930s, a Dutch team led by Ter Haar and Oppenoorth excavated on a presumed Late Pleistocene terrace of the Solo River at Ngandong, discovering 11 or 12 cranial specimens, varying from very complete calvariae to small vault fragments, plus two tibiae. These they placed in a further species, *Homo* (or *Javanthropus*) *soloensis*. Much later discoveries were made at Sambungmacan and Ngawi, also along the Solo River and thought to be of comparable age to those from Ngandong.

Von Koenigswald and later Sartono numbered the recovered hominin specimens according to their supposed taxonomy, giving Roman numerals to the cranial specimens (*Pithecanthropus* I, II, III, IV, etc.) and letters to the mandibular specimens (*Pithecanthropus* A, B, etc., and *Meganthropus* A, B, etc.). Later again, in the interests of preserving the freedom of taxonomic thought, a site-specific system was substituted by Teuku Jacob (Trinil 1, 2; Sangiran 1, 2, 3, etc.; Ngandong 1, 2, etc.). More recently, the material from Sangiran has become exceedingly numerous and different teams have been working there independently; therefore the tendency has been to name new specimens according to the specific location at Sangiran: Kresna, Bukuran, and so on. Figure 3.5 shows the best preserved cranium of Javan *Homo erectus* – Sangiran 17, from Bapang sediments in the Pacing Valley (a tributary of the Cemoro) at Sangiran.

The Dating of the Javan Hominins

De Vos (2004) has discussed the history of understanding of the chronostratigraphy of the Pleistocene formations of Java. Von Koenigswald had divided the Pleistocene faunas into successive Jetis (formerly spelt Djetis), Trinil, and Ngandong faunal stages, which he regarded as, broadly speaking, Early, Middle, and Late Pleistocene respectively. John de Vos reorganized these on the basis of richer material, recognizing instead the Ci Saat, Trinil H.K. (Hauptknochenshicht, meaning Main Bone Bed), Kedung Brubus, and Ngandong stages, with the relatively uncontroversial Punung and Wajak *Homo sapiens*-bearing faunas leading on into the Late Pleistocene and perhaps Holocene.

The hominin-bearing levels at Sangiran include black lake clays at the base, overlain by cross-bedded fluvial deposits, with a well-marked intervening separate layer, the Grenzbank. The Solo River terraces were formed later. The original assumption, based on lithology, was that the black clays represented

Figure 3.5 Two famous members of the Indonesian hominin sequence. Top: the cranium of Sangiran 17 (internal brain capacity ~1100 cm^3), the most complete specimen of *Homo erectus* found in Java (reconstruction by Hisao Baba). Middle right: a half-frontal view of the cranium and mandible of Liang Bua 1 (only ~380 cm^3), the type specimen for *Homo floresiensis*. Note that the mandible lacks a chin. Bottom: a modern human cranium from New Guinea for comparison. Source: middle-right photo by Debbie Argue. Others: School of Archaeology and Anthropology ANU collection.

what was called the Pucangan Formation elsewhere in Java, and the fluvial deposits the Kabuh Formation, but site-specific names now tend to be used: Sangiran Formation for the black clays, and Bapang Formation for the fluvial deposits above the Grenzbank.

The Sangiran Dome has been difficult to date because of its very complex stratigraphy in combination with certain geophysical problems, such as the probable presence of "extraneous" argon in datable minerals. At present, there are two competing dating models. Swisher et al. (1994) obtained an $^{40}Ar/^{39}Ar$ age of 1.65±0.03 mya for pumice described as being 2 m above the level within the Sangiran Formation where two of the fossils, Sangiran 27 and 31, had been found. In support of such an early date, Larick et al. (2001) produced a series of $^{40}Ar/^{39}Ar$ dates for the Bapang Formation which reduced consistently from 1.51±0.08 mya at the Grenzbank to 1.02±0.06 mya at the Upper Tuff of the Bapang Formation, this tuff marking the uppermost occurrence of *Homo erectus* in Sangiran. However, Japanese researchers (see especially Hyodo et al. 2011) have produced much younger dates, largely on the basis of magneto-stratigraphy; the Upper Tuff is placed by them within the Matuyama–Brunhes paleomagnetic transition at 793–795 kya, and this would seem to be corroborated by the presence, below the Matuyama–Brunhes transition, of a tektite layer which has been potassium–argon dated elsewhere to 803±3 kya.

For the Perning locality, Swisher et al. (1994) produced an even earlier $^{40}Ar/^{39}Ar$ date of 1.81±0.04 mya, which they associated with the Mojokerto child skull. Huffman et al. (2006) then relocated the actual find site of this child to 20 m above the Swisher et al. dated horizon, implying a younger date. They argued in addition that these dates might actually have derived from a mixed sample. The real age of the Mojokerto skull needs further investigation.

As for the late *erectus* remains from the Solo Valley, Indriati et al. (2011) have used $^{40}Ar/^{39}Ar$ and ESR/U-series dating to determine the age of the 20 m terrace at Ngandong and the associated faunal site of Jigar. The argon dating gave an average of 546±12 kya and the U-series about 500 kya, but the ESR (early uptake) estimates averaged only 72±10 kya, the oldest reading being 143 kya. The discrepancy is difficult to explain, but may relate to problems with temperature and humidity. All the evidence for the Sambungmacan and Ngawi *erectus* remains suggests that they are of ages comparable to those at Ngandong.

A recent date from the Dubois collection from the Hauptknochenschicht at Trinil, taken from sediment contained in shells by both $^{40}Ar/^{39}Ar$ and luminescence dating, produced minimum and maximum ages of 0.43±0.05 and 0.54±0.10 mya – younger than the youngest age for the Bapang Formation at Sangiran (Joordens et al. 2015). If this somewhat surprisingly young dating is borne out by future studies, it would appear that not only must the faunal sequences be rethought, but that the Trinil remains may well be not very much earlier than those from Ngandong.

The Homo erectus *Cranium*

A series of papers by Susan Antón have clarified a great deal about the morphology of *Homo erectus*. Although she included East African, Georgian, and Chinese samples in the species, as well as the specimens from Java, she has shown that there are clear divisions between the geographic samples (Antón 2002, 2003). In particular, all Javan specimens differ from all Chinese ones in that the frontal squama slopes evenly upwards and backwards from the supraorbital torus, with hardly any indication of the mid-frontal convexity and deep ophryonic groove of the Chinese specimens; the Javan supraorbital torus in superior view projects medially, whereas in the Chinese sample it is the lateral portions of the torus that are most developed; and the Javan occiput is broad and angulated, not narrowed and block-like as in the Chinese sample. Compared to the African and Georgian fossils often attributed to *Homo erectus*, all the Asian fossils have an ophryonic groove that is broader laterally than medially, reflecting a brain that extends further forward in the midline, as argued by Antón (2002). In addition, the Javan braincase tends to be more strongly keeled and is more "pear-shaped" in dorsal view; superior temporal lines diverge more posteriorly and are less high on the vault; the glenoid fossa is wider anterior-posteriorly and narrower mediolaterally; and there are no paranasal pillars (Antón 2003). The Javan fossils are strongly prognathic, with the largest teeth of any of the "erectine" samples.

The Mojokerto child was probably 4–6 years of age at death, but nonetheless has an occipital torus and a metopic eminence and other features which confirm that it is a juvenile of *Homo erectus* (Antón 1997).

Kaifu et al (2013) have described the early (Sangiran/Grenzbank) crania from the Sangiran Dome, distinguishing a "comparatively thin-vaulted, gracile type" and a "moderate to thick-vaulted, robust type," which they suggested reflects sexual dimorphism.

The chronologically later Ngandong, Sambungmacan, and Ngawi crania differ from the earlier Sangiran and Trinil specimens by their overall larger size and larger cranial capacities. But, as emphasized by Santa Luca (1980), there are cross-cutting similarities between individual specimens from earlier and later sites. Sambungmacan, at least as illustrated by the Sambungmacan 4 calvaria, is very similar to Ngandong but with a lower cranial vault (Kurniawan et al. 2013).

The **Homo erectus** *Mandible*

The description of *Meganthropus palaeojavanicus*, based on an enormous right anterior mandibular fragment (Sangiran 6a) from the Grenzbank or the underlying Sangiran Formation, ushered in a period of doubt about whether all the Pleistocene Javan fossils represented a single species or more than one. The subsequent description of *Pithecanthropus dubius*, a smaller mandibular fragment (Sangiran 5) with double-rooted premolars, added to these doubts. A few subsequent specimens were attributed to these two putative taxa, although *P. dubius* seems to have largely faded from consideration, leaving the mighty *Meganthropus* as a perpetual source of worry. Kaifu et al. (2013) have recently discussed its status, pointing out that the Sangiran/Grenzbank dentognathic specimens do tend to be larger as well as more "primitive" than the later Bapang ones, although there is still a great deal of size variation amongst them. Their reconsideration of the available evidence indicates that there was only one hominin taxon present amongst these early Javan specimens and that the size differences are most likely to indicate a strong sexual dimorphism, thus paralleling the evidence from the cranium.

Homo erectus *Teeth*

Javan *Homo erectus* was characterized by cheek teeth of very large size compared with those of any of the other populations sometimes referred to *Homo erectus*, or indeed to *Homo sapiens*. The upper molars can be distinguished from those of

Homo sapiens by having more bucco-palatally splayed roots, although the roots of the third molars are coalesced in both species (Smith et al. 2009).

The very robust early (Sangiran Formation) deformed facial specimen Sangiran 27, sometimes attributed to *Meganthropus*, has larger cheek teeth than any other specimen, although in general it fits well with other Javan *Homo erectus* (Indriati and Antón 2008). This might agree with Kaifu et al.'s (2013) model of strong sexual dimorphism characterizing the earlier Javan *Homo erectus*, although the paucity of maxillary dentitions in the Javan sample as a whole warns that we ought to be cautious about this.

Homo erectus *Postcranial Material*

Trinil 1 (femur I) is a beautifully preserved, complete femur with an exostosis on the posteromedial aspect of the upper part of the shaft, of much-discussed etiology. Femora II, III, IV, and V are just shafts, although the first of these is tolerably complete. Femur VI, the one supposed to be from Kedung Brubus, is not human at all (Day and Molleson 1973). Day and Molleson (1973) and Day (1984) tested all the Trinil bones chemically and by other methods such as X-ray diffraction and energy dispersive microanalysis, without coming to firm conclusions about contemporaneity. But Bartsiokas and Day (1993) used a new methodology to examine calcium/phosphorus ratios and revisited the Trinil stratigraphic evidence, concluding firmly that the Trinil 1 femur came from a more recent stratum and belongs to *Homo sapiens*, whereas femora II–V really were *Homo erectus*. Calcium/phosphorus ratios were more recently calculated by Joordens et al. (2015), to counter-claim that the Trinil 1 femur falls within the range of the other femora and, perhaps more significantly, the skullcap. If this is so, then it too must be considered a specimen of *Homo erectus*.

Day and Molleson (1973) compared the Trinil femora with those from Zhoukoudian ("Peking Man"), with Olduvai Hominid (OH) 28 (up to that time, the only more or less contemporary African specimen known) and, as far as possible, with *Homo sapiens*. Trinil I has markedly lower torsion than Peking IV and the others from Trinil all have markedly lower curvature than Peking IV or OH 28. The robusticity index in Trinil I and II is lower than in Peking IV, Peking I (probably), or OH 28. The platymeric index in Trinil II, III, and IV is markedly higher than in Peking I and IV and OH28. The pilastric index in Trinil II, III, and V is 90.5–97.0, overlapping slightly with the five Peking femora (80.3–91.2), but higher than in OH28 (75.5) and lower than Trinil I (103.6) – but the range for *Homo sapiens*, 72.6–147.1, overlaps them all.

Kennedy's (1983) study included the same specimens as those examined by Day and Molleson (1973), as well as three femora from Koobi Fora. She found that Trinil femora II, III, and IV are in some respects like other archaic femora (i.e., thick cortex, high distal cortical index), but nothing definitive could be said about femur I because of its pathology. Kennedy discussed whether the similarities and differences of femora II–IV compared to other non-Javan archaic femora were symplesiomorphic (i.e., shared ancestrally) or (her preferred interpretation) independently acquired as a consequence of geographic isolation.

The only Sangiran femoral specimen of definitely known origin, Kresna 11 from the Grenzbank (Grimaud-Hervé et al. 1994), in fact compares very well with all the Trinil femora, including, interestingly, Trinil 1; all have noticeably higher platymeric and pilastric indices than the Zhoukoudian femora and were within the range of some modern human populations for the platymeric index but lower for the pilastric index (lacking any pilaster). Further analysis (Puymerail et al. 2012) shows that they have less marked cortical thickening overall than other archaic femora, although the medial cortex becomes thicker distally, and that the minimum shaft breadth is distal in position.

In summary, the known Javan *Homo erectus* femora seem to have a distinctive morphology, in some respects resembling those from China and/or Africa but in other respects different.

Evolution within Javan **Homo erectus**

The two cranial specimens of "*erectus* grade" from Olduvai in Tanzania, OH9 and OH12, are very different in size and some aspects of morphology, while at the same time showing mosaic similarities with specimens of the same "grade" from Koobi Fora in Kenya (and indeed Daka in Ethiopia); this suggests that together they form an African lineage, exhibiting a considerable degree of evolutionary stasis (Antón 2004), but with marked size differences amongst them, suggesting a high degree of sexual dimorphism. Thus, the inferred sexual dimorphism of the earlier Javan specimens may be a retained primitive feature. Strong sexual dimorphism is also seen in the Dmanisi "erectine" sample, but not in the Chinese samples and evidently not in the later Javan sample either. This is one indication of ongoing evolution within Java. As we have seen, the evidence is clear that at least the African, Chinese, and Javan samples constitute separate lineages – that is, they must rank as separate evolutionary species in the argument of such authors as de Queiroz (2007). Thus, *Homo erectus* is a species so far known only from the Early and Middle Pleistocene of Java: the Early Pleistocene "erectines" of Africa are *Homo ergaster*, those of China are *Homo pekinensis*, and most likely the Dmanisi sample constitutes a further species, *Homo georgicus*.

Evolutionary changes within *Homo erectus* appear detectable. Kaifu et al. (2013) compared the early (Grenzbank/Sangiran) and later (Bapang) crania from Sangiran, finding the former to be more primitive, generally smaller, with a smaller cranial capacity and a deeper postorbital constriction. As represented by the nearly complete cranium Sangiran 17 (Figure 3.5), the Bapang specimens are evolved towards the later (apparently Middle Pleistocene) Sambungmacan and Ngandong condition (Kurniawan et al. 2013). The Ngandong material was described in detail by Santa Luca (1980). The apparently similarly aged Sambungmacan and Ngawi crania are close in appearance and morphology; all differ from the earlier Sangiran and Trinil specimens by their overall larger size and larger cranial capacities. But Santa Luca (1980) has argued that there are cross-cutting similarities between individual specimens from later and earlier sites, such that no overall distinction can be made except for that of cranial size. Durband (2008), however, found that the morphology of the mandibular fossa in Ngandong, Sambungmacan, and Ngawi is different from that in Sangiran, another indication of *in situ* evolution within Java. There is no indication that these late *Homo erectus* populations evolved in any sense into *Homo sapiens*. But on the analogy of what we now know about the small genetic contribution to modern humans from Neanderthals and the enigmatic Denisovans, we cannot rule out a similarly minor contribution to modern humans from *Homo erectus*, although as far as the known morphological evidence goes there seems to be no indication of this at present.

The Philippines, Sulawesi, and Nusa Tenggara: Pleistocene Mammals and Stratigraphy

We have now reached the end of our coverage of *Homo erectus* in Java, and must move eastwards to examine three colonizations by archaic hominins that really do give Island Southeast Asia a right to be called the location of the "First Islanders." The Pleistocene was a time of three important faunal dispersals eastward from Sundaland and with them, it appears, there were hominins. At the moment, the dispersal to Flores is by far the best known and dated, and it demonstrates that hominins had somehow managed to cross sea gaps before 1 million years ago. When the second edition of *Prehistory of the Indo-Malaysian Archipelago* was published in 1997 rather little was known about this, because the important discoveries at Mata Menge in Flores were not published until 1998 (Morwood et al. 1998). Since then, with new discoveries in Flores, Sulawesi, and Luzon, the topic is taking on a new excitement.

In 1997, it appeared that these faunal migrations went in three separate directions – from Bali along the Lesser Sundas to Flores, from Borneo to Sulawesi, and separately from Borneo via Palawan to the Philippines. These Wallacean land masses were apparently never land-bridged to Asia or Australia during the Pleistocene (Groves 1985; Heaney 1985, 1986), at least not according to current faunal evidence, so hominins and other mammals had to cross sea gaps. But now some of the actual directions of human and mammal migration are being rethought and a north to south movement from the Philippines through Sulawesi to Flores is perhaps as likely as separate movements eastwards from Sundaland. Certainty, however, is elusive.

The Philippines

In the Philippines, faunas of probable Middle Pleistocene age are known from many localities, especially from Cagayan, Pangasinan, and Rizal Provinces on Luzon (de Vos and Bautista 2003; van der Geer et al. 2010). They include large stegodons and elephants, rhinos, deer, bovids perhaps ancestral to the extant pygmy tamaraw (related to the water buffalo and still living on Mindoro Island), suids that might be of the same genus as those of Pleistocene Sulawesi (*Celebochoerus*), crocodiles, and the giant land tortoise genus that also occurred in Early Pleistocene Java and Flores (see note 5).

This fauna presumably entered the Philippines from Taiwan, or from Borneo via Palawan or Sulu. At present, no definite evidence exists for a continuous Pleistocene land bridge along either route, except from Borneo to Palawan only. Rhinos especially would have been unlikely to have crossed wide sea expanses by swimming, but whether they could have crossed narrow and shallow tidal channels remains unclear. The question of whether or not this fauna was associated with hominins is still under debate and the current research involving Middle Pleistocene faunas and potential stone tool assemblages in the Cagayan Valley holds great promise.[12]

Sulawesi

The arrival of terrestrial mammals on Sulawesi is documented by the Cabenge fauna from several localities in the Walanae Valley in the southwestern part of the island (Figure 3.2; Bartstra et al. 1991–1992; Bartstra and Hooijer 1992; van der Geer et al. 2010). Like the oldest Satir and Ci Saat faunas on Java, it has South Asian affinities and contains species of stegodon and a pygmy elephant, an extinct species of large pig (*Celebochoerus*), and the giant land tortoise of Java and Luzon. The Cabenge fauna thus perhaps arrived in Sulawesi some time prior to 2 mya but it contains no hominins so far. The Cabenge mammals are all species that can swim, so no continuous land bridge need have been required. A direct Sundaland origin for the Cabenge fauna has long been considered likely (Groves 1976; Bartstra 1977; Sartono 1979), although the absence of any comparative Middle Pleistocene faunal assemblages from Borneo makes certainty elusive.

The younger Tanrung fauna of Sulawesi, currently not precisely dated, contained larger species of stegodon and elephant but again so far no hominin fossils. However, an ancestral anoa (*Bubalus* sp.), the suid genus *Celebochoerus*, and a stegodon are newly reported with stone tools from the late Middle Pleistocene open site of Talepu near Cabenge in the Walanae Valley (van den Bergh, Kaifu et al. 2016). Uranium series dates on associated animal teeth and bones and luminescence dates on the containing sediments suggest an age between 194 and 118 kya. From the published illustrations, the lithics appear to be similar to those from Wolo Sege, Mata Menge, and Liang Bua on Flores, to be described later.

The Talepu fauna probably overlaps with the Tanrung and some hominins, presumably archaic ones, were clearly present on Sulawesi by this time. The large stegodons also reached the Sangihe Islands located north of the Minahasa arm of Sulawesi, presumably by swimming. It is thus possible that the Tanrung fauna represented a new Middle Pleistocene faunal immigration with hominins into Sulawesi, but exactly when it arrived and where it came from – Borneo or the Philippines – remains uncertain.

The recent placental and still extant mammal fauna of Sulawesi, known from many Late Pleistocene and Holocene archaeological sites but not well dated in terms of arrival, includes highly endemic suids (*Babyrousa* spp. and *Sus celebensis*), pygmy buffaloes (two species of anoa – *Bubalus* sp.), macaque monkeys (seven species), tarsiers, and giant rats. Anoa were present at Talepu, and newly published uranium series dates for rock paintings in South Sulawesi imply a presence of babirusa on the island by at least 35 kya (Aubert et al. 2014). The modern marsupial fauna of Sulawesi also includes two genera of cuscus (phalangerids) of Sahul origin, which presumably arrived during the Pliocene or earlier Pleistocene with the natural rafting of the eastern arms of the island from the northern edge of Sahul. Their bones are found in late Paleolithic cave layers in South Sulawesi, but the relationship of these marsupials to the older Cabenge and Tanrung faunas remains uncertain.

Also uncertain, as noted, is the question of where these Middle Pleistocene faunas of the Philippines and Sulawesi originated. The seas between Taiwan and Luzon are very deep and any former land bridge would demand considerable tectonic movement. However, the Cagayan elephant and rhino might hint at such a route.[13] Nevertheless, the easiest route into the Philippines based on recorded Pleistocene biogeography would have been from Borneo through Palawan, so perhaps we should allow that both routes might have been followed at different times.

Flores and Nusa Tenggara

The evidence for a Pleistocene land bridge or mammal migration along the Nusa Tenggara chain from Sundaland to Flores is nowadays rather tenuous, even though a glance at a map will indicate that the narrowest Wallacean sea crossings lie along this route. The problem is that the sea passages of Wallacea were considerably narrowed during glacial periods of low sea level, hence the currents flowing through them between the Pacific and Indian Oceans were correspondingly magnified in strength, especially through the narrow gaps along the Nusa Tenggara chain. These islands that lie east of Bali have fewer native mammal species than either Sulawesi or the Philippines. While stegodons reached them there are no signs (ignoring Neolithic and later translocations by humans) of other widespread large indigenous Sundaland groups of mammal species such as felines, elephants, pigs, deer, rhinos, or bovids, either Pleistocene or recent.[14]

Admittedly, rodents might be an exception – these animals are so widespread, even reaching Sahul, that their migrations were clearly multidirectional and across wide sea gaps. But the southern end of the Wallace/Huxley Line, which runs east of Bali down the 30 km wide Strait of Lombok, was apparently never land-bridged during the Pleistocene and glacial sea level minima would have been insufficient to produce any but purely local land connections in Wallacea, for instance between Lombok and Sumbawa.

Despite this, large land tortoises (*Megalochelys* sp.), Australian varanid lizards ancestral to Komodo dragons (Hocknull et al. 2009), smaller monitor lizards, crocodiles, rodents, and stegodons were able to reach the Nusa Tenggara Islands, especially Flores (van den Bergh et al. 2009), through migration from both Sunda and Sahul sources. Some of the stegodons also reached Sumba and Timor and, as we have seen, they were also in the Philippines and Sulawesi. Indeed, stegodons have become rather important in discussions about hominin migrations from Sundaland across the Wallace/Huxley Lines because of their widespread distributions. Mindanao, Sulawesi, Flores, and Timor each had separate large and dwarfed species, probably derived from *Stegodon trigonocephalus* of Java (Hooijer 1975; Sartono 1969; van den Bergh, de Vos et al. 1996; van den Bergh et al. 2009). One dwarfed species existed on Sumba as well (Hooijer 1981). What is more, the dwarfing process appears to have occurred twice within the species *Stegodon florensis* on Flores. One is obliged to assume that stegodons arrived on these islands by swimming (using their trunks as snorkels!) on at least two occasions during the Pleistocene, each time evolving dwarf stature in their small island environments before another batch of larger-sized newcomers arrived.

To explain these stegodon distributions, Audley-Charles and Hooijer (1973) once suggested that Flores and Timor were joined by an Early Pleistocene land bridge through Alor, prior to subsidence of the now 3000 m deep Timor Sea, and that Flores was similarly joined to southwestern Sulawesi. Other scholars have been reluctant to accept these postulated land bridges owing to the degree of tectonic movement they demand and the absence of any other definite faunal connections apart from the stegodons. There is no sign that the Cabenge or Tanrung faunas of Sulawesi traveled to Flores, which tends to rule out the existence of a continuous land bridge. However, island-hopping between the series of small islands that would have been exposed by low sea levels between southwestern Sulawesi, via Salayar and the many coral islets of Taka Bone Rate, to Flores (visible in Figure 3.2), seems quite possible.[15]

The most informative Pleistocene faunal sequence in Nusa Tenggara comes from Flores, where stegodons and Komodo dragons coexisted with hominins and their stone tools for over 1 million years.[16] In the Soa basin, an area of 35 by 22 km formed by many small tributaries of the upper Ae Sissa River in central Flores, a pygmy stegodon (*Stegodon sondaari*), rodents, Komodo dragon, a crocodile, and a giant tortoise similar to the *Megalochelys* of Java and Sulawesi were already present before 1 mya towards the base of the 80–120 m thick Ola Bula Formation. This comprises a series of lacustrine deposits formed from white volcanic tuffaceous siltstones and sandstones, with stone tools (discussed below) argon-dated to 1 million years ago at a non-fossiliferous location called Wolo Sege (Brumm et al. 2010). By 900 kya, bones of a large stegodon (*Stegodon florensis*) occur in the Soa basin at Mata Menge, with newly reported hominin remains dated there from 0.65 to 0.8 mya (van den Bergh, Li et al. 2016). These are discussed below by Debbie Argue, and the large stegodon appears to have continued its migration route to reach Sumba and Timor. An immediate Sulawesi source for it is suggested by most authorities.[17]

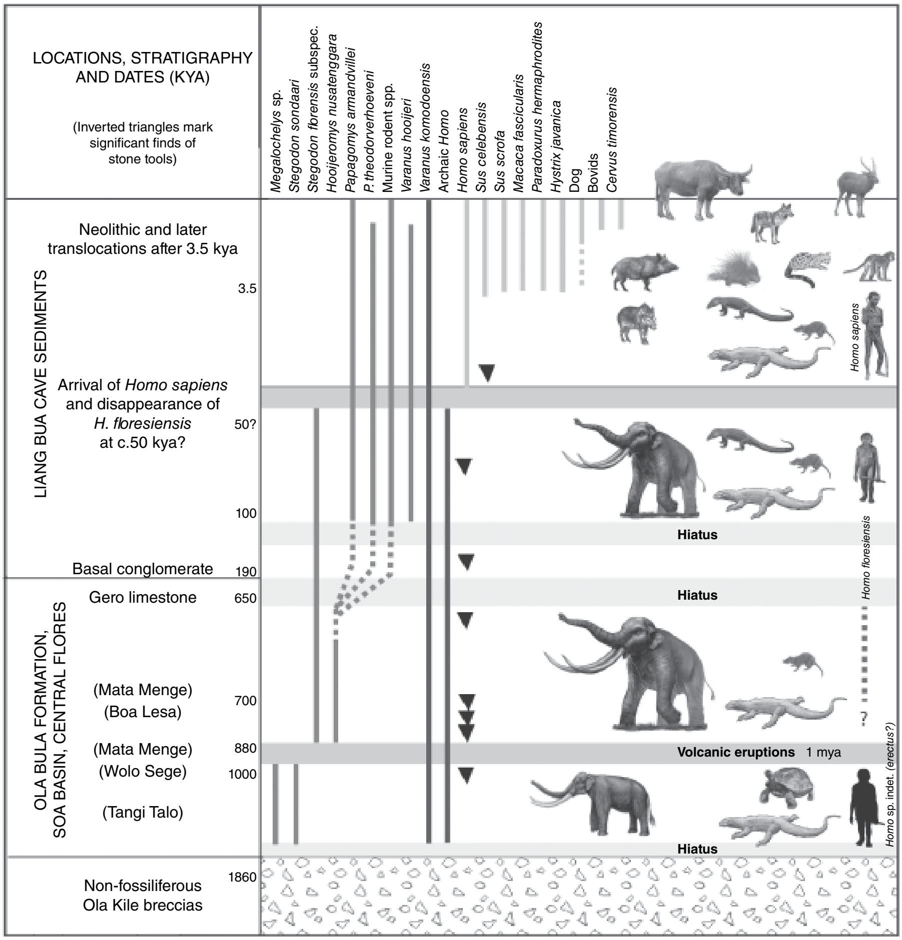

Figure 3.6 The faunal and archaeological sequence on Flores (for an earlier version see Brumm et al. 2010). The faunal turnover dated to 900 kya with the arrival of large *Stegodon florensis* is clearly shown, as is the prior presence of hominins indicated by stone tools more than 1 million years old from Wolo Sege. Source: original courtesy of Gerrit van den Bergh and Nature Publishing Group. Reproduced with permission of Nature Publishing Group; modified by the author.

By 100 kya, the Middle Pleistocene large *Stegodon florensis* of Flores had become dwarfed again like the earlier *Stegodon sondaari*. Its (mostly juvenile) bones are found with stone tools and butchering marks in association with the bones of *Homo floresiensis*, dating between 100 and 60 kya in the cave of Liang Bua in western Flores.[18] The hominins, archaeology, and dating for all of this will occupy us below, but at this point the Pleistocene history of Flores can be summarized as having at least one faunal and hominin immigration from an external source (Sulawesi?) more than 1 million years ago, with a possible second immigration early in the Middle Pleistocene (Figure 3.6).

Homo floresiensis (and *Homo erectus*?) in Flores

The mysteries surrounding hominin migration across sea gaps to reach the island of Flores, already introduced above, became deeper in September 2003 when part of the skeleton of a very small (c. 30 kg body weight) female hominin was found with the upper right leg and pelvis still in articulation, buried 6 m down in Liang Bua Cave in the interior western part of the island (Figure 3.5). The cave had been excavated previously but not to any great depth, and the enthusiasm by the late Michael Morwood for his team to dig deeper led to one of the most important finds ever made in Indonesian paleoanthropology. As published in 2004 (Brown et al. 2004; Morwood et al. 2004), the newly named *Homo floresiensis* was stated to have a brain size of 380 cm^3 (since amended to 426 cm^3) within a very thick skull, short legs, and relatively long arms and feet.

The skeleton was found roughly 2 m below a layer of white volcanic tuffaceous silt bracketed by C14 dates of 13 and 11 kya, so it was obviously older than this depositional event. The originally published assumption from C14 dates taken nearby and higher in the profile was that the skeleton was about 18,000 years old. Fragments of at least nine other individuals from a similar population, including another mandible and long bones, were found in deeper layers in 2003 and 2004 (Morwood et al. 2005). Apart from Komodo dragons, the only large mammals (excluding rats and bats) present with the hominins beneath the tuffaceous silt were stegodons, almost entirely juvenile, many with cut marks on their bones suggesting intentional butchering with stone tools. The deposits below the tuffaceous silt contained no sign of any bone or shell body ornaments or pigments, artifact categories that the excavators presumed to signify a presence of behaviorally modern humans. It now appears also that these lower deposits lack charcoal (Morley et al. 2016).

The initial dating of this hominin to only 18 kya raised problems, as did the allied suggestion that the species could have survived to as recently as 12 kya (Morwood et al. 2005). This is remarkably recent compared to latest ages for *Homo erectus* in Java and Neanderthals in Eurasia (Higham et al. 2014), both now believed to have become extinct before 40 kya and perhaps well before 40 kya in the case of *Homo erectus*. Given a presence of modern humans in Australia by at least 50 kya, one would have to suggest either that early modern humans in Flores were very nice and polite to their archaic hominin neighbors for upwards of 40,000 years, or that the dates are far too young.

It therefore comes as no surprise to find that the original dates were indeed far too young, as shown by a recent program of stratigraphic and soil micromorphological analysis combined with further luminescence, argon, and uranium series dating of sediments and both hominin and animal bones. The cave sediments underwent many phases of erosion through time, especially due to the activities of the nearby Wai Racang River, and unconformable sediments were often laid down over the eroded upper surfaces of older ones. The new dating reveals that the remains of *Homo floresiensis* in Liang Bua Cave date to 100–60 kya and other dates applicable to stone tools fall between 190 and 50 kya. The relevant deposits are also sealed beneath a volcanic tephra that dates to 50 kya.[19]

Concerning the pedigree of this new species, some recent analyses[20] suggest that the ancestor perhaps departed from Africa before 1.6 million years ago and was part of the migration that also gave rise to the small hominins at Dmanisi. If so, it might have entered Indonesia as part of the earliest very small-brained but very robust *Homo erectus* population also found in the Sangiran Formation and Grenzbank at Sangiran. Others believe that some of the size reduction occurred in the small island of Flores itself during the past 1 million years from a larger *erectus* ancestor, given that mammal and human size reduction on small islands is such a common biogeographical trend.[21] These different opinions are discussed further by Debbie Argue below. A new factor in the debate is the finding of further small hominin remains dating between 0.65 and 0.8 mya at Mata Menge in central Flores (a site to be discussed in more detail later), remains which the discoverers relate to *Homo floresiensis* (van den Bergh, Li et al. 2016).

Regardless of how this debate over *Homo floresiensis* is resolved, two important matters are now very apparent. This hominin is surely much too old to be a deformed modern human, as some have recently suggested.[22] Furthermore, it was not a prey animal at the hands of another hominin species since its bones show no cutting marks, unlike those of the contemporary juvenile pygmy stegodons found in the cave, which clearly served as food. *Homo floresiensis* was probably testimony to a very early hominin migration across sea gaps between eastern Indonesian islands, possibly from Sulawesi as discussed above and presumably with stone tool use since lithics dating to about 1 million years ago have been found in other sites in Flores, such as Wolo Sege and Mata Menge. It is not clear how often hominins might have reached Flores, but if they did so only once, then the record speaks to us of utter isolation on a small island for at least 1 million years, a remarkable and unprecedented "experiment" in human evolution.

Another very small hominin metatarsal (foot bone) dated to 67,000 years ago from Callao Cave on Luzon in the northern Philippines, also in a non-land-bridged part of Wallacea, opens the possibility that tiny hominins were not only located on Flores (Mijares et al. 2010). The Callao Cave fauna had no stegodon bones, only endemic species of pig and deer, but some of the deer bones show cutting marks. Unfortunately, the Callao Cave metatarsal was not associated with stone tools. More human remains have been found in this cave since the initial discovery and the possible explanations are still under consideration; the metatarsal does overlap in size with some of the small Agta Negrito populations who still live in northern Luzon today and it also overlaps with *Homo floresiensis*. This is all that can be said at present, but secure identification of an archaic hominin in Luzon would be very exciting indeed.

An Invited Perspective by Debbie Argue

A new kind of human, *Homo floresiensis*, or less scientifically "the hobbit," was discovered in 2003 during an archaeological excavation in Liang Bua Cave by Thomas Sutikna, Wayhu Saptomo, Benyarim Tarus, Jatmiko, Sri Wasisto, and Rokus Awe Due. The team of Indonesian and Australian researchers was led by the late Professor Mike Morwood and Dr Tony Djubiantono under the auspices of the Indonesian National Research Centre for Archaeology. The excavation aimed to find insights into the origins of the first Australians (Morwood and van Oosterzee 2007), but instead discovered something completely unexpected. Below the stratigraphic levels in which modern human burials were found, the archaeologists discovered bones representing a number of very different and very small individuals in strata that we now know are dated to between 100 and 60 kya (Sutikna et al. 2016).

The most spectacular find was a partial skeleton (LB1) found at 6 m depth. The LB1 remains were partially articulated and included an almost complete skull and leg bones, parts of the pelvis, hands, feet, and some other fragments. The form of the pelvis indicated that LB1 was probably female. Although it is not known how she died, archaeological evidence shows that she was not deliberately buried but died in a shallow pool of water and was slowly covered by silt.

The LB1 skeleton is so tiny that at first the discoverers thought they had found the remains of a child. But analysis of the mandible revealed that all the molars had erupted, which indicates that she was a mature adult when she died. She also had a small endocranial volume, 410 cm^3 (amended to 426 cm^3 by Kubo et al. 2013), which is very similar to the brain sizes of the Australopithecines who lived in Africa between 3.9 and 2 million years ago. Modern human endocranial volumes range between 1200 and 1600 cm^3. It was also clear that this adult cranium had characteristics very different from a modern human. To establish to which species the newly discovered bones belonged, Brown et al. (2004) compared them with *Homo erectus*, *H. ergaster*, *H. georgicus*, *H. sapiens*, and *Australopithecus africanus*. They found that *H. floresiensis* carried a mix of archaic and modern characteristics that had never before been found in one skeleton. Therefore, they declared a new species to the world, *Homo floresiensis*, named for the island on which the bones were discovered.

Originally, Brown et al. (2004) proposed two possible hypotheses for the origin of the species: that it could have been the descendant of an unknown small-bodied and small-brained hominin which had earlier arrived on Flores, or that it could have been the end product of a long period of isolation of Indonesian *H. erectus* (although *H. erectus* itself has not yet been discovered on Flores). The biological response to isolation on islands is known as insular dwarfism. But when Morwood and Brown (Morwood et al. 2005) later described new skeletal remains, including another mandible, tibia and radius, as well as the right humerus and ulna of LB1, they concluded that while *H. floresiensis* should be included in the genus *Homo*, it was not likely to be related to *H. erectus*. Thus, its genealogy remained uncertain.

Subsequent studies have revealed more about the species. *H. floresiensis* was a biped, but its manner of walking appears to have been different from ours. Bill Jungers of Stony Brook University has discovered that LB1's feet were long, 70% of the length of her shins (Jungers et al. 2009), a proportion seen today only in gorillas. Our feet are 55% of the length of our shins. LB1's long feet meant that she had to bend her knees to a greater degree than modern humans in order to walk. According to Jungers, she would never have won a 100 m dash or marathon against modern humans.

LB1's legs were short for her body, close to the length of the reconstructed femur of *A. afarensis* (AL288–1 or "Lucy"), much shorter than any known modern human femur. This makes her arms appear relatively long compared to ours – not as long relatively as those of a chimpanzee, but well beyond the range of modern humans. In fact, LB1's arm–leg relationship was very similar to that of *Australopithecus garhi*, who lived 2.5 million years ago in Africa (Brown et al. 2004; Argue et al. 2006; Jungers et al. 2009).

Susan Larson and colleagues (2007) examined the clavicle, scapula, and humerus of LB1 and LB6 (LB6 is represented by a scapula, radius, ulna, 2 toe bones, and 10 finger bones; Jungers et al. 2009). They showed that these bones in their morphology were similar to those of the 1.5 million-year-old *H. ergaster* fossil skeleton (KNM-WT 15000) from the Turkana region in Africa. Like this individual, the Liang Bua hominins did not have the same shoulder geometry and rotational ability of the modern human shoulder. They hypothesized that *H. floresiensis* retained a functional complex that characterized early *H. ergaster*. The wrists, too, are archaic; Tocheri et al. (2007) have shown that three carpal bones of LB1 show a pattern found in living African apes, as well as in all fossil hominins older than 1.7 mya.

LB1 has a number of facial characteristics that are different from those of *H. sapiens*. The orbits are round, whereas ours are squarer (even though our eyes might look round, the bony structure beneath is squarish). Above the *H. floresiensis* orbits there is a prominent continuous mound of bone, a "supraorbital torus." On its face are longitudinal mounds of bone ("canine juga") that extend from each canine tooth to each side of the nasal opening. Its forehead is short and slopes back from the supraorbital tori. The widest part of the skull is at about the level of the ears, whereas on modern humans the widest part is higher up on the cranium. The two mandibles available for the species show that *H. floresiensis* did not have a chin. Modern human chins, whether they recede or project, have a bony "upside-down T" cross-section (Schwartz and Tattersall 2000) at the outside front of the mandible, which provides buttressing for the bone. The two known *H. floresiensis* mandibles have buttressing on the inside of the mandible in the form of two horizontal ridges that bridge the jaw below the front teeth. This character *never* occurs in *H. sapiens.*

Brains are not usually preserved in ancient fossil remains, but in some cases the arteries and the convolutions of the brain are visible as markings on the inside of the skull. This is the case for LB1. Dean Falk and her colleagues (2005) studied these markings and found that the skull had housed a relatively large frontal lobe (Broca's Area 10). This part of the brain is home to our capabilities for planning, learning from mistakes, and passing on knowledge from generation to generation. So, we know that although *H. floresiensis* was tiny and had a small brain, it probably had at least similar mental abilities to ours.

The **Homo floresiensis** *Controversy*

When the species was announced it was reported to have survived until about 13 kya (Roberts et al. 2009), but the new dating discussed above places it between 100 and 60 kya in Liang Bua Cave. However, the original claim that a new and very archaic-looking hominin lived at the same time as modern humans in Indonesia offered quite a challenge to the prevailing paradigm in human evolution. Human evolutionary studies operate within a conceptual framework of a "branching tree," in which australopithecines (c. 4–2 million years ago) were followed by the first member of our genus, *Homo habilis* (c. 2 mya), then progressively by *H. ergaster*, *H. erectus*, *H. heidelbergensis*, *H. neanderthalensis*, and finally *H. sapiens*. While there is debate about a possible initial overlap and admixture between *H. sapiens* and *H. neanderthalensis*, it has always been thought that our species, *H. sapiens*, became the sole remaining species after all archaic hominins became extinct. Furthermore, *H. erectus* was thought to be the first hominin to live in Java, arriving during the Lower Pleistocene, but the existence of *H. floresiensis* suggests that another archaic species once existed in the region as well, although during a much later period.

Adversarial reactions that accepted the original young chronology occurred immediately after the discovery of *H. floresiensis* was announced. The first proposed that its very small stature and tiny brain indicated a modern human who suffered from a pathological condition called microcephaly (Henneberg and Thorne 2004; Martin et al. 2006; Jacob et al. 2006), a disorder characterized by a marked reduction of brain growth, with or without other abnormalities (Mochida and Walsh 2001). Microcephalic people can also exhibit other abnormalities such as short stature, joint defects, and cognitive impairment. The incidence of hereditary microcephaly is low in modern populations (e.g., 1:30,000 in Japan, 1:250,000 in Holland, 1:2,000,000 in Scotland (Woods et al. 2005:719) and archaeological examples only total five so far (Argue et al. 2006).

Argue et al. (2006) tested the microcephaly hypothesis by comparing microcephalic modern human crania with those of australopithecines and early and modern (non-microcephalic) *Homo.* Their metric results clustered LB1 with archaic hominins, separating LB1 considerably from modern humans, including microcephalic ones. They concluded *H. floresiensis* was a previously unknown early hominin, as Brown et al. (2004) had hypothesized, and that it evolved from a founder population of archaic *Homo*.

Publications focusing on other genetic or metabolic disorders as explanations for *H. floresiensis* continued to be produced. Hershkovitz et al. (2007) compared the skeletal remains of *H. floresiensis* and patients with Laron Syndrome, finding strong similarities, including small stature and reduced cranial volume. Laron syndrome is a condition that is expressed in consanguineous families and causes short stature, underdeveloped musculature, shallow orbits, small hands and feet, and other symptoms. The authors concluded that the bones from the Liang Bua excavation could represent a local, highly inbred *H. sapiens* population.

A claim that *H. floresiensis* was part of a long-term population that suffered from cretinism, resulting from an iodine deficiency causing thyroid malfunction and growth problems, has also been proposed (Obendorf et al. 2008). More recently, Down Syndrome has been evoked as an explanation (Henneberg et al. 2014).

The problem with the "pathology" hypotheses is that they do not account for all the facts. Firstly, they are based upon limited aspects of the one skeleton, LB1. Its size and tiny head, and the skeletal parts of all other individuals represented in the site, are ignored. These bones represent hominins of the same small stature as LB1 – none represent persons of modern stature. Microcephaly and Laron syndrome are very rare conditions and one would expect that, even if an archaeological excavation did reveal a rare skeleton showing such syndromes, most other remains would be from a normal, non-pathological population. The *absence* of modern-statured human skeletal material in the lower levels of Liang Bua (there are Metal Age burials in the upper layers) is not explained by such pathology-based hypotheses. Further, the skeletal remains in Liang Bua span a period of about 40,000 years. The pathology hypotheses fail to explain how a rare condition such as microcephaly or Laron Syndrome could be sustained in all known members of a single population for such a long time.

Finally, any pathology-based hypothesis must account for all, or most, of the features of these people. That is, it must account for the non-sapient mandibular structure, the archaic head shape, facial features, and shoulder, the ape-like wrist structure, the relatively short legs in relation to arms, and also the very long feet on a very short body. The microcephaly/Laron/Down Syndrome hypotheses do not address these matters and do not account for them. They become even less likely now that *H. floresiensis* is dated to a time span that predates modern humans. Science promotes us to favor a hypothesis that explains best the greatest number of observations.

There remain, then, two hypotheses for the origins of *H. floresiensis*:

1. that it was the dwarfed descendant of an *erectus* population that evolved under conditions of isolation on a small island (the "island rule");
2. that it descended from an early hominin lineage distinct from that which gave rise to *Homo erectus*.

Was Homo floresiensis *a Dwarfed* Homo erectus*?*

The "island rule" (Foster 1964) stipulates that body size of mammals alters when a founder population reaches an island, becomes reproductively separated from its mainland origin group and faces an environment different from that of its mainland cousins. For example, a smaller body size would be expected as a response to a limited food supply and conversely a larger body size to an absence of predation (Foster 1964). Some studies have disputed the universality of this "rule" (Meiri et al. 2008), but it remains the case that rapid insular changes in body size are very common (Millien 2006).

Lyras et al. (2008) compared cranial measurements for *H. floresiensis* with those for *H. sapiens*, *H. erectus*, *H. habilis*, and *A. africanus*, concluding that *H. floresiensis* could not be separated from *H. erectus* (Sangiran 17). They therefore suggested that *H. floresiensis* evolved from an earlier *H. erectus* population, via an island dwarfing evolutionary process. Baab et al. (2013) obtained similar results from their metric analyses and reinforced that LB1 was distinct from modern humans, including those with Laron syndrome, cretinism, and microcephaly.

Most recently, Kaifu et al. (2011) have undertaken a detailed comparison of the characteristics of the LB1 cranium, finding that 17 of the 67 characteristics studied are compatible with the hypothesis that *floresiensis* was derived from *H. erectus*. They also endorsed the island dwarfing hypothesis for *H. floresiensis*.

In 2016, van den Bergh, Li et al. announced new fossil material recovered from excavations in the Soa basin, Flores, dated to ~700,000 years ago (~600,000 years earlier than *H. floresiensis* in Liang Bua Cave). This material is too fragmentary to determine to which species it belongs, but it is thought to be "*H. floresiensis*-like" by the discoverers, who also favor a dwarfing hypothesis.

Was Homo floresiensis *Descended from a Separate Early Hominin Lineage?*

Using mostly cranial characters, but including some from the mandible and postcranium, Argue et al. (2009) presented two equally parsimonious phylogenetic trees, each of which placed *H. floresiensis* in the early *Homo* section of the tree, close to *H. habilis* and *H. rudolfensis* but far from *H. erectus*. Their results led them to hypothesize that *H. floresiensis* derived from a more archaic lineage than the erectines and that this lineage existed at the same time as *H. habilis* and

H. rudolfensis (i.e., 2.0–1.4 mya, in Africa). They therefore proposed that *H. floresiensis* represented an earlier migration out of Africa than that which led to *Homo erectus* in Java.

In light of all the above opinions, we may conclude that our knowledge about the morphology of this enigmatic species has proliferated since the first announcement of *Homo floresiensis* in 2004, but we are still uncertain about its phylogeny. How did it get to Flores, given that this island has, it is supposed, never been attached to a mainland? Were they partially arboreal? Could they have overlapped and interacted in Flores with *H. sapiens*? *H. floresiensis* is still somewhat of a puzzle, but it poses so many significant questions for such a little creature.

Cultural Evidence Related to *Homo erectus* and *Homo floresiensis*

It is most unfortunate that all the *Homo erectus* fossil remains from Java have been found in situations of presumed secondary deposition, devoid of direct cultural context. Stone tools potentially flaked by *Homo erectus* do occur on the island, but never directly with human fossils (with the possible exception of the new site at Semedo) and rarely in securely dated contexts. Furthermore, there are no unambiguous examples of "living floors" of the kind found in Africa and western Eurasia. These circumstances have led several authors to claim that no stone tools in Island Southeast Asia can be securely dated to the Early and Middle Pleistocene timespan of *Homo erectus* at all (Hutterer 1985; Bartstra 1985), and even that *Homo erectus* was extinct by the time modern humans arrived to colonize a pristine and vacant tropical niche (Dennell 2009; 2014:19–20). The latter is quite a strong suggestion, but one which I am reluctant to accept given the survival of other hominins such as Neanderthals and Denisovans into an overlap and replacement phase with modern humans (e.g., Higham et al. 2014 on the Neanderthal demise). It is hard to imagine how a presumably intelligent and large-brained hominin, such as Javan *erectus* of Ngandong grade, would simply become extinct, especially after more than half a million years of successful evolution, without severe competition from better-adapted or more numerous modern humans. *Homo floresiensis* also appears to have survived until 50 kya in Nusa Tenggara, as discussed above in terms of the Liang Bua chronology.

Some skepticism concerning the making of stone tools by *Homo erectus* could still be justified for Java, purely on grounds of weakness of data. But since the last revised edition of *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007) some dramatic new discoveries of stone tools have been made in the Sangiran region and at Semedo in Java, Talepu in Sulawesi, and certainly in Flores. *Homo floresiensis* and flaked lithics are unambiguously associated at Liang Bua, and the oldest stone tools from Wolo Sege and Mata Menge are convincingly dated to between 1 and 0.65 mya, in the latter site now in association with hominin remains (Figure 3.6). Furthermore, new dates from artifact-bearing sediments in the Gunung Sewu caves in south-central Java push stone tools there back to almost 200 kya, beyond any reasonable likelihood of a presence of *Homo sapiens*. We also have an interesting contrary situation in Callao Cave in Luzon, where hominin remains dated to 67 kya are not found with any stone tools at all. The pendulum for or against stone tool use by archaic hominins in Island Southeast Asia is still swinging, as indeed it is for a use of fire (Morley et al. 2016).

At this point back in 1985, when I was first writing *Prehistory of the Indo-Malaysian Archipelago*, I discussed approaches towards the classification and analysis of the very simple and basic "Oldowan" stone tool industries that characterize the totality of the Southeast Asian Paleolithic, using observations from publications by the late Glyn Isaac, who worked widely in East Africa during the 1960s and 1970s. I discussed the lithic industries that could, with some fertile imagination at that time, be associated with *Homo erectus* in various regions of Island Southeast Asia, comparing them with the undoubted handiwork of this species in China. I also discussed these industries in terms of two technological categories – the so-called "chopper/chopping-tool industries" characterized by the Javan Pacitanian industry and reputed to be the handiwork of *Homo erectus*, and the so-called "pebble and flake industries" deemed more characteristic of early *Homo sapiens*.

Nowadays, three decades later, such a classification is decidedly unhelpful. As Mark Moore and Adam Brumm (2007) have pointed out, all of the industries involved in this discussion really belong to one basic reduction sequence, similar to that of all other Early Palaeolithic (but pre-Acheulian) hominins in Africa and Eurasia, and focused on the removal of flakes from river pebble or quarried cores. Industries in specific sites differ from one another because of a range of local factors. These can include types of raw material available (e.g., fine and glassy chert versus coarse and grainy volcanic and metamorphic rocks), whether or not people flaked from cores on site or simply brought back ready-to-use items and left the cores at source (e.g., in a pebble-rich river bed), and whether or not people had easy access to plentiful raw material or had to reuse and resharpen raw materials that were scarce.

Even that rather hoary old concept of a "Movius Line," derived from a suggestion by the late Hallam Movius that the Early Palaeolithic industries from roughly India westwards were defined by a presence of bifacially flaked "Acheulian" hand-axes, while those to the east, including China and Southeast Asia, had much simpler "chopper/chopping-tool industries," has faded in significance with the passage of time. In fact, some Chinese sites, especially the Baise group in Guangxi, have very large numbers of hand-axes, despite ongoing debates about their age. Similarly, as Brumm and Moore (2012) point out, many of the so-called "Acheulian" finds of bifacial hand-axes, even in Africa, are from surface rather than unarguable excavated and dated contexts. In fact, the vast majority of Early Palaeolithic industries all over the Old World share the same basic core, flake, and debitage forms. It is true that bifacial hand-axes are perhaps rarer in many Southeast Asian sites than in contemporary sites in Africa and western Eurasia, but exactly why this should matter, beyond questions of raw material, is not at all clear to me.[23] Dennell (2009) regards the East Asian occurrences of bifacial hand-axes as being independent in origin of those in western Eurasia. In this regard, many of them could just be fortuitous variants derived from core reduction in the search for a sharp edge.

In fact, as I point out in *First Migrants* (Bellwood 2013), modern archaeology and evolutionary biology offer little scope for any suggestion that types of stone tools can be specific markers of different species of hominin, at least not in the tropical latitudes of the world, where elaborate tools to make clothing, shelter, and to hunt glacial-era herds of tundra-roaming mammals were not necessary. The Eurasian Upper Palaeolithic with its blades, burins, and bone needles might be a marker of the arrival of modern humans in the cooler latitudes north of the Mediterranean or the Himalayas, and also in southern Africa, but such industries simply did not develop in the tropical regions of Southeast Asia because of the warm and benign environmental conditions. Neither have they ever been recorded in Pleistocene Australia or New Guinea.

However, as we will see in Chapter 5, modern humans (*Homo sapiens*) certainly added other technological skills unavailable to their archaic hominin predecessors and contemporaries. These include the edge-grinding of pebble axes, dated from as long ago as 38 kya in Japan and northern Australia; the use of pottery from 15 kya in eastern mainland Asia, and the occasional Holocene appearances of microliths or bifacial points in parts of Island Southeast Asia and Australia. Prior to these additions, which also included a use of red ochre for art and personal ornaments, lithics cannot be used to distinguish hominin species, as documented again by Moore, Brumm, and colleagues for the lithic sequence from *Homo floresiensis* to *Homo sapiens* in Liang Bua (Moore et al. 2009). Like the lithic industries recently excavated from deep caves in central Java, Liang Bua witnessed no significant lithic evolution of a purely technological nature in those layers in which we might expect a first appearance of *Homo sapiens*.

Java and the Tools of Homo erectus

The most important Javan industries that have been claimed as the handiwork of *Homo erectus* come from Sangiran, Ngandong, Matar, Semedo, and from riverine locations in south-central Java (the Pacitanian industry). A number of caves (especially Song Terus; Hameau et al. 2007) in the Gunung Sewu limestone hills in south-central Java have also produced ESR and U-series absolute dates on mammal teeth associated with stone tools that fall well before the time range for *Homo sapiens*, but the lithics from these sites are not yet fully reported.

The Sangiran eroded dome has yielded lithics and worked bones presumed to be of upper Sangiran, Grenzbank, Bapang, and Notopuro Formation origin from at least five excavated localities: Dayu, Ngebung, Brangkal, Karangnongko, and Ngledok.[24] There have also been very large numbers of surface finds of both flake and large pebble implements from all over the Sangiran region (Widianto et al. 1997). The lithics include andesite and chert cores and flakes, and a remarkable category of so-called "bolas stones" or "spheroids" (figures 3.7 and 3.8).[25] The Sangiran bolas stones are almost perfectly spherical and heavily flaked or hammer-dressed (but not polished); human

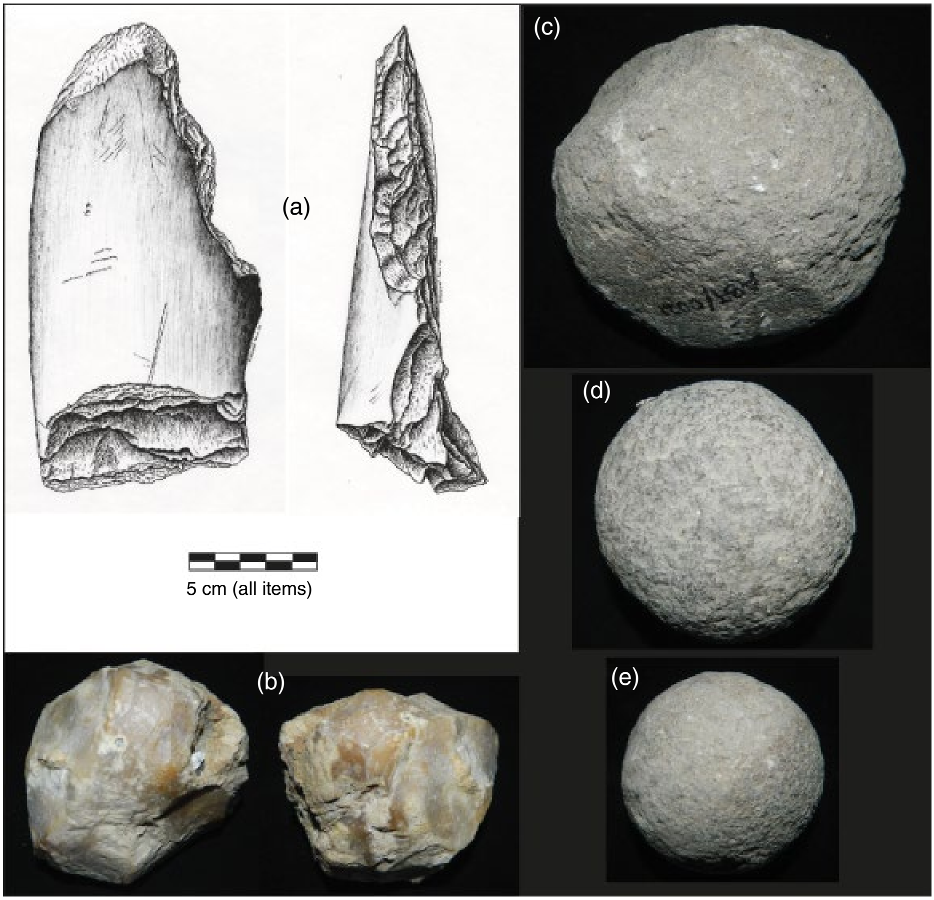

Figure 3.7 Artifacts from Sangiran. (a) a tool 18.5 cm long (2 views) flaked on a stegodon tusk, excavated from the Bapang Formation at Ngebung, about 5 m above the Grenzbank and probably around 800,000 years old. Courtesy of Semenanjung, Mission Quaternaire & Préhistoire en Indonésie, MNHN/CNRS/IRD & Pusat Penelitian Arkeologi Nasional. Drawn by Dayat Hidayat. (b) flaked spheroid (2 views) of cryptocrystalline rock from Grogolan, unrolled and presumed to be of Bapang Formation date. (c–e) hammer-dressed "bolas stones" from Bapang layers at Sangiran (all surface finds, and note the massive size of (c) at 12.7 cm diameter). Courtesy Balai Pelestarian Situs Manusia Purba Sangiran. Photos (b–e) are by the author.

workmanship is certainly apparent to me unless some kind of volcanic origin can be proposed, but functions remain unknown (actual bolas stones seem unlikely owing to their considerable weight, between 500 and 1100 gm). Such spheroids are also found in many African developed Oldowan and Acheulian assemblages (Willoughby 1985), which adds to the likelihood that they represent genuine human handiwork. Were they used for pounding uncooked meat and tubers (Zink and Lieberman 2016)? We cannot yet be sure without residue analysis, should any food residues survive on them.

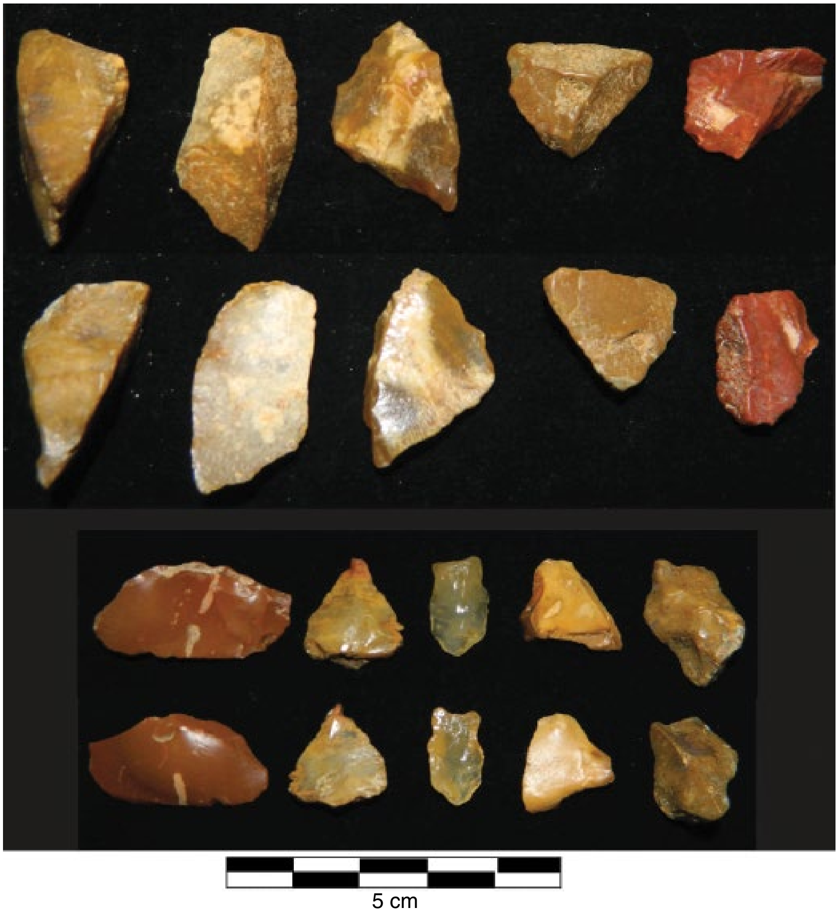

Figure 3.8 Flakes and small cores of chert and similar raw materials (dorsal surfaces at top, ventral below) from Dayu, upper Sangiran Formation, or Grenzbank, excavated by Harry Widianto (Widianto 2006; Stone 2006). More than 200 similar flakes were found in the 3 by 3 m by 1.2 m deep excavation. Source: courtesy of Balai Pelestarian Situs Manusia Purba Sangiran. Photos by the author.

There are also tools made on mammal bone and proboscidean tusk (Figure 3.7a), and working of bivalve shells has also been recently attested from the original Dubois excavations at Trinil, at around 500 kya, involving drilling to assist meat extraction and also simple engraving (Joordens et al. 2015).[26]

Outside Sangiran and Trinil, large pebble tools of the Pacitanian industry were first discovered by von Koenigswald and Tweedie in 1935 in the bed of the Baksoko River near Pacitan, in south-central Java. Further work was subsequently carried out by van Heekeren (1972), who reclassified the material, reported on finds from adjacent valleys, and suggested that the tools were eroding from four implementiferous terraces in the Sunglon and Baksoko Valleys, with the oldest Baksoko material coming from about 15 to 20 m above the streambed. Bartstra and Basoeki (1989) also pointed out, after exhaustive geomorphological reconnaissance, that alluvial gravels lacking fossils extend up the valley sides to heights of up to 28 m above the streambeds. Tools are occasionally found *in situ* in these high gravel levels and earliest dates according to Bartstra and Basoeki could fall around the Middle to Late Pleistocene boundary. The Pacitanian industry is made on silicified tuff (the best material), silicified limestone, and fossil wood. It comprises a few bifacial hand-axes and high-backed, steep-angled "scrapers," together with numerous flake tools and waste flakes, some of very large size (Mulvaney 1970; Bartstra 1976).

As discussed above in connection with the "Movius Line," the finding of bifacial tools shaped like hand-axes in the Pacitanian industry is of interest, since it hints at connections with the Early and Middle Pleistocene Acheulian hand-axe industries of Africa and western Eurasia. Interestingly, hand-axes have not so far been reported from the excavated sequence of stone tools from Flores, and they are not conclusively stratified with the remains of *Homo erectus* in Sangiran. However, the open site of Semedo near Tegal in north central Java, 200 km slightly northwest of Sangiran, has produced tools that closely resemble hand-axes and bifacial chopping tools from the same Middle Pleistocene sediments as a cranial portion of *Homo erectus* (Widianto and Grimaud-Hervé 2014, and see Figure 3.9). This is a very important discovery that might relate to an additional out–of-Africa migration of hominins related to the species *Homo heidelbergensis* (see Figure 3.1 and Bellwood 2013:50–52). There is no actual evidence for a presence of *Homo heidelbergensis* in Java, but an eastward flow of slightly more evolved skills in stone tool production could have taken place, moving from Africa through India and eventually reaching Indonesia.

Material associated with the later Middle Pleistocene *Homo erectus* fossils from the Solo Valley has also been problematical in the past. At Ngandong, according to von Koenigswald (1951:216), "a few small stone scrapers and some triangular chalcedony flakes were observed, but they have disappeared from our collection." Nevertheless, one of the original investigators, Oppenoorth (1936; see also van Stein Callenfels 1936), was considerably more enthusiastic. He reported worked animal bone and antler from the general vicinity of the skulls, together with stone balls of andesite apparently similar to the "bolas stones" discussed above from Sangiran, as well as to similar spherical stone artifacts from the *Homo erectus* site of Zhoukoudian near Beijing. He also found a spine of a marine stingray close to skull VI. However, according to a geological section presented by Sartono (1976, after Ter Haar), all these items were found in superficial layers of the terrace above the skulls, except perhaps for the bone tools. Most recently, jasper flakes and andesite bolas stones have been found at Matar, in the Solo River terrace on the other side of the river from Ngandong (Fauzi et al. 2016). Teuku Jacob (1978) also recorded two unrolled tools of andesite – a well-made unifacial pebble chopper and a retouched flake – from the late Middle or Late Pleistocene gravel deposit at Sambungmacan, approximately contemporary with the layer that yielded the skull of a late specimen of *Homo erectus*. Recent excavations at Ngandong have also recovered stone and bone tools, and animal bones with cut marks (Harry Widianto pers. comm.).

Figure 3.9 A bifacial hand-axe (top) and bifacial chopping tool (bottom) of basalt from Semedo, central Java. Scales are 5 cm long. Source: courtesy of Siswanto and Sofwan Noerwidi, Balai Arkeologi Yogyakarta.

Flores and the Tools of Homo floresiensis

Interest in Flores as a possible Wallacean locus for *Homo erectus* was aroused in 1970, when Maringer and Verhoeven (1970a, 1970b) found pebble tools and retouched flakes in association with stegodon bones at Mengeruda in the Soa basin, in scattered exposures over an area about 3 km long. Generalized affinities were drawn with the Pacitanian, Sangiran, and Cabenge (Sulawesi) industries, and the suggestion was made that contemporaries of the Ngandong hominins might have been able to venture along the Nusa Tenggara chain to reach Flores.

In 1991–1992 an Indonesian–Dutch expedition re-examined the sites visited by Maringer and Verhoeven and excavated more stone tools from another location near Mata Menge (van den Bergh, Mubroto et al. 1996). The tools – flakes of chert and basalt – were claimed to be of definite human handiwork and to come from a sedimentary context just above the Matayama–Brunhes paleomagnetic reversal at 790 kya. Bones of stegodon and a giant rat were found in the same layer. Nearby, at Tangi Talo, an older deposit yielded bones of a pygmy stegodon, a large tortoise, and Komodo dragon, but no stone tools. These discoveries provided the initial foundation for the Flores faunal sequence discussed above (Figure 3.6).

A little later in the 1990s, an Indonesian–Australian team continued work at Mata Menge and the nearby sites of Boa Lesa and Kobatuwa, finding more stone tools (Figure 3.10) and stegodon bones in river channels sealed beneath unbroken tuff marker layers within the Ola Bula Formation, which was sealed in turn by a supervening 5 m thick layer of freshwater limestone, the Gero Formation, assumed to date from about 650 to 500 kya (Figure 3.6). Fission track dates on zircons from the Ola Bula deposits that contained the stone tools placed them between 880 and 800 kya at Mata Menge, and at 840 kya at Boa Lesa (Morwood et al. 1998; Morwood et al. 1999; Brumm et al. 2006).

As noted above, new research in fluviatile sandstone sediments within the Ola Bula Formation at Mata Menge has confirmed this chronology and also produced a tiny hominin mandible and six teeth, related by the excavators to *Homo floresiensis* (van den Bergh, Li et al. 2016). The current uranium series, electron spin resonance, and argon dates fall between 0.65 and 0.8 mya. With these hominin bones were found remains of a dwarfed *Stegodon florensis* (Figure 3.3), here interestingly with no signs of cut marks, even though four stegodon vertebrae were found in articulated position. Also present were Komodo dragon, crocodile, and rodents. Forty-seven stone cores, flakes, and other lithic materials were found close to the hominin bones (Brumm et al. 2016).

These early dates for Mata Menge have since been confirmed at another nearby Soa basin site called Wolo Sege, where more stone tools have been found near the base of the Ola Bula Formation, sealed under an ignimbrite (volcanic ash) layer argon-dated ($^{40}Ar/^{39}Ar$) to 1.02 million years ago (Brumm et al. 2010). So a fairly continuous presence of stone tools in Flores between 1 and 0.65 mya is now confirmed.

As for the Late Pleistocene stone tools found with *Homo floresiensis* in Liang Bua Cave, Moore et al. (2009) originally reported no fewer than 11,667 excavated stone artifacts, mainly of volcanic raw materials, from five of the nine stratigraphic units in the cave (units 1 to 8 are Pleistocene, 9 is Holocene). However, it is possible that these figures might need revision owing to the recent reanalysis of the Liang Bua stratigraphy (Sutikna et al. 2016). Some tools are perhaps now more likely to have been associated with *Homo sapiens* than with *Homo floresiensis*.

Despite this uncertainty, the previous analysis of Moore et al. (2009) indicated a greatest density in unit 4, then dated to 55–50 kya (or perhaps 74–61 kya according to Gagan et al. 2015), in which 7230 lithic specimens were found over an excavated area

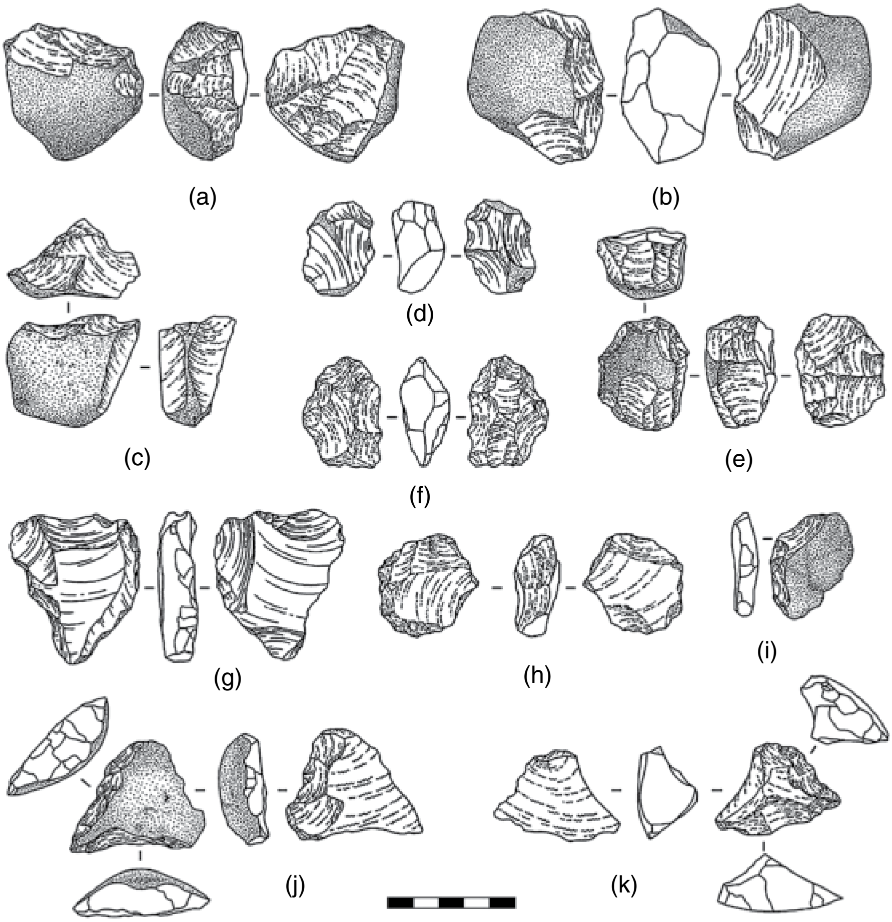

Figure 3.10 Stone artifacts from Mata Menge (from Moore and Brumm 2007). (a–e) artifacts made on small pebble blanks; (g–k) artifacts made on small flake blanks (blank is unidentified in f). (d) and (g) are chert, rest volcanic rocks. Source: Moore and Brumm (2007). Courtesy of Mark Moore and *Journal of Human Evolution*; reproduced with permission of Elsevier.

of 25 m^2 (estimated from published site plans – Westaway et al. 2009: Figure 1). The artifact categories described by Moore and colleagues include cores (but not hand-axes) made from pebbles and large flakes reduced by multidirectional and sometimes bipolar working, the stone flakes that form the vast majority of all artifacts recovered, together with pebble hammer stones and anvils. Many flakes appear to be retouched. The excavators note, however, that patches of edge gloss on flakes and the use of chert as a raw material seem to be mainly restricted to the Holocene, hence probably associated with modern humans. The Liang Bua stone tools appear generally to be in the same technological tradition as those from Mata Menge and Wolo Sege, and possibly Talepu on Sulawesi.

Retrospect

This chapter has examined the hominin prehistory of Indonesia, commencing around 1.5 million years ago and continuing until the arrival of the first members of the species *Homo sapiens*, a momentous event in evolutionary terms but, alas, one with a far less momentous chronology. A cautious gambler might go for 70 kya for the arrival of modern humans; those who like high odds might go for 100 kya or more. The date of arrival of the first archaic hominins is equally uncertain, with various options between about 1.8 and 1.2 mya.

Nevertheless, many other aspects of knowledge have changed considerably in recent years. The island of Flores, across the Wallace Line, was occupied by hominins at least 1 million years ago. The hominins who undertook this journey, both in Java and Flores and whether *erectus* or ancestral *floresiensis*, made stone tools. The latter observation may be increasingly obvious nowadays, given the pace of discovery of stone tools dating back more than 2 million years ago in Africa, but for many years in the twentieth century there was a belief that Java Man was not a proper toolmaker. New results that might imply an archaic hominin presence with stone tools are also appearing from Luzon and Sulawesi.

Biologically, our general understanding of the evolution of *Homo erectus* in Java has changed little in recent years, at least not in a fundamental way, but the discovery of *Homo floresiensis* has certainly rocked the boat. Some early claims that the whole story of human evolution would have to be rewritten as a result of the Liang Bua discovery were perhaps a little premature, but *Homo floresiensis* does bring up the major question of how the dwarfed stature and tiny brain size of that hominin actually evolved – were they retained from a small hominin immigrant species that entered Indonesia early in the Pleistocene, or did the dwarfing occur *in situ*? Whatever the answer, *Homo floresiensis* remains a very isolated example of an archaic and dwarfed hominin morphology, significant no doubt for an understanding of ancient Indonesia and perhaps also for an understanding of major aspects of human evolution in Africa and mainland Eurasia.

Other questions strike the enquiring mind. What exactly were those "bolas stones" in Java? Were they pounders to make raw meat and bone marrow more digestible? Does the presence of bifacial hand-axe-like tools in Java imply any connection with the Acheulian lithic complex of Africa and Eurasia, at least to as far east as India? If yes, could a new species of hominin, perhaps a more evolved *Homo erectus* or even a *Homo heidelbergensis*, have introduced it? Does the apparent absence of hand-axes in Flores reflect the isolation of this island across sea gaps, implying that the ancestors of *Homo floresiensis* only got there once, and before the Acheulian apparently arrived in Java? Did early hominins reach the Philippines? Apparently someone was making stone tools in Sulawesi at more than 100 kya, and it remains possible that Flores was settled from this island.

We might also ask if archaic hominins played any role in animal extinctions during the Pleistocene, for instance of stegodons in Java before the arrival of the Punung rainforest fauna during the last interglacial? However, *Homo floresiensis* appears to have coexisted successfully with dwarf stegodons in Flores until well into the Late Pleistocene, so can we point instead to the arrival of *Homo sapiens* as the culprit? Many of these questions will never be answered with absolute certainty, but the excitement of new discovery will always keep them alive.

Notes

1. The Denisovan species, indeed, might even have spread beyond the Wallace Line according to autosomal genetic traces of its former presence within some of the modern human populations of Australia and New Guinea (Cooper and Stringer 2013), although it is also possible that the recognized admixture occurred earlier on the mainland of Asia.
2. Curtis et al. 2001; Widianto 2001; Sémah and Sémah 2013.
3. Widianto 2012; and François Sémah pers. comm. for Pucung, which I was able to visit with him in May 2016.
4. For the Javan Pleistocene mammal sequence see de Vos and Sondaar 1982; de Vos et al. 1982; Sondaar 1984; Theunissen et al. 1990; van den Bergh 1999; van den Bergh, de Vos et al. 1996; van den Bergh et al. 2001; van der Geer et al. 2010.
5. Formerly referred to the genus *Geochelone*, but now thought to be related to *Megalochelys* of the Siwalik hills in northern Pakistan and India (Gerrit van den Bergh, pers. comm.).
6. For Sangiran stratigraphy and dating see Matsu'ura 1982; Watanabe and Kadar 1985; Larick et al. 2001; Kaifu et al. 2005; Kaifu et al. 2008; Bettis et al. 2009; Widianto and Simanjuntak 2010; Hyodo et al. 2011; Widianto 2012; Larick and Ciochon 2015.
7. See also van den Bergh et al. 2001; Hyodo 2001: Figure 5; Falguères 2001; Bouteaux and Moigne 2010.
8. Swisher et al. 1994; Larick et al. 2001; Bettis et al. 2009; Zaim et al. 2011; Larick and Ciochon 2015.
9. For lists see von Koenigswald 1951; Medway 1972; Sartono 1976.
10. Indriati et al. 2011 list many of the previous dating references for Ngandong.
11. Kaifu et al. 2005; Kaifu et al. 2008; Sémah et al. 2003; Sémah and Sémah 2015.
12. Thomas Ingicco of Muséum national d'Histoire naturelle in Paris informs me that new discoveries of Middle Pleistocene mammals and stone tools at the Kalinga site in the Cagayan valley are due to be published soon.
13. Thomas Ingicco pers. comm.
14. A newly published pig skull fragment, uranium/thorium dated on a carbonate crust to 33–23 kya, has been found in reworked materials in a lower cave system at Liang Bua on Flores (Gagan et al. 2015). Caution perhaps dictates that further material be similarly dated before full acceptance of this surprisingly old date. Suid bones do not occur at this date in the main Liang Bua cave and none occur in association with *Homo floresiensis*.
15. As suggested by Sondaar 1981; Morwood and Aziz 2009; Dennell et al. 2013; Morwood 2014; Kealy et al. 2015. In February 2016 I was able to visit one of these islands, the massive 100 by 40 km coral formation of Taka Bone Rate (formerly the Macan Islands) to the southeast of Salayar, which would have been exposed as a single very large island by low glacial sea levels.
16. Van den Bergh, de Vos et al. 1996; Van den Bergh et al. 2009; Morwood and Aziz 2009; Morwood 2014.
17. Morwood and Aziz 2009; van den Bergh et al. 2009; van der Geer et al. 2010:200.

18. Van den Bergh et al. 2008; Meijer et al. 2010; Gagan et al. 2015; Sutikna et al. 2016. The new Liang Bua dates for *Homo floresiensis* are from luminescence (sediments) and uranium series (speleothems, hominin, and stegodon bones) methods. Radiocarbon dates that formerly placed *Homo floresiensis* as recent as 12 kya are now known to belong to much younger deposits (Sutikna et al. 2016).
19. On Liang Bua stratigraphy and dating see Westaway et al. 2009; Moore et al. 2009; Sutikna et al. 2016; Morley et al. 2016.
20. Aiello 2010; Argue et al. 2006; Argue et al. 2009; Groves 2008; Morwood and Jungers 2009; Jungers and Baab 2009.
21. Lyras et al. 2008; van Heteren 2008; van Heteren and Sankhyan 2009; Perry and Dominy 2009; Kaifu et al. 2011; Ingicco et al. 2014.
22. Eckhardt et al. 2014; Henneberg et al. 2014. Numerous perspectives on *Homo floresiensis* are summarized in Indriati 2007 – see especially pp. vi–xi, and note Indriati's observation (p. viii) that many anatomists and biologists tend to regard *Homo floresiensis* as a pathologically afflicted modern human, whereas most palaeoanthropologists and archaeologists regard her as an authentic archaic hominin. I am firmly in the latter camp. See also Callaway 2014 and Stringer 2014 for current reviews.
23. Tools deemed to be of Acheulian affinity ("hand-axes") have been reported from Arubo 1, central Luzon (Pawlik 2004), and from stream beds in South Sumatra (Simanjuntak et al. 2006), but only from surface or near-surface contexts that do not yet provide convincing proof of a presence of *Homo erectus* in these locations.
24. Von Koenigswald and Ghosh 1973; Simanjuntak and Sémah 1996; Simanjuntak 2001; Widianto et al.1997; Widianto et al. 2001; Widianto and Simanjuntak 2009; Bouteaux and Moigne 2010.
25. Bolas: a missile consisting of a number of balls connected by a strong cord, which when thrown entangles the limbs of the quarry (esp. in South America), *Concise Oxford Dictionary*.
26. See also Choi and Driwantoro 2007 for suggestions of shell tool usage from traces of use wear in the upper Sangiran layers at Sangiran.

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Chapter 4
The Biological History of *Homo sapiens* in Island Southeast Asia

When it comes to evolution, be it of flesh or of faith, demography is all.
Steve Jones (2013), *The Serpent's Promise*, p. 408.

In the 30 years since my *Prehistory of the Indo-Malaysian Archipelago* was first published in 1985, some very fundamental advances in the study of ancient and modern DNA and in the multidimensional analysis of human skeletal remains (especially crania and teeth) have made increasingly obvious one very major observation. This is that the living *Homo sapiens* populations of Island Southeast Asia reflect the impact of two very prominent migration episodes, more than 50,000 years apart in time, each with a sufficiently strong demographic profile (see the opening quotation) to have made a permanent impact. Of course, these were not necessarily the only periods during which populations moved, as made clear by Murray Cox in his invited perspective on the genetic evidence, below. But they were arguably the most significant, with the furthest-reaching consequences. Each migration appears to have spread through Island Southeast Asia quite quickly, one prior to 50 kya (how much prior remains unclear), the other between 4000 and 3000 years ago.

The biological populations who descend primarily from these two successive immigrations are referred to by the geographical terms "Australo-Papuan" and "Asian."[1] The former were, and many still are (Figure 4.1), most closely related phylogenetically and phenotypically[2] to the Pleistocene/Holocene and modern indigenous populations of Australia and New Guinea (Bulbeck et al. 2006). The younger Asian group was, and still is (Figure 4.2), most closely related phylogenetically and phenotypically to Late Holocene and modern indigenous populations of southern China and Mainland Southeast Asia. The chronological distinction made here between these two biological populations is of fundamental importance, since all reliable evidence points to the second, Asian, migration as occurring into the islands during the Late Holocene (archaeologically during and since the Neolithic), and not before.

The first migration, of anatomically and behaviorally modern *Homo sapiens* ancestral to the living Australo-Papuan populations (including the Andamanese, plus the

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

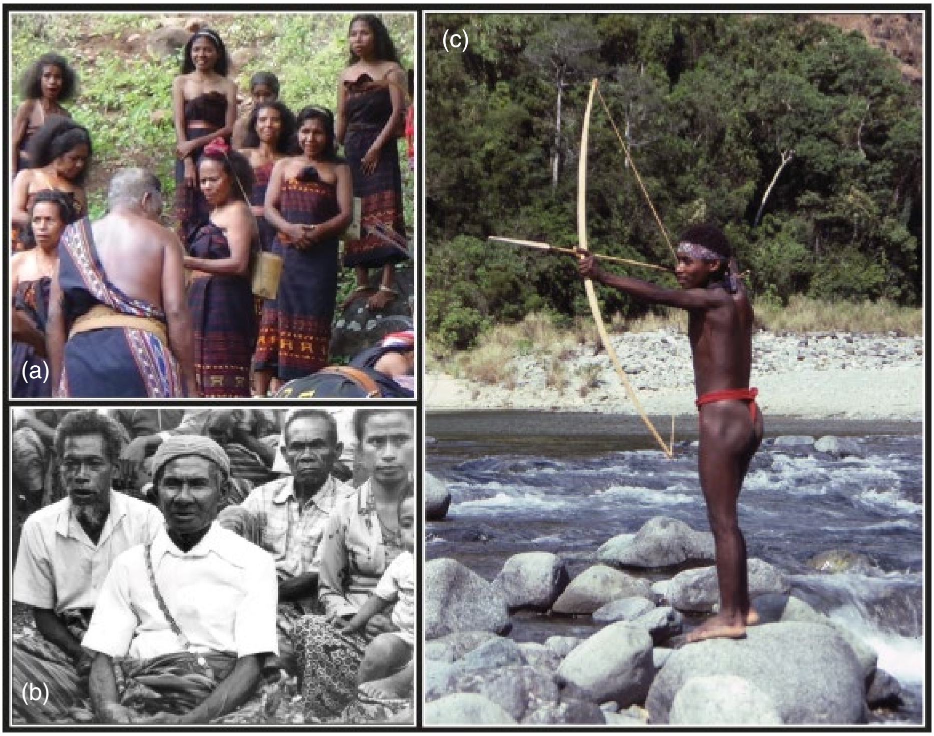

Figure 4.1 Modern populations with large proportions of Australo-Papuan ancestry. (a) people of Alor, eastern Nusa Tenggara. (b) Atoni elders, South Amanuban, Indonesian Timor. (c) Aeta Negrito boy in Cagayan Province, eastern Luzon. Sources: (a) photo by the author; (b) photo by James Fox; (c) copyright Jo Kamminga.

Peninsular Malaysian and Philippine Negritos), witnessed the Paleolithic settlement of many regions of Island Southeast Asia, together with New Guinea, the Bismarck and Solomon Islands, and Australia. This population flow reached southern Australia and eastern New Guinea (including the Bismarck Archipelago) by 50 kya or very soon after, but never traveled beyond the Solomons into Remote Oceania, presumably because the increasing sea distances were too great for the boat-building and navigational technologies of the time. In Island Southeast Asia, this arrival of the first modern humans presumably led to the eventual demise of *Homo erectus* and *Homo floresiensis*, neither of whom appear ever to have migrated beyond Wallacea, or indeed beyond the Philippines, Sulawesi, and Flores on present evidence.

Today, many Australo-Papuan indigenous populations carry facial, dental, and cranial characteristics, Y chromosomes, mitochondrial DNA, and basic autosomal genetic signatures ("ancestry components") that render them the relatively direct descendants of these Pleistocene migrants. Of course, "relatively direct descendants" does not mean that the ancestors of these populations have never moved at all during the past 50,000 years, since we know that some new mitochondrial and Y-chromosome haplogroups entered the region after this time but prior to the Neolithic immigration

Figure 4.2 Modern populations with large proportions of Asian Neolithic ancestry. (a) young Murut man, Sabah, 1910. (b) Mentawai elder, off the western coast of Sumatra, early 1980s. (c) Punan family at Lio Batu, upper Baram River, Sarawak, 1953. Sources: (a) courtesy of Sabah Museum, G.C. Woolley Collection; (b) courtesy of Vernon Weitzell; (c) courtesy of the late Hedda Morrison.

of the Asian populations. However, any subsequent Paleolithic migrations probably involved re-assortment within the region as opposed to major immigration from outside.

At this juncture, I should add that a major hypothesis put forward in this book proposes a foundation migration of the younger Asian populations, with Neolithic material culture and Austronesian languages, from southern China, through Taiwan and the Philippines, and eventually onwards into Indonesia, Oceania, Vietnam, Peninsular Malaysia, and Madagascar. This is discussed as the "Out of Taiwan" hypothesis in Chapters 6 to 8. Not everyone agrees, and most disagreements revolve around three perspectives that are claimed to annul it:

a) that there is a mismatch between the hypothesis and mitochondrial DNA haplogroup history;
b) that there is a lack of direct proof that Austronesian languages spread with actual speakers rather than via "interaction" of some kind;
c) that there is a lack of proof that Neolithic people in Island Southeast Asia grew Asian crops such as rice and millets.

In my view, each of these objections can be easily challenged and put into its proper perspective. I / we deal with them below and especially in chapters 6 and 7.

The First *Homo sapiens* in Southeast Asia

I can perhaps start by stating clearly what modern biological anthropology (including genetics) and archaeology tell us about the emergence of *Homo sapiens* and its spread out of Africa into tropical Eurasia (for general reviews see Bellwood 2013, 2015). As a species of tropical to warm temperate African origin, the first modern humans to leave Africa crossed either through Sinai or across the Bab-el-Mandeb Strait at the southern end of the Red Sea and settled in Arabia, the Levant, and India. Their oldest remains outside Africa, defined from the anatomically modern features of their skulls, have been found in caves in Israel, where they appeared during the last interglacial or just after, at about 120–90 kya, and apparently shared their territory for many subsequent millennia with Neanderthals. Whether these early modern humans in Israel were ancestral to any living humans in Eurasia today is a question fraught with much disagreement.[3] In Southeast Asia, osteological remains of modern humans dating between 50 and 35 kya have been found in Laos, Borneo, the Philippines, and especially Australia. Claims based solely on dental data exist for a modern human presence in caves in Java, Hunan, and Guangxi (southern China) as early as 100 kya, but these dates are not as well founded as those in the younger time range.[4]

This well-documented presence of modern humans in Southeast Asia by 50 kya is, of course, considerably later than their first appearance during the last interglacial in the Levant. This situation resembles that for *Homo erectus*, discussed in Chapter 3, where there is also a rather puzzling apparent time gap between the Dmanisi hominins at 1.8 mya and the first certain dates approaching 1.2 mya for *Homo erectus* in Java. In the case of modern humans this time gap need not be so surprising in terms of current genomic research (Mallick et al. 2016), since it is becoming ever more apparent that while Eurasians in general must have separated from Africans around 100 kya, many extant Eurasian populations, such as Australo-Papuans, only began to separate from each other after 60 kya. This probably means that modern humans took several millennia to penetrate regions of cold climate, including reaching the Americas from Siberia around 16 kya, and also that they might have been slow to penetrate the rainforests that existed from Burma eastwards during and after the last interglacial (c. 120 to 70 kya).

This scenario of delay ignores the less reliable 100 kya claims for modern humans from Java and southern China (if these are correct, then there was no time gap), but it brings up the possible existence after 70 kya of an inviting glacial-era "dry-season corridor," discussed in Chapter 2, that eventually led people down to and across the equator. New observations by Gagan et al. (2016) on oxygen and carbon isotope ratios in cave speleothems from South Sulawesi and Flores indicate a reduction in vegetation cover in these regions between 68 and 61 kya, a reduction which these authors relate to volcanic activity (but not the Toba eruption) and also tie to early modern human migration. Indeed, whether due to vulcanicity or to cycles in Pleistocene climate, the concept of a rainforest "door" periodically opening and closing in Southeast Asia could be crucial for explaining the timing of modern human migration across the equator through Indonesia to Australia.

The oldest well-dated skeletal evidence for *Homo sapiens* in Southeast Asia (see Figure 5.1) currently comes from Laos, where the Tam Pa Ling female skull cap and another mandible are dated to between 46 and 51 kya, unfortunately with no associated archaeology. The "Deep Skull" of Australo-Papuan or Negrito affinity from Niah West Mouth in Sarawak, Borneo (Bellwood 2007: Plate 10), has been directly dated to about 37–36 kya,[5] as has another skull of rather uncertain Australo-Papuan or possibly Asian affinity found in 1888 in a now-destroyed rock fissure at Wajak in Java. Niah also has well-dated cultural remains from 50 kya onwards, presumably related to modern human activity. Other human remains that may be of a similar pre-LGM antiquity, including a mandible of Australo-Papuan affinity, come from Tabon Cave on Palawan in the southwestern Philippines.[6] There is also the enigmatic metatarsal discussed in Chapter 3 from Callao Cave in northern Luzon, dated to 67 kya, but as noted already this might belong to an archaic small-bodied hominin like *Homo floresiensis*. In Australia, an ochre-covered inhumation burial at Lake Mungo from western New South Wales is dated to about 40 kya by luminescence dating (Bowler et al. 2003) and the archaeological record itself in Australia and New Guinea goes back further to approach 50 kya (Summerhayes et al. 2010; Allen and O'Connell 2014). All authorities assume that it was exclusively associated with *Homo sapiens*, not archaic hominins.

More recent crania in Mainland Southeast Asia that extend in time into the early and middle Holocene suggest a continuation of the same basic population, with all stated to have Australo-Papuan affinity when craniometrically diagnostic remains are available (see the invited contribution by Matsumura and colleagues later in this chapter). Phenotypically, this means a long (dolichocephalic) skull with large zygomatic bones and a prominent face, large teeth, and long slender limbs. Such features characterize, for instance, the tightly folded (usually squatting, seated, or flexed) Paleolithic and

Hoabinhian burials from the cave of Moh Khiew in southern Thailand; from other Hoabinhian caves in northern Vietnam, including Hang Cho in Hoa Binh Province (c. 13 kya); from the caves of Gua Gunung Runtuh, Gua Teluk Kelawar, Gua Cha, and Gua Kerbau in Peninsular Malaysia (early Holocene); and from the Vietnamese and Peninsular Malaysian Para-Neolithic (mid-Holocene) open-air shell middens of Da But, Quynh Van, Con Co Ngua, and Guar Kepah (Figure 4.3).[7]

Modern and ancient genetic data also support the above reconstruction. Ancient mtDNA samples from skeletal remains found in Thai-Malaysian Peninsula caves, including those from Moh Khiew, belong to mitochondrial haplotypes close to those of the modern Senoi (non-Malay) peoples of interior Malaya (Oota et al. 2001). The Senoi, although now agriculturalists, are close linguistic and phenotypic relatives of the neighboring Semang Negritos. Both the Semang and the Andamanese hunter-gatherers have very deeply rooted mtDNA haplotypes within haplogroup M that suggest to geneticists very long-term in-place evolution in relative isolation, probably from the period of initial modern human spread through tropical Asia.[8] Similar observations from the Y chromosome have been made for Philippine Negritos (Figure 4.1c), who share several haplotypes with Aboriginal Australians (Delfin et al. 2011).

This picture of a widespread and phenotypically varied Australo-Papuan population throughout Mainland Southeast Asia, in occupation everywhere until contact occurred with Asian Neolithic populations after 4500 years ago, has been recently brought into absolute clarity by some remarkable skeletal discoveries in Guangxi and northern Vietnam. Here, we come to one of the most focused demonstrations of Neolithic population incursion and massive material culture change anywhere in Southeast Asia, or indeed in Asia as a whole.

The relevant skeletal material is discussed in more detail in the following invited contribution by Hirofumi Matsumura and his colleagues, who focus for their mid-Holocene data on pre-Neolithic cemetery populations from sites in southern China, northern Vietnam, and Peninsular Malaysia. The burials in these sites are all in squatting, seated, or flexed postures, as in Figure 4.3. Con Co Ngua is particularly important since the excavated sample of burials from here, radiometrically dated (like those from Da But) to about 6 kya, has risen to about 250 individuals since new excavations in 2013. Most of the Con Co Ngua burials are well preserved and all are craniometrically and dentally Australo-Papuan (Matsumura and Oxenham 2014; Trinh and Huffer 2015).

This early Holocene population complex on the mainland of Southeast Asia provides a major statement about the peoples who occupied this whole region prior to the Neolithic. Multidimensional analysis of their craniometric and non-metric dental characteristics suggests that they descended fairly directly from the first modern human arrivals in Southeast Asia more than 50 kya, as represented by the cranial remains from Tam Pa Ling, Niah, and Tabon. They remained in occupation, apparently universally, until the commencement of the Neolithic.

(no common scale)

Figure 4.3 Flexed and squatting early to middle Holocene burials with Australo-Papuan cranial affinities from Malaysia, Indonesia, northern Vietnam and Guangxi. None have definite grave goods, except possibly for the Gua Cha stone "pillow". (a) Hoabinhian young male, from the 1979 excavations at Gua Cha, Kelantan (Adi 1985). (b) Niah West Mouth burial 87

Early to Middle Holocene Skeletal Data from Island Southeast Asia

In recent years, rather little craniometric or dental analysis has been published on Holocene skeletons from Island Southeast Asia, as opposed to the data-rich situations in Vietnam and China. However, there is still enough material to suggest the same picture of an initial Australo-Papuan basal population followed by an Asian Neolithic immigration, as revealed so clearly in northern Vietnam. Hirofumi Matsumura and colleagues discuss the crucial new discoveries in Gua Harimau in Sumatra in their invited contribution, and I introduce other sites here from Taiwan, the Philippines, and Indonesia.

Tightly folded pre-Neolithic and relatively complete burials similar to those in mainland southern China and northern Vietnam occur in Xiaoma Cave in southwestern Taiwan (c. 6 kya: Hsiao-chun Hung pers. comm.) and on Liangdao Island in the Matsu Islands (Taiwan), just off the coast of Fujian near Xiamen. The latter has been directly C14-dated to 6200 BCE (Hirofumi Matsumura and Hsiao-chun Hung, pers. comm.).[9] This Liangdao individual (Liangdao burial 1) also carried mtDNA haplogroup E1, found today in relatively small proportions amongst Austronesian-speaking populations throughout Island Southeast Asia (including Taiwan) and the Mariana Islands (Ko et al. 2014). This possibly attests to admixture between the Australo-Papuan late Paleolithic population represented at Liangdao and Asian Neolithic arrivals, one of which, with Asian cranial morphology, was buried supine at about 5500 BCE in a another Liangdao site not far from burial 1 (Chen Chung-yu, pers. comm.).

Tightly folded pre-Neolithic burials also occur in several caves in East Malaysia, the Philippines, and Indonesia. Examples include the 11.5–8.7 kya series of about 25 burials in flexed or seated postures in the West Mouth in the Niah Caves in Sarawak,[10] although unfortunately these burials are not craniometrically informative due to poor facial preservation (Figure 4.3b). This is an observation that unfortunately applies also to another series of perhaps six flexed but not directly dated (yet apparently preceramic) burials from Sa'Gung and Duyong caves on Palawan Island in the Philippines.[11]

Other flexed or seated burials come from Gua Kimanis and Gua Tengkorak in eastern Kalimantan,[12] the latter identified by Widianto and Handini (2003) as of Australo-Papuan affinity, and there are several from caves in the Gunung Sewu limestone region of south-central Java. One of the latter is a Pre-Neolithic flexed burial from the cave of Song Keplek[13] (skull 4), indirectly dated to about 5 kya, with an Australo-Papuan dentition and mandible. Other Gunung Sewu cranial specimens in this morphological group come from Gua Braholo (skull 5) and Song Terus (skull 1), and another comes

(courtesy Sarawak Museum). (c) Huiyaotian, Guangxi (courtesy Li Zheng, and see Matsumura et al. in press). (d, e) earlier squatting burial and later flexed burial from Con Co Ngua, Thanh Hoa Province, Vietnam (courtesy Marc Oxenham). (f) flexed burial no. I.74 from Gua Harimau, southern Sumatra, directly C14-dated to 4500 years ago (courtesy Truman Simanjuntak and Hirofumi Matsumura).

from Gua Pawon in West Java (skull 5). There is also at least one squatting burial from Gua Lawa in the interior of central Java. None of these specimens has been directly dated, but all are pre-Neolithic, with Gua Pawon having indirect C14 dates between 6 and 10 kya.[14] Available reports on these burials (except for the recent reports for Niah) refer them to an Australo-Papuan pole of variation, as also a group of 12 disturbed skeletons from a destroyed Hoabinhian shell midden at Sukajadi Pasar in northern Sumatra (see location in Figure 5.1), here with a marine shell date from a disturbed context of around 9.5 kya.

In eastern Indonesia, a secondary burial with an uncertain original posture from Liang Lemdubu Cave in the Aru Islands, dated to around 17 kya, is also attributed to this Australo-Papuan morphological group. So too, although much later in time, are skeletal remains from several sites on Flores, all presumed to be of Holocene date. One adult female of very small stature in this group, from a cave called Liang Toge, has been dated to about 4 kya (Jacob 1967a:79). Younger skeletal remains dating from around 2 kya excavated from the rock shelter of Tanjung Pinang on Morotai Island, north of Halmahera, also have generalized Australo-Papuan affinities (Bulbeck forthcoming). In these easterly regions of Indonesia, still peopled by groups with quite strong Australo-Papuan biological affinities, such observations are not surprising.

We see from the above that a population with an Australo-Papuan craniofacial morphology was in universal occupation in both Mainland and Island Southeast Asia, as far as we can tell from current sample distributions, down to the commencement of the Neolithic during the late third and second millennia BCE. The whole region to as far east as the Moluccas was thereafter subjected to considerable immigration by Asian Neolithic populations originating in what is now southern China, strongest in the north and west, but with increasing admixture between Asians and Australo-Papuans in the east and south, especially towards New Guinea. This second Asian Neolithic migration never penetrated the interior of New Guinea or Australia, hence the biological gradient in human populations that one can see nowadays, as also did European explorers in the eighteenth century (e.g., Thomas et al. 1996, for the 1774 observations of Johann Reinhold Forster on Cook's Second Voyage).

The Biological Arrival of an Asian Neolithic Population in Island Southeast Asia

If the Out of Taiwan hypothesis for the origins and dispersals of the ancestors of the majority of the speakers of Malayo-Polynesian languages is correct (chapter 6), then we should expect to see an ancient skeletal situation in Island Southeast Asia whereby populations of Australo-Papuan origin were widespread or even universal during the early Holocene, followed by an appearance of populations of Asian Neolithic ancestry and then by admixture between the two. The hypothesis gains strength from the observation that the Negrito populations related to Australo-Papuans in the Malay Peninsula and Philippines were traditionally hunter-gatherers, rather than farmers (Figure 4.4). The situation was more mixed in eastern Indonesia, where it reflects the long-term

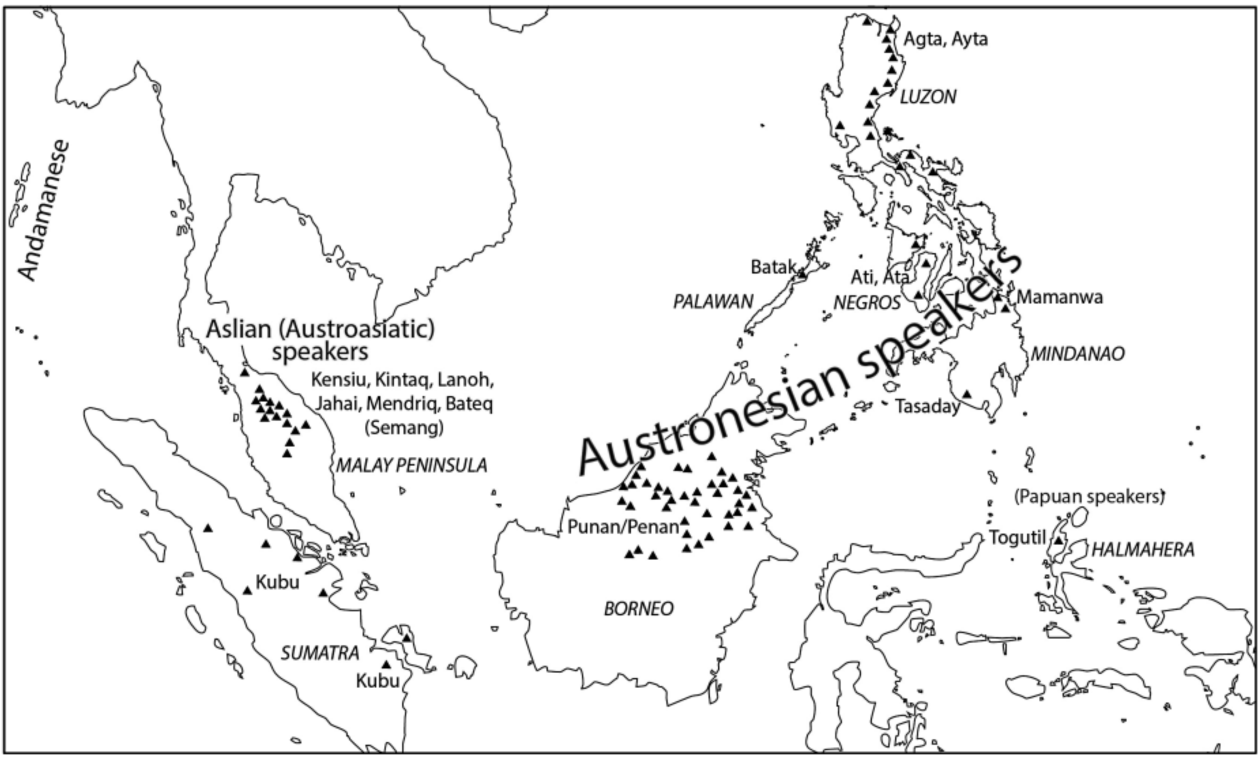

Figure 4.4 The distribution of ethnographic hunter-gatherers in Island Southeast Asia and Peninsular Malaysia. Note that there is no total correlation between language group and phenotype: Australo-Papuans include the Philippine, West Malaysian, and Andamanese Negritos, whereas the hunter-gatherers of Sumatra and Borneo are of Asian Neolithic ancestry. The Togutil are probably derived from both sources. Sources used for this map include Wurm and Hattori (1983) for Punan; Fox and Flory (1974) for Philippines; and Lebar 1972.

genetic survival and demographic success of the Papuan-speaking native peoples of New Guinea and adjacent islands. The highly visible modern cline of admixture from west to east through Wallacea, from Asian to Australo-Papuan, is indeed most striking, as observed by Alfred Russel Wallace and as emphasized genetically by Murray Cox in his invited contribution below. This surely reflects something fundamental about the weakening of the Malayo-Polynesian migration in demographic terms as it penetrated ever further towards the south and east of Island Southeast Asia. Reasons for this presumably relate to the prior presence of food production and arboriculture in the New Guinea region, as well as to a likely presence there of strains of malaria to which Austronesians had no previously acquired resistance (Serjeantson and Gao 1995).

Amongst the available skeletal material that is of Asian Neolithic ancestry in Island Southeast Asia we can list the following examples. The cave of Song Keplek in Gunung Sewu, central Java, has one extended supine burial with Asian dental features that is directly C14-dated to about 1000 BCE, hence undoubtedly Neolithic. This individual (burial 5 in the site-recording system used in the site) had its lateral incisors removed during life (tooth ablation), as in many Neolithic dentitions in southern China and Taiwan. The teeth also had a red stain from chewing betel nut, again as attested in many Neolithic sites in Taiwan (Noerwidi 2012, 2014; Pietrusewsky 2016). There is another undated individual of similar morphology to Song Keplek 5 from Gua Pawon in West Java.

Other skeletal material that is clearly of Asian Neolithic affinity, particularly on such criteria as a shovel-shaped cross-section of the incisor teeth, is quite widespread in Neolithic and Early Metal Age Indonesia. Analyzed examples published so far are all apparently younger than 1500 BCE, although chronologies unfortunately are often obscure. A flexed burial of this morphology in Song Tritis, another of the Gunung Sewu caves, is stratigraphically dated to after 1000 BCE (Widianto 2006:178). Other examples associated with either jar or supine inhumation burial come from Anyer and Plawangan in Java, Gilimanuk in Bali, Leang Cadang in southern Sulawesi, Melolo in Sumba, and Leang Buidane in the Talaud Islands.[15] These are all Early Metal Age, dating after 500 BCE, and some of the Anyer and Melolo crania are stated to have continuing Australo-Papuan features suggesting long-term population admixture.

Recent excavations of quite large cemetery populations in sites such as Gua Harimau in Sumatra (almost 80 burials dated c. 2500 BCE to 300 CE; Simanjuntak 2016) and Pain Haka in Flores (48 burials, 800–200 BCE; Galipaud et al. 2016) should soon revolutionize our understanding of this Asian Neolithic migration. The invited contribution below by Hirofumi Matsumura and colleagues discusses the older flexed Australo-Papuan burials from Gua Harimau as well as the upper-level extended ones of Asian craniofacial morphology. In addition, many Neolithic burials have also recently been recovered from sites near Tainan in the southwest of Taiwan, some with incisor evulsion (Pietrusewsky et al. 2016), but no craniometric data are yet available.

Taking this skeletal material at face value, the most likely hypothesis is that Asian Neolithic populations entered the archipelago from the north, in terms of their affinities with contemporary southern Chinese and native Formosan populations. An exact source region within China is not particularly obvious from the cemetery data taken in isolation, especially without considering the genetics. Yet there is certainly no obvious craniometric reason to claim any movement of Asian Neolithic populations into Indonesia down the Thai-Malaysian Peninsula, where Austroasiatic-speaking Negrito populations and their Senoi relatives apparently remained in full occupation until about 2500–2000 years ago, when early Malay speakers arrived with their Early Metal Age technology from western Indonesia (chapters 6 and 8).

The Significance of Skin Pigmentation in Equatorial Latitudes

There is another somatic factor, apart from craniometric and dental evidence, that supports a relatively recent arrival of Asian Neolithic populations in Island Southeast Asia. Skin pigmentation is mainly produced in the deepest layer of the epidermis by melanosomes that produce the two brownish-black and reddish-yellow melanin pigments, which vary in their proportions between different populations (Jablonski 2006; Chaplin and Jablonski 2009). The visible color is also affected by the thickness of the outer skin layer, or stratum corneum, which contains keratin. These factors do not vary congruently; African and Melanesian skins are characterized by dark pigmentation but little keratinization, East Asian skins have a thick stratum corneum packed with keratin but little pigmentation, European skins have low scores for both pigmentation and keratin. Indeed, human skin colors are formed by the actions of several factors that seem to vary rather independently, presumably reflecting regional selective and environmental factors.

In general, there is an obvious latitudinal correlation for skin color as a barrier to the penetration of ultraviolet (UV) light – dark at the equator, lighter toward the poles and in regions of dense cloud cover. Since UV light destroys the B vitamin folate, needed for cell division, the dark skins of tropical peoples are necessary protection against the sun. Conversely, UV light also synthesizes vitamin D, necessary for bone health and to avoid rickets (Loomis 1967). So UV light cannot be excluded altogether and the light skins of high latitudes allow more of it to penetrate. Nowadays, the wearing of cover-all clothing or continuous indoor living reduces UV penetration for people of all skin colors in all latitudes, and this cultural complication can exacerbate susceptibility to premature birth, tuberculosis, and rickets (Gibbons 2014).

How quickly can skin colors evolve and change? It is generally assumed that our immediate tropical African *sapiens* ancestors were universally dark-skinned, just as are the most deeply indigenous people who live close to the equator in Africa now. So acquisition of light skin color was probably a result of early human migration, including that of the Neanderthals, towards higher latitudes in Eurasia. However, tropical Americans are not reported to be noticeably darker than other Native Americans after a settlement period of perhaps 16,000 years (Brues 1977:302), so in this case the rate of change (here presumably from light to dark, unlike the original Out of Africa situation) might have been quite slow. Australians also did not undergo marked changes in pigmentation from the tropics to southern Tasmania, despite their presence on the Sahul continent for at least 50,000 years. On the other hand, genetic evidence suggests that the light skins of Europeans became even lighter during the

Neolithic about 7000 years ago (Olalde et al. 2014), perhaps selected by the relative lack of Vitamin D in an agricultural cereal-based diet with cover-all clothing. In this case, the evolution could have been more rapid and under more powerful selection.

The reason I have added this discussion is to draw attention to the presence of the relatively light Asian skin morphology that today dominates the Indo-Malaysian tropics and across the further Pacific, outside the regions of Australo-Papuan darker skin morphology. The Asian morphology exists in a latitudinal belt that supports much darker aboriginal populations in all other regions of the Old World (Africa, southern India, Melanesia, and northern Australia). I find it hard to escape the conclusion that, had all living Island Southeast Asian populations evolved entirely within the archipelago, they should be as dark as the latitudinally neighboring Melanesians and Negritos.

There is a clear case here of a pattern that does not fit expectations drawing upon natural selection alone. The only sensible explanation involves migration from the north. Lack of vitamin D in a cereal-based diet might have worked to lighten skin tones in Neolithic Europe and western Asia, but the prehistoric diets of Island Southeast Asia were not heavily cereal-based as far as we know, and not at all in Oceania. Also, Island Southeast Asians did not need fair skins to allow UV radiation to penetrate because they inhabited the tropical zone – dark skins would arguably have been more suitable and would be universal today had all populations evolved *in situ* since the arrival of the first modern humans. All in all, it is extremely difficult to deny the significance of recent migration from higher latitudes in explaining the ancestry of most of the modern peoples of Island Southeast Asia.

The Biological History of Southeast Asian Populations from Late Pleistocene and Holocene Cemetery Data

An Invited Perspective by Hirofumi Matsumura, Marc Oxenham, Truman Simanjuntak, and Mariko Yamagata

Debates over the population history of Southeast Asia have generally revolved around the issue of whether the pre-Neolithic inhabitants were of a different biological lineage from the Neolithic and post-Neolithic populations, including present-day ones. The former are represented on the mainland of Southeast Asia by the skeletons of the Palaeolithic Hoabinhian foragers and by their Para-Neolithic successors with pottery and ground stone axes. Revealing the genealogical relationship between these early foragers and the Neolithic populations who entered Mainland Southeast Asia after 3000 BCE is crucial for clarifying our understanding of the population history of the region. Currently, the most comprehensive studies pertinent for this question published so far have been two non-metric dental analyses which have demonstrated a significant morphological gap between early Holocene (Pre-Neolithic) Southeast Asians and modern East Asians (Matsumura and Hudson 2005; Matsumura and Oxenham 2014).

Much of the early theorizing on this question held that modern Southeast Asians originated in East Asia (including modern China) and spread south and southeast through migratory processes and subsequent genetic exchange with indigenous populations.[16] This model has become known to biological anthropologists as the "Two-Layer" model and has gained theoretical support from historical linguistics and archaeology. The pre-modern dispersals of the Austroasiatic language family on the Southeast Asian mainland and the Austronesian language family through Island Southeast Asia and Oceania have been specifically linked for the most part with the expansions of Neolithic food-producing peoples, augmented by later Early Metal Age movements (Bellwood 2005). Linguistic data indicate that southern China and Taiwan provided the ultimate sources of many of the existing language families of Southeast Asia (Chapter 6), while archaeology places the origins of Neolithic rice-farming societies in the Yangzi basin during the early Holocene (Chapter 7), prior to subsequent population expansions from southern China into Southeast Asia.

Craniometric Analysis

This chapter addresses the biological history of population migration across Southeast Asia based on craniometric analysis using pertinent archaeological skeletal materials. The analysis utilizes 16 commonly available cranial measurements (Martin's numbers M1, M8, M9, M17, M43(1), M43c, M45, M46b, M46c, M48, M51, M52, M54, M55, M57, and M57a). Evolutionary affinities are assessed using Q-mode correlation coefficients (Sneath and Sokal 1973). The 83 studied archaeological and modern cranial series are listed in Table 4.1. To aid interpretation of phenotypic affinities, Neighbor Net Splits tree diagrams have been generated by applying the software package *Splits Tree Version 4.0* (Huson and Bryant 2006) to the distance (1–r) matrix of Q-mode correlation coefficients (r).

Figure 4.5 presents the results of the Net Splits analysis. The unrooted network tree resulting from this analysis branches into two major clusters to the left and right of the central neck region of the diagram. Modern Northeast and East Asians occupy the upper left of the tree, and present-day Southeast Asians are scattered amongst them. The morphologically far-distant Australian and Papuan/Melanesian groups, as well as the Vedda of Sri Lanka and the Nicobarese, form another major and separate cluster at the lower right.

Early Indigenous Hunter-gatherers

Paleolithic human samples in Southeast Asia are crucial to any debate over the peopling of the region. The earliest accepted anatomically modern humans in Southeast Asia come from the caves of Tam Pa Ling in Laos (Demeter et al. 2012, 2015), Niah in Sarawak (Brothwell 1960; Kennedy 1977; Curnoe et al. 2016) and Tabon in Palawan (Macintosh 1978), with dates ranging from 47 to 30 kya. The major issue with utilizing these oldest modern human remains relates to

Table 4.1 Sources of compared cranial samples in East and Southeast Asia.[17]

Sample	Country	Period	Remarks and location
		★ ***Pleistocene and Early Holocene Samples***	
Liujiang	China	Late Pleistocene	Individual, Guangxi Province
Lang Gao	Vietnam	Hoabinhian	Averages of two individuals (nos. 17 and 19), Hoa Binh Province (Nguyen 2007)
Lang Bon	Vietnam	Hoabinhian (c. 5000 BCE)	Individual, Thanh Hoa Province (Nguyen 2007)
Mai Da Dieu	Vietnam	Hoabinhian (c. 5000 BCE)	Individual, Thanh Hoa Province (Nguyen 2007)
Mai Da Nuoc	Vietnam	Hoabinhian (c. 6000 BCE)	Individual, Thanh Hoa Province (Nguyen 1986, 2007)
Hoabinhian (average)	Vietnam	Hoabinhian (c. 9000–6000 BCE)	Six specimens including fragmentary remains from the above four sites and one from Mai Da Dieu in Thanh Hoa Province (Nguyen 2007)
Bac Son	Vietnam	Early Holocene (c. 6000–5000 BCE)	Sites of Pho Binh Gia, Cua Gi, Lang Cuom, and Dong Thuoc in Lang Son Province (Mansuy and Colani 1925)
Con Co Ngua	Vietnam	Da But Culture (c. 4500–3500 BCE)	Thanh Hoa Province. See Figure 4.3d, e
Gua Cha	Malaysia	Hoabinhian (c. 6000–4000 BCE)	Individual H12, Kelantan (Sieveking 1954). See Figure 4.3a
Zengpiyan	China	Early Holocene (c. 6000 BCE)	Guangxi Province (IACAS 2003)
Gua Harimau 2	Indonesia	Pre-Early Metal Age (2600–600 BCE)	Sumatra (Simanjuntak 2016). See Figure 4.3f
		◆ ***Neolithic Samples***	
Man Bac	Vietnam	Neolithic (c. 2000–1800 BCE)	Ninh Binh Province (Nguyen 2001; Oxenham et al. 2011)
An Son	Vietnam	Neolithic (c. 1800 BCE)	Long An Province (Nguyen 2006; Bellwood et al. 2011)
Ban Chiang	Thailand	Neolithic–Early Metal Age (c. 1500–300 BCE)	Udon Thani Province (Pietrusewsky and Douglas 2002)
Non Nok Tha	Thailand	Neolithic–Early Metal Age (c. 1500–500 BCE)	Khon Kaen Province (Bayard 1971)
Khok Phanom Di	Thailand	Neolithic (c. 2000–1500 BCE)	Chonburi Province (Tayles 1999)
Tam Hang	Laos	undated	Hua Pan Province (Mansuy and Colani 1925; Huard and Saurin 1938; Demeter et al. 2009)
Weidun	China	Neolithic (c. 5000–3000 BCE, Majiabang Culture)	Jiangsu Province

Table 4.1 (Continued)

Sample	Country	Period	Remarks and location
Baikal	Russia	Neolithic (c. 6000–2000 BCE)	Lake Baikal (Debets 1951)
Jomon	Japan	Neolithic (c. 3000–300 BCE)	Over almost the entire archipelago
Hemudu	China	Neolithic (c. 4300 BCE, Hemudu Culture)	Zhejiang Province, Yangzi delta (ZCARI 2003)
		● ***Bronze to Early Metal Age Samples***	
Anyang	China	Yin (Shang) Period (c. 1500–1027 BCE)	Henan Province (IHIA 1982)
Ban Non Wat	Thailand	Early Metal Age (c. 1100–1400 BCE)	Nakhon Ratchasima Province (Higham and Kijngam 2012a, 2012b)
Giong Ca Vo	Vietnam	Early Metal Age (c. 300–0 BCE)	Ho Chi Minh City (Dang and Vu 1997; Dang et al. 1998)
Go O Chua	Vietnam	Early Metal Age (300–1 BCE)	Long An Province (Nguyen et al. 2007)
Rach Rung	Vietnam	Early Metal Age (c. 800 BCE)	Moc Hoa District, Long An Province (The and Cong 2001)
Hoa Diem	Vietnam	Early Metal Age (Hoa Diem 2 = 150 BCE; Hoa Diem 1 = 100–300 CE)	Hoa Diem in Khanh Hoa Province (Yamagata et al. 2012)
Dong Son	Vietnam	Dong Son Period (c. 1000 BCE–300 CE)	Sites of Dong Son Culture (Nguyen 1996)
Gua Harimau 1	Indonesia	Late Neolithic and Early Metal Age (c. 700 BCE–200 CE)	Sumatra (Simanjuntak 2016)
Yayoi	Japan	Yayoi Period (c. 800 BCE–300 CE)	Sites of Doigahama, Nakanohama, Kanenokuma, and others in Northern Kyushu and Yamaguchi Districts, W. Japan
Hirota Yayoi	Japan	Yayoi Period (c. 800 BCE–300 CE)	Hirota in Tanegashima Island, Kagoshima Pref. (Kokubu and Morizono 1958)
Jiangnan	China	Eastern Zhou–Former Han Periods (770 BCE–8 CE)	Sites in Jiangsu Province, lower Yangtze River (Nakahashi and Li 2002)
Jundushan	China	Spring and Autumn Period (c. 500 BCE)	Yanqing Prefecture near Beijing (BCRI 2007)

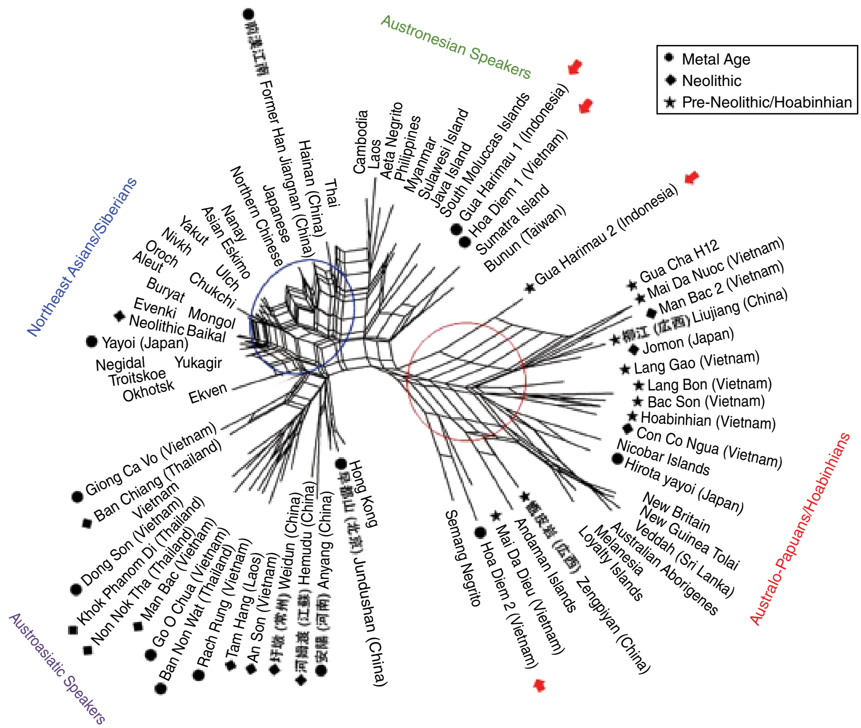

Figure 4.5 A Neighbor Net Splits tree generated from the matrix of Q-mode correlation coefficients, based on 16 male cranial measurements. Arrows indicate the new results from Gua Harimau and Hoa Diem.

their less than ideal preservation and the lack of complete cranial data sets. On the other hand, there are several sets of nearly complete preceramic Hoabinhian skeletons associated with cultural assemblages dated between 23 kya (Yi et al. 2008) and the middle Holocene, especially in northern Vietnam and Peninsular Malaysia. In the latter region, the Gua Cha rock shelter has produced Hoabinhian human remains that include specimen H12, an adult male with an almost complete skull (Sieveking 1954; Trevor and Brothwell 1962; Adi 1985).

Overlapping with the terminal Hoabinhian is a subsequent phase associated with pottery-using hunter-gatherers, termed the Bacsonian in Vietnamese archaeology.[18] Shell midden sites with polished stone axes and pottery characterize the Da But aspect of the Bacsonian (Bui 1991), for which by far the largest skeletal assemblage comes from the open-air cemetery site of Con Co Ngua in Thanh Hoa Province, dated to about 4000–3000 BCE (Nguyen 1990; Nguyen 2003; Trinh and Huffer 2015).

As shown in Figure 4.5, all the analyzed Hoabinhian specimens are consistently defined as having a close Australo-Papuan affinity in terms of their craniometric morphology. The data used to create Figure 4.5 come from complete male crania, to avoid confounding issues of varying robustness between males and females, although female or incomplete male skulls have been analyzed elsewhere (Matsumura 2006; Matsumura et al. 2008; Matsumura et al. 2011). Figure 4.5 also demonstrates that Australo-Papuan cranial traits were retained through the subsequent Bacsonian and Dabutian cultural phases in northern Vietnam. Indeed, there is a long history of scholarship suggesting morphological similarities, with implied genetic relatedness, between ancient and recent Aboriginal Australians and Papuans on the one hand and pre-Neolithic Southeast Asians on the other, particularly with respect to dolichocrany with protruding glabellae, large jaws with relatively large teeth, alveolar prognathism, and long slender limbs.

These observed close biological ties support the hypothesis that the Hoabinhian populations were descended from the first modern humans to colonize the region, these being migrants who may have tracked eastwards along the southern rim of Asia (Oxenham and Buckley 2016). Figure 4.5 further suggests that the genetic resources from these pre-Neolithic populations were retained to a high degree in some later population samples, such as the Jomon and the Early Metal Age Hirota Yayoi in Japan.

Neolithic Dispersal in Mainland Southeast Asia

As discussed in chapters 6 and 7, the prehistoric expansions of the Austroasiatic-, Tai-, and Austronesian-speaking populations can be linked archaeologically with the Neolithic dispersal of food-producing populations, beginning in Southeast Asia during the later part of the third millennium BCE. The remainder of this perspective deals with new cranial and dental evidence that supports this view.

On the mainland of Southeast Asia, most of the relevant skeletal materials come from excavations in Vietnam and Thailand. Some of the most important Vietnam samples come from Man Bac in Ninh Binh Province (c. 2000–1800 BCE; Matsumura et al. 2008; Oxenham et al. 2011), a site that represents the Phung Nguyen culture of the lower Red River valley. Man Bac has yielded dense rice phytoliths and the analyzed skeletons come from our excavations there between 1999 and 2007. A millennium or more later (500 BCE to 100 CE), the Early Metal Age Dong Son culture flourished along the Red and Ma rivers of northern Vietnam, as did the contemporary Dian culture in Yunnan, both associated with rice agriculture and outstanding bronze working and, by this date, clearly involved in the ancestries of many of the Tai- and Viet-Muong-speaking peoples. The Dong Son human remains come from several sites excavated by the Institute of Archaeology (Nguyen 1996) and the Centre for Southeast Asian Prehistory in Hanoi.

The Neolithic and Early Metal Age Thailand specimens analyzed jointly cover the period between 2000 and 300 BCE and are represented by skeletal series from the sites of Khok Phanom Di (c. 2000–1500 BCE), Ban Non Wat (1800–300 BCE), Ban Chiang (2100–300 BCE), and Non Nok Tha (1500–1000 BCE), all with evidence of rice agriculture.[19] Given that the Tai linguistic homeland lies in southern China and that languages of this family did not enter what is now Thailand until the early historical era, perhaps one millennium ago, it seems most likely from current linguistic distributions that the late prehistoric populations of central and northeastern Thailand, from the Neolithic onwards, were speakers of Austroasiatic languages within the major Mon-Khmer subgroup of that family.

As depicted in Figure 4.5, the Neolithic Man Bac series is cranio-morphologically heterogeneous, with the majority of crania exhibiting a significant morphological discontinuity with the earlier Hoabinhian, Bacsonian, and Dabutian populations. The closest affinities of this Man Bac majority, grouped in Figure 4.5 as Man Bac, are with the later Dong Son people of Vietnam and the majority of the Chinese Neolithic samples. The latter in turn have close similarities with present-day Siberians. This circumstance suggests an appearance by 2000 BCE of Neolithic immigrants with close genetic links to East Asians at Man Bac and elsewhere in northern Vietnam, and testifies to the impact of agriculturally driven demic diffusion in this region.

In the case of Thailand, although dental non-metric profiles imply gradual population admixture between indigenous and immigrant groups (Matsumura and Oxenham 2014), the cranial morphological perspective leaves little doubt as to the close affinity between the Neolithic and Bronze / Early Metal Age Thailand samples and Northeast / East Asians, the latter including samples from China and Siberia. These results also, as in Vietnam, indicate intense levels of agriculturally driven demic expansion into Thailand, with source populations located in what is now geographically defined as China.

Neolithic Dispersal in Island Southeast Asia

A large number of prehistoric sites have been discovered in Island Southeast Asia that render the Out of Taiwan hypothesis for Austronesian origins (chapters 6 and 7) as most likely to be correct, in accordance with the linguistic evidence. Nevertheless, quite a few authors in the field of osteo-morphological study have recently challenged this view, capitalizing on a virtual lack of well-preserved human skeletons and relying on a default hypothesis of non-migration. For instance, the 100+ skeletal individuals excavated in the Neolithic and Early Metal Age cemetery in the West Mouth of the Niah Caves in Sarawak are all heavily damaged, in particular the crania, so that measurements from them were unavailable for this study.

However, new excavations are changing this rather bleak prospect, especially in Gua Harimau, located in Padang Bindu in southeastern Sumatra. Research here since 2012 has uncovered 78 human burials ranging from pre-Neolithic to Early Metal Age in date. Provisional radiocarbon dating by the Indonesian National Nuclear Energy Agency suggests that the skeletons date overall between 2600 BCE and 1000 CE. Crania reconstructed so far include those from Pre- Metal Age burials 53 (700 BCE), 74 (2500 BCE), and 79 (before 2500 BC), all these belonging to Gua Harimau series 2, and Early Metal Age burials 12, 19, 20, 23, 48, 59, and 60, dating to approximately 200 CE and belonging to Gua Harimau series 1.

Newly excavated skeletal material from Early Metal Age southern coastal Vietnam may also be relevant for questions of population dispersal in Island Southeast Asia, given that Malayo-Polynesian Chamic-speaking populations settled the coastline of central Vietnam during the late Neolithic or Early Metal Age. Unfortunately, the central Vietnam Sa Huynh jar burial culture has little skeletal material owing to acidic sand dune soils, but the more southerly Early Metal Age sites of Giong Ca Vo and Giong Phet in Can Gio District, Ho Chi Minh City, dated between 400 BCE and 100 CE, have better preservation (see Chapter 9). Giong Ca Vo has yielded 339 jar burials, 306 with surviving skeletal material (Dang et al. 1998). The jars are spherical and distinct from the typical Sa Huynh burial jars, which are cylindrical (with distinctive hat-shaped lids), but the abundant ear ornaments of nephrite (including some from Taiwan) and glass in these two sites are typical also of the Sa Huynh culture. Another mortuary site in southern Vietnam is Hoa Diem (Yamagata et al. 2012), located in Cam Rang Bay in Khanh Hoa Province. This site has many burials in globular jars with accessory vessels, some strikingly similar to the decorated pottery from Kalanay Cave in the central Philippines (Favereau 2015). Several well-preserved Hoa Diem crania dated to around 200 CE are available for analysis and there are also some extended burials that are older than the jar burials, one directly radiocarbon dated to about 100 BCE (Hoa Diem 2).

Quite interestingly, as shown in Figure 4.5, craniometric analysis demonstrates a very tight linkage between the Neolithic and Early Metal Age Gua Harimau 2 series from Sumatra and that from Hoa Diem (Hoa Diem 1: jar burial group). This group in turn approaches the branches occupied by some living populations in Taiwan (Bunun), the Philippines, Sulawesi, Sumatra, and the Moluccas. These two Early Metal Age series point to shared ancestry and interaction between contemporaneous communities in Insular Southeast Asia, especially around the South China Sea.

However, the most important observation from Gua Harimau is that its series 1 and 2 crania exhibit population replacement *in situ*. Here, the pre-Neolithic occupants (Gua Harimau 2) were related to Australo-Papuans (Figure 4.3f), whereas the Gua Harimau 1 newcomers all carried East Asian craniofacial features, suggesting arrival at perhaps 700 BCE or even later. In addition, the earlier Hoa Diem 2 individual, buried in an extended position rather than in a jar, as well as the living Semang Negritos, are loosely connected with the Australo-Papuan cluster. This implies that these populations carry a greater degree of genetic heritage from indigenous sources akin to living Australo-Papuans.

However, contrary to the general view that Giong Ca Vo was a maritime trading port possibly associated with Austronesian-speaking populations, the samples from here cluster with other samples from Mainland Southeast/East Asia rather than Island Southeast Asia. One of these samples, from the Neolithic site of An Son in Long An Province, is associated with evidence of *japonica* rice agriculture (Bellwood et al. 2011).

Conclusions

Distinct patterns of clinal variation between pre- and post-Neolithic Mainland Southeast Asian cranial samples suggest a center to periphery spread of genes into the region from further north in East Asia. This pattern is consistent with archaeological and linguistic evidence for demic diffusion involving agriculturally driven population expansion in the Neolithic. Furthermore, the strong cranial affinities between many early Neolithic Mainland Southeast Asians and populations in East Asia suggest that these newcomers initially did not admix on a large scale with indigenous Australo-Papuan populations but founded colonies of immigrants who only gradually became admixed, as revealed by the Man Bac cemetery in northern Vietnam.

As far as Island Southeast is concerned, our craniometric study lacks extensive data on Neolithic samples, although the phenotypic variation in living samples apparent in the network tree accords with the afore-mentioned model of Neolithic population expansion from further north. Cox and colleagues (2010) have emphasized the significant genetic cline (or gradient) originally recognized by Wallace across the eastern regions of Island Southeast Asia, extending into New Guinea and Melanesia. They conclude that this cline likely reflects the mixing of two long-separated ancestral source populations: one descended from the initial Papuan-like inhabitants of the region and the other related to Asian groups that immigrated during the Neolithic.

The later Early Metal Age affinities between Island and Mainland Southeast Asian coastal populations, and in turn East Asians, are likely a consequence of South China Sea interaction from at least 500 BCE onwards, if not from the Neolithic. The archaeological, linguistic, and now cranial data make it very clear that the origins of modern Southeast Asians are to be found in a complex interplay between local indigenous populations with extremely deep historical roots and multiple and multidirectional arrivals of new migrants, ultimately originating from amongst the first agricultural populations of what is now central China.

The Genetic History of Human Populations in Island Southeast Asia During the Late Pleistocene and Holocene

An Invited Perspective by Murray Cox

Although often unrecognized, molecular anthropology has a surprisingly long pedigree in Island Southeast Asia. Just five years after Hirszfeld and Hirszfeld (1919) performed the first population genetic analysis of human blood groups (in the global mix of soldiers fighting in Europe during the First World War), the first studies of blood group diversity across Island Southeast Asia were being published (Bais and Verhoef 1924; Heydon and Murphy 1924). In this respect, the founding of molecular anthropology was contemporary with the first major work of modern social anthropology (Malinowski 1922), which similarly benefited from the stimulating environment of Island Southeast Asia and the Pacific region in the 1910s and 1920s.

A century later, research on the molecular diversity of Island Southeast Asia is nearly unrecognizable in all but its aim: to reconstruct the history of the region's peoples using inherited genetic characters. Early work on blood groups, both the familiar ABO system and more esoteric blood proteins such as Duffy and hemoglobin, provided relatively little definitive insight into population prehistory. The key exception was a consistently observed distinction, albeit often blurred, between populations in Melanesia versus those in Island Southeast Asia and Polynesia (Cavalli-Sforza et al. 1994; Mourant et al. 1976), a feature of Pacific genetic diversity that is still important for understanding the prehistory of this region today.

Molecular anthropology really came into its own during the late 1980s and early 1990s when new molecular techniques, particularly the Polymerase Chain Reaction (PCR), first allowed researchers to observe small DNA changes directly. Sex-specific markers, especially on the maternally inherited mitochondrial DNA (mtDNA) and the paternally inherited Y chromosome, gave us our first estimates of the times and movements of prehistoric groups in the Pacific region (Kayser 2010). Today, ongoing success in automation and miniaturization is allowing geneticists to analyze whole genome sequences – the entire DNA complement of an individual – at community, regional, and global scales. This "genomic" research, which will dominate molecular anthropology for the foreseeable future (Stoneking and Krause 2011), promises to reveal the biological history of peoples in the Indo-Pacific region with ever-increasing precision. Indeed, genome sequences are the ultimate genetic data – at least for the purposes of reconstructing the human past – and any stories that remain untold after the genomic era will necessarily have been lost to the depths of time. Genomic data are even being obtained from ancient DNA, which promises to reveal the biology not of people living today, but of their ancestors

(Pickrell and Reich 2014). While ancient mtDNA sequences have been reported from the Solomon Islands and New Zealand (Knapp et al. 2012; Ricaut et al. 2010), the first nuclear markers are just appearing and promise great insight into the region's prehistory (Matisoo-Smith 2015).

Genetic evidence from around the world supports the view that modern humans arose in Africa, dispersing from there around 50 kya to settle Europe and Asia. Although there is some contention around timing and whether there was one or multiple waves (Rasmussen et al. 2011), there is general agreement that the first inhabitants of the Pacific world were the ancestors of today's Papuans and indigenous Australians. Dating of early archaeological sites indicates that these first travelers probably arrived in, and spread across, Island Southeast Asia within just a few thousand years (O'Connell and Allen 2004). Uniparental genetic markers are consistent with this view: some of the earliest mtDNA lineages to branch off the M and N super-haplogroups (the major trunks of the mtDNA tree that chronicle our species' rapid expansion out of Africa) are found today in Papuans, indigenous Australians, and some Island Melanesian populations (Ingman and Gyllensten 2003). These very early mtDNA lineages, which include M17a, M47, M73, N21, N22, R21, R22, and R23 (Figure 4.6), are typically rare, but widely dispersed (Tumonggor et al. 2013).

As the first and least legible writing on what has since become a well-used palimpsest, very little is known genetically about these first arrivals. Nevertheless, we see their presence on the Y chromosome as well. Haplogroups C and K, with their downstream branches M and S, similarly highlight a rapid movement out of Africa, followed by a radiation within Island Southeast Asia (Karafet et al. 2015). In contrast to mtDNA, many of these early male lineages reach appreciable frequencies in Island Southeast Asia today, likely reflecting secondary expansions later in the Pleistocene, well after the initial settlement period. Genome-level sequencing promises to improve the resolution of the Y chromosome tree, thereby providing an even more detailed reconstruction of past population movements (Poznik et al. 2013; Karmin et al. 2015).

The African exodus caused anatomically modern humans to encounter and interact with pre-existing archaic hominin populations across Eurasia. For a long time, it was thought that modern humans simply replaced these ancient groups, but growing evidence shows that all non-African individuals derive a small proportion of their genome from Neanderthals (typically 2–4%; Sankararaman et al. 2014). Island Southeast Asians, especially in Wallacea, carry an additional contribution from Denisovans[20] (Krause et al. 2010; Reich et al. 2011), an equally ancient sister group to Neanderthals, otherwise known only from their DNA (Meyer et al. 2012). Morphological evidence for Denisovans is extremely limited, originally comprising just one bone from the tip of a pinkie finger. But with them, for the first time, the genome of an early human species was identified before its skeletal morphology.

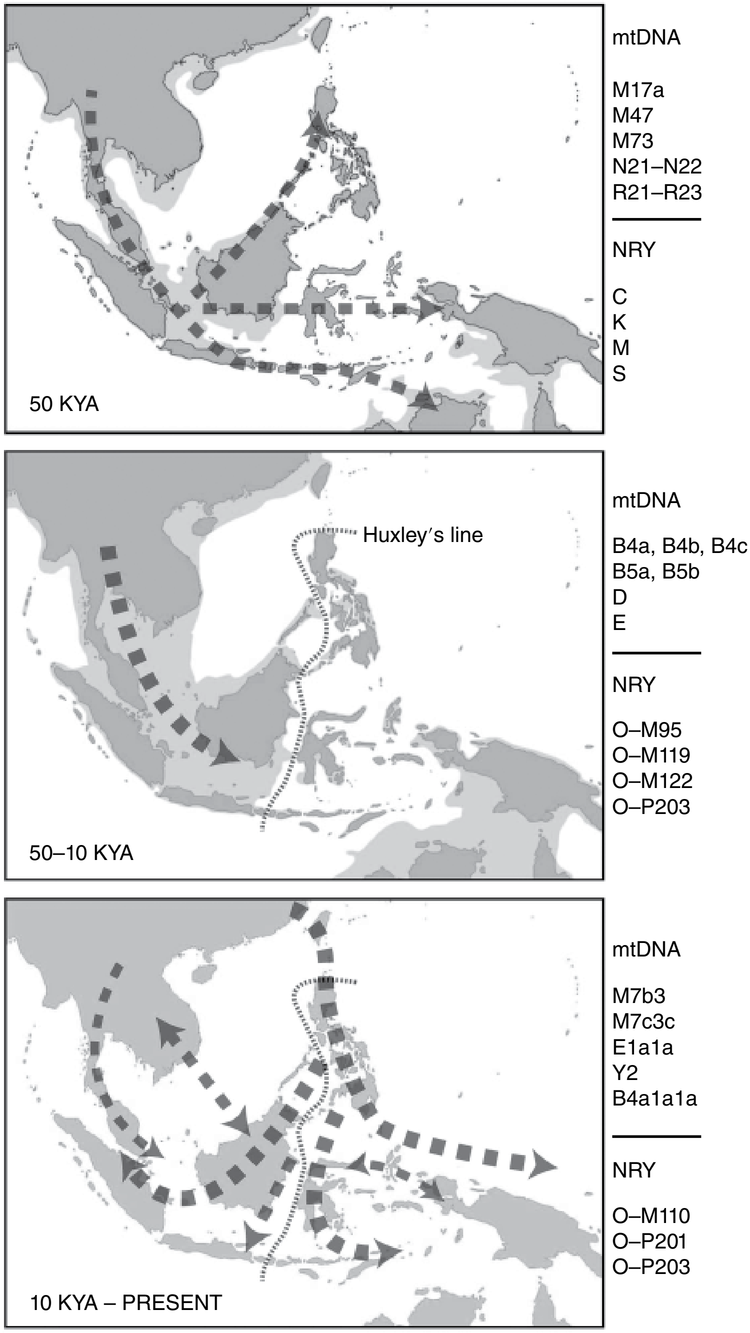

Figure 4.6 Approximate migration tracks of mtDNA and Y-chromosome haplogroups into and through Island Southeast Asia in three time bands during the past 50,000 years. The lowest map represents the haplogroups most closely associated with Austronesian speakers.

Because regions of Denisovan DNA are closely linked with markers of Papuan ancestry in Island Southeast Asian individuals, this contact likely occurred during, or very soon after, the expansion from Africa (Cooper and Stringer 2013; Veeramah and Hammer 2014). Intriguingly, genetic contributions from much older hominins have also been detected in modern humans (Hu et al. 2014), possibly hinting at additional contact with *Homo erectus* or *H. floresiensis*. The absence of genome sequences for these older species hinders accurate provenancing of these genetic contributions. Nevertheless, the human genome is increasingly viewed as a mosaic formed from repeated admixture events with other human-like species (and therefore broadly mimicking the species history of other primates such as baboons; Ackermann et al. 2014).

Modern humans may retain these archaic lineages for a reason. For instance, the gene variant that allows modern Tibetans to survive high altitudes in the Himalayas likely derives from archaic humans (in this case, Denisovans) (Huerta-Sanchez et al. 2014), as do key variants in the immune system genes of many Eurasian groups (Abi-Rached et al. 2011). In all likelihood, we owe much more to our sister species than has historically been admitted. Whether genes from archaic hominins provide some biological advantage to modern Pacific peoples remains completely unexplored.

Although the first movements of modern humans into Island Southeast Asia set the stage, the late Pleistocene also saw numerous arrivals and migrations within the region. This contrasts with the occasional portrayal of this period as a long hiatus before the distinctive events of the Holocene. While the perception of stasis is not true, the disruptive processes of the Neolithic now make it challenging to reconstruct population history during the late Pleistocene with any accuracy. Certainly, some founder lineages began to diversify during this period. On the mtDNA, many haplogroups that are common and widespread today (such as B4a, B4b, B4c, B4c1b3, B5a, B5b, B5b1, D, and E) arose between 10 and 40 kya (Soares et al. 2008; Tumonggor et al. 2013). As these lineages vary considerably in diversity (and hence, probably their age) and exhibit quite different geographical distributions, it is unlikely that any single demic event explains their presence in Island Southeast Asia. These lineages often occur as key components of modern populations in Peninsular Malaysia, particularly semi-isolated Negrito communities (Jinam et al. 2012). It therefore seems likely that they reflect repeated population movements from mainland Asia, possibly of hunter-gatherers (such as the Hoabinhians) who lived along the now-submerged river systems that once ran out from mainland Asia between the modern islands of Sumatra, Java, and Borneo.

Although these genetic lineages cannot be linked in any convincing way with specific archaeological assemblages, Pleistocene population movements are also seen on the Y chromosome. Several major subclades of haplogroup O, such as O-M119, O-M95, O-P203, and O-M122, arose between 8 and 35 kya (Karafet et al. 2010; Trejaut et al. 2014). A key feature of Island Southeast Asia, which probably dates to this time, is an exceptionally strong east–west divide in genetic diversity. Broadly following Wallace's (1962) biogeographical line, although shifted slightly east in agreement with his lesser-known phenotypic division between "Malayan" and "Polynesian" (also glossed by Wallace as "Papuan") races (see Figure 5.1), people living across this boundary exhibit one of the largest differences in genetic diversity observed anywhere in the world. Haplogroups C-M38*, M-P34, and S-M254 account for more than half of Y chromosomes in the east and yet are nearly absent in the west. Conversely, haplogroup O lineages O-P203, O-M95*, and O-M119* exceed a frequency of 60% in the west but are markedly less common in the east (<10%; Karafet et al. 2010). Similar patterns are seen in the mtDNA (Tumonggor et al. 2013). Differences of this magnitude have only been observed elsewhere when imposed by major geographic barriers such as the Himalayas or the Sahara Desert. Clearly, no comparable geographic barriers occur in Island Southeast Asia and alternative explanations are necessary. Since Holocene lineages cut across this division, current interpretations favor restricted mobility of hunter-gatherer populations during the Pleistocene. However, like most genetic features that seem best attributed to the Pleistocene period, there is less clarity around how or why these patterns arose.

The genetic events of the Holocene are less ambiguous, simply because they are more recent and have not yet been overwritten. This period is characterized by major dispersals: some ultimately from mainland Asia and possibly attributed to the spread of agricultural populations (Bellwood 2005); others within and between island chains in Island Southeast Asia and perhaps more likely caused by alternative farming and maritime activities (Bulbeck 2008). At least some of these dispersals are also thought to account for the widespread, indeed near-complete, spread of Austronesian languages across Island Southeast Asia, as well as the first long-distance migrations out into the remote islands of the Pacific (Kayser 2010).

On the mtDNA, lineages M7b3, E1a1a, M7c3c, and Y2 saw major expansions at this time. Perhaps around 20% of these dispersals may reflect movements from Taiwan (Brandão et al. 2016), the favored source location of Austronesian languages, while others may better reflect movements within and between other island groups (such as the Philippines and eastern Indonesia; Tumonggor et al. 2013). Networks representing relationships between lineages are frequently inconclusive about directions of dispersal during the Holocene. When movements are rapid, insufficient time elapses for a step-wise series of mutations to develop, and this characteristic seems to hold for many lineages that arose within, or entered into, Island Southeast Asia during the Holocene. However, many Island Southeast Asian populations do show signs of population growth and expansion at this time, reflected in summary statistics such as Fu's Fs and Tajima's D, and also in the "star-like" phylogenies of many mtDNA lineages.

Perhaps the most famous mtDNA lineage is the Polynesian motif (B4a1a1a) and related forms. Although originally thought to have spread from Taiwan (Hertzberg et al. 1989) and thus providing a direct analogue for the dispersal of Austronesian languages, this lineage is now known to possess an unusual geographical distribution and its history remains surprisingly unclear (Cox 2005; Richards et al. 1998). The Polynesian motif itself is found only at low frequency in eastern Indonesia (2.3%; Cox 2005), although it reaches as high as 7.4% on Timor (Tumonggor et al. 2014). The lineage occurs no further west than Bali (0.4%; Tumonggor et al. 2013) and is absent from the Philippines (Tabbada et al. 2010), but is the dominant mitochondrial lineage across the islands of Oceania (Duggan et al. 2014). The contemporary view is that the Polynesian motif arose about 6000 years ago, perhaps in the Bismarck Archipelago (east of New Guinea), from where it dispersed more widely as part of later population movements (Soares et al. 2011). Curiously, a variant of the Polynesian motif is exceptionally common on Madagascar (13–50%; Razafindrazaka et al. 2010), an island off the east coast of Africa that was settled during the mid-first millennium AD from western Indonesian sources (Cox et al. 2012).

The Polynesian motif may once have been more common in western Indonesia than it is today, as suggested by genome-wide markers that increasingly place the Asian source of Malagasy in Borneo (Kusuma, Brucato et al. 2016), with likely genetic connections to sea nomad populations (Kusuma et al. 2015). However, an inclusive framework that describes the full distribution of this unusual mtDNA lineage still appears to be lacking; it clearly describes the major population movement from Near to Remote Oceania (Duggan et al. 2014), although a direct upstream connection with population dispersals from Taiwan as part of the Austronesian expansion seems increasingly unlikely (Soares et al. 2016).

Holocene dispersals are also recorded on the Y chromosome. The broad distributions of haplogroup O-P201 and probably O-M110 and O-P203 likely date to this time. Tellingly, these lineages are found on both sides of Wallace's line, as would be expected if they were carried by rapidly dispersing communities with a strong maritime tradition. Hundreds of thousands of genetic markers spread across the genome are now providing important new insights into possible dispersal routes. All populations in Island Southeast Asia harbor genomic ancestry that is closer to aboriginal Taiwanese (Formosans) than mainland Asian groups (Lipson et al. 2014). Although genome-scale data are still sparse – some populations are politically indisposed to sampling, while others that are critical for reconstructing Island Southeast Asian prehistory have simply not been studied – this evidence provides convincing statistical support that Taiwan played an instrumental role in Holocene dispersals across Island Southeast Asia.

Even more importantly, a team led by David Reich has obtained the first genomic markers from any ancient tropical Pacific remains. More than 144,000 genome-wide markers were screened on ancient DNA extracted from three ~3000-year-old skeletons at the Early Lapita site of Teouma in Vanuatu (Petchey et al. 2014; Skoglund et al. 2016). Crucially, these individuals carry no Papuan variants, but instead closely match part of the genetic profile of indigenous Taiwanese, such as the Ami and Atayal, as well as populations from the northern Philippines, such as the Kankanaey, that are plausibly descended from the first phase of the Austronesian expansion. Unlike all present-day Oceanians who carry at least 25% Papuan genomic markers, it seems that the Early Lapita settlers reached unoccupied parts of Remote Oceania with minimal admixture along the way, consistent with morphological evidence (Valentin et al. 2016). Thus in both cases of farming dispersals elucidated by ancient DNA – the Austronesian expansion into the Pacific and the spread of Neolithic farmers in Europe – the first migrants did not mix substantially with the people they encountered, and extensive admixture occurred only after a substantial time delay.

This mixing of populations, following the initial dispersal, produced many of the genetic patterns that characterize the region today. For instance, Lipson et al. (2014) identified a second Asian substratum that links western Indonesian populations with Austroasiatic-speaking groups on the Asian mainland. One possibility is that there was once a substantial Austroasiatic presence in Island Southeast Asia, since linguistically erased. Perhaps more likely, non-Austroasiatic-speaking groups may have moved into western Indonesia during the late Pleistocene, with Austroasiatic languages spreading across Mainland Southeast Asia at a later date. Alternately, Austronesian speakers may have interacted with groups in mainland Southeast Asia before expanding into western Indonesia. It follows that Asian movements into Island Southeast Asia during the Holocene may have been two pronged: a western route from the mainland to Sumatra, Java, and Borneo; and a second north-to-south route through Taiwan, the Philippines, and eastern Indonesia. These preliminary results again provide an exciting glimpse of what genome-scale data promise to reveal.

After groups with Asian ancestry spread through Island Southeast Asia during the Holocene, they interacted extensively with earlier Australo-Papuan communities (Friedlaender et al. 2008). At approximately the same time, there were movements westward from New Guinea, bringing the Trans-New Guinea Papuan languages to eastern Indonesia, as well as new agricultural crops such as bananas (Denham and Donohue 2009). Today, almost all Island Southeast Asian and Pacific individuals carry genomic markers of both ancestries. Western Indonesian populations reach nearly 100% Asian ancestry, which drops to zero in many highland New Guinea groups (Cox et al. 2010). Yet surprisingly this change from Asian to Papuan ancestry is not gradual, but instead appears as a sharp transition over a relatively small region of eastern Indonesia. The cause of this rapid shift in ancestry proportions remains unclear, but may be associated with social change following the Austronesian expansion and/or a switch in subsistence practices. Markers from across the genome date the start of this admixture process with considerable certainty to 4000 years ago (Xu et al. 2012). Additional contributions may possibly have reached Island Southeast Asia at this time from India (Pugach et al. 2013), with more definite contacts occurring later during the Historic era (Kusuma, Cox et al. 2016). These findings firmly place the admixed nature of Island Southeast Asian peoples within the suite of genetic, linguistic, and cultural changes that so radically altered this region during the mid- to late Holocene.

It is worth noting that movements during the Pleistocene and Holocene are also reflected in genetic systems beyond our own. As we move, so too do the species we carry along with us – willingly or not. Studies of genetic diversity in pigs highlight two movements into Island Southeast Asia: one from Taiwan to the Philippines and colonial-era Micronesia; and a second along the chain of islands linking Sumatra to Timor and then out via New Guinea to Remote Oceania (Larson et al. 2007). Similar stories are told by the movements of chickens (Thomson et al. 2014), rats (Matisoo-Smith and Robins 2004), the paper mulberry (Chang et al. 2015), and other commensal plants and animals. The human pathogen *Helicobacter pylori*, which lives (mostly asymptomatically) in the stomachs of many people, is represented by two main genetic types in the Indo-Pacific region: the first reflecting very early movements from Africa; the other a more recent dispersal from Asia (Falush et al. 2003) and thus potentially associated with the Austronesian expansion. Given the extent of microbial diversity – our bodies play host to more bacterial cells than human cells – our microbial companions may well provide a largely untapped resource for reconstructing prehistoric movements and contact.

While genetic data have traditionally aimed to inform the route and timing of human population movements, they are now also providing unexpected insight into social processes. Some social actions, especially marriage practices that in turn affect the number and distribution of offspring, leave long-term echoes in the genetic record. Proportions of Asian ancestry in eastern Indonesian populations (e.g., Flores, Sumba, and Timor) vary across regions of the genome (Kayser et al. 2008). Asian ancestry averages 89% on the mtDNA (which is only passed down the female line), 69% on the X chromosome (which spends two-thirds of its time in women and one-third in men), 59% on the autosomes (equal time in men and women), and 13% on the Y chromosome (only passed down the male line) (Lansing et al. 2011). This progression suggests that men and women experienced different social pressures. In particular, higher Asian ancestry in female-associated genomic markers hints that the Austronesian expansion was favorably biased towards Asian women.

This genetic pattern might be explained by the existence of matrilocal "house societies" during the Austronesian expansion (Lansing et al. 2011). As communities spread, women sometimes accepted husbands from neighboring indigenous communities. Under matrilocal residence, the children of such marriages would inherit their father's Papuan Y chromosome, their mother's Asian mtDNA, and presumably also spoke her Austronesian language, given that mothers play an especially influential role in passing language to their children.

Even if marriage with Papuan men was rare, there was ample time for a pronounced sex bias to develop. For instance, models in which only 2% of marriages occur with Papuan men are sufficient to predict the sex bias observed across all four genetic systems, while simultaneously accounting for the widespread replacement of indigenous tongues by Austronesian languages.

Of course, it is crucial to recall that we are viewing these genetic patterns some 4000 years after the events that initially triggered them. Consequently, they represent the outcome of that first expansion phase, together with the effects of processes that occurred over the next four millennia. Polynesians today have substantially more Asian ancestry (~80%) than individuals in eastern Indonesia (50–60%). The settlement of Remote Oceania was enacted by individuals who still mostly derived from expanding Asian groups, but subsequently moved into uninhabited territory where their genetic profile essentially became fixed. In contrast, higher Papuan ancestry in eastern Indonesia likely reflects additional admixture with Papuan groups long after the initial contact period. The Austronesian expansion, for all practical purposes, is a process that is still ongoing.

Other social behaviors can also affect genetic patterns. We can tell that male dominance – where men pass social status and hence fecundity to their sons – has historically been uncommon in Island Southeast Asia (Lansing et al. 2008). However, a fairly frequent switch from matrilocal residence, where husbands move to the village of their wives, to patrilocal residence, where brides move to the village of their husbands, has been influential (Jordan et al. 2009). In matrilocal societies, men move widely between communities, while women stay at home. The converse holds for patrilocal societies, which are common across Island Southeast Asia today. In predominantly patrilocal regions, mtDNA lineages tend to exhibit broader geographical distributions than Y chromosome lineages, consistent with the greater expected dispersal of women than men (Tumonggor et al. 2013). However, in the princedom of Wehali on Timor, where the ancestral state of matrilocal residence has been retained, the opposite genetic pattern is seen (Tumonggor et al. 2014).

To date, genetic data have largely been treated as a silent observer of human history. Indeed, most of the markers discussed above have no physical or physiological effect and provide nothing more than a record of the past. Nevertheless, our genetic inheritance influences both what we look like and how we act, and there is increasing interest in identifying how history has shaped our genes and how they in turn have shaped us. In the 1960s, James Neel proposed that prolonged voyaging might select for individuals whose gene variants allow them to survive cycles of feast and famine. He called this the "thrifty" genotype (Neel 1962). Although soon afterwards gene frequencies were found to vary between different populations in the expected manner (such as Gm blood group types between Austronesian- and non-Austronesian-speaking populations in Papua New Guinea; Giles et al. 1965), technologies at the time could not determine whether these differences were caused by selection or history. Genomic data now provide a framework to revisit this question. A variant of the *PPARGC1A* gene, found in 70% of Polynesians but absent in New Guinea, regulates fat usage, raises susceptibility to diabetes, and may help explain the different prevalence of type II diabetes in Polynesians and neighboring populations (Myles et al. 2007). Other selected gene variants target alternative mechanisms of energy metabolism and may explain the large body mass of Polynesians (Kimura et al. 2008). Fifty years after Neel raised his hypothesis, genetic data are beginning to more firmly support the thrifty genotype, highlighting characters that were once advantageous but now find themselves maladapted in the modern world.

Yet other genes hint at alternative pressure points for selection. The blond hair seen in many Melanesian children has been linked to a single DNA change (Kenny et al. 2012). More influentially, gene variants that confer resistance to malaria, such as the molecular basis of Southeast Asian ovalocytosis (SAO), are associated with Austronesian languages, but are not found in Taiwan and instead appear to have been selected within expanding Austronesian communities in the lower tropical latitudes (Wilder et al. 2009). Similarly, the very frequent Ge negativity genes that occur in coastal areas of New Guinea protect against malaria and have experienced strong selection pressure (Maier et al. 2003). Austronesian and Papuan groups were also infected with different strains of the hepatitis B virus (Locarnini et al. 2013; Paraskevis et al. 2013) and likely evolved different host resistance variants to counter them. Indeed, elevated Papuan ancestry may have been driven in part by selection. Children of mixed marriages likely gained the benefits of both worlds – receiving the cultural repertoires of both parents and a suite of genetic variants that may have favored survival during voyaging and protected against local diseases. Genetic data cannot speak to the social pressures that such children may or may not have faced, but from the perspective of biology, they may have had an evolutionary advantage.

Other gene variants (Pickrell et al. 2009; Sabeti et al. 2007), or changes in the way that existing gene variants are regulated (Martin et al. 2014), were almost certainly favored during the movements of Pacific peoples, and this promises to be a major focus of research in coming years. As well as being a goal in itself, reconstructing population history is increasingly perceived as necessary to infer which genes are under selection, as demographic processes (such as bottlenecks) can mimic patterns caused by selection. As amply shown above, human population genetics is increasingly illuminating facets of human prehistory that lie outside its traditional purview. Given the growth of this field over the past 20 years, there is every reason to believe that molecular anthropology will continue to influence and challenge our understanding of the prehistory of Island Southeast Asia for quite some time to come.

The modern Australo-Papuan populations of Island Southeast Asia still form a coherent biological subdivision in terms of their DNA and phenotypic features (Figure 4.1). Negrito populations (or more recently "negrito" in lower case for Endicott 2013) still inhabit parts of Peninsular Malaysia, the Philippines, and the Andaman Islands. Populations identified as Negrito no longer exist in Indonesia, where the interior equatorial rainforests of Sumatra and Borneo perhaps supported a lower late Paleolithic population density than the more open monsoonal forests of the Philippines. However, many of the peoples of eastern Indonesia, especially in eastern Nusa Tenggara and of course in Papua itself, are today predominately Australo-Papuan in genetic heritage.

The modern populations of Malaysian and Philippine Negritos, all traditionally hunters and gatherers (Figure 4.4), have universally switched their languages from extinct forebears in the past. The Semang switched to the Aslian subgroup of the major Austroasiatic language family in the Malaysian situation, and the Philippine Negritos into Austronesian languages (Reid 1994a, 1994b, 2013). Some Negrito populations have also moved into a lifestyle of shifting cultivation, for example the Pinatubo and Ayta of western Luzon (Fox 1953; Brosius 1990). The universality of language switching (except in the Andamans) testifies to some quite intense interaction with neighboring agriculturalist societies over a long period of time, but insufficient to threaten the phenotypic survival of the Negrito population as a whole. For instance, current autosomal genetic studies of Semang and Senoi (Aslian speakers) and Temuan (Austronesian Malayic speakers) in Peninsular Malaysia reveal only a very limited sharing of ancestry components with the numerically and socially dominant Malays (Hatin et al. 2014).

The question of short stature remains to be explained. There is no late Pleistocene or early Holocene skeletal evidence that would give any support to the idea that the peoples of the Indo-Malaysian region were ever *all* short-statured Negritos (Bulbeck 2013). That their ancestors were once of generalized Australo-Papuan genetic and morphological affinity is, however, a much more supportable proposition. The short stature may be a localized and independent development in each case. In a substantial series of papers published in the journal *Human Biology* in 2013 we find, indeed, that this is the preferred explanation.[21] There are also short populations in the rainforests of the New Guinea Highlands and northern Queensland who are not otherwise distinct in appearance from their indigenous Papuan and Australian neighbors, who are of taller stature.

Explanations for the short stature are numerous. Gajdusek (1970) and Howells (1973:173–174) suggested that it might have had great adaptive value in mountainous tropical forest environments with limited nutritional resources, where a high ratio of strength to body weight would have been advantageous. Selection for it might have occurred as indigenous hunter-gatherer populations in Peninsular

Malaysia and the Philippines were pushed into wet interior rainforests during the past 4000 years by Aslian- and Malayo-Polynesian-speaking agriculturalists clearing and settling the lowland river valleys and coastlines (as suggested by Reid 1987; Headland and Reid 1989:47). Cavalli-Sforza (1986) also pointed out that a small body size decreases internal body heat during exercise in a hot humid climate, typical inside closed rainforests, thus reducing sweating. Migliano et al. (2013) have recently suggested that cessation of growth early in life, especially if associated with very early reproduction by young mothers, would have allowed energy to be used in the immune response system to combat infectious disease in adult life. Could Neolithic farmers have brought in such infectious diseases, imposing them on indigenous hunter-gatherer and ancestral Negrito populations who harbored only low resistance? There are no direct data on this question, but the Neolithic incursion into Island Southeast Asia might have exacerbated any existing trends towards short stature amongst indigenous hunter-gatherers in forested low latitude Holocene climatic conditions.

At present, the majority of the peoples of the Philippines and western and central Indonesia share considerable physical homogeneity that reflects the heritage of Neolithic immigration by Asian phenotypic and genomic populations through Taiwan and the Philippines (Figure 4.2). This is still the case, despite 2000 years of sporadic Indian, Middle Eastern, Chinese, and European immigration. A greater degree of Australo-Papuan inheritance can be seen in some inland tribal peoples of the larger islands of Indonesia and the Philippines and, of course, amongst many of the peoples of the steeply clinal region of eastern Indonesia. The modern human genetic landscape of Island Southeast Asia still reflects the many millennia of admixture between long-present Australo-Papuan and more recent Asian populations. In fact, the Malayo-Polynesian migration clearly “ran out of steam” as it approached New Guinea with its Australo-Papuan indigenous peoples, some quite likely armed already with some form of food production since mid-Holocene times.

We return again to aspects of Neolithic and Early Metal Age population history in chapters 7 and 8, but one major message from the two invited perspectives above is that evolutionary processes in Island Southeast Asia have been complex and have involved a great deal of admixture between populations of different origin. There are no “pure races” hiding out there, and neither should we expect to find any. However the reality of admixture does not mean that significant migrations since the initial arrival of *Homo sapiens* have never occurred in Southeast Asia, or that the admixture situations we can recognize in the recent prehistoric past have always represented the standard human situation. My perspective is that modern and recent situations of admixture have little directly to do with the question of whether or not significant migrations occurred in the remoter past, even if the present must always reflect the past in some way. The very obvious fact that speakers of Austronesian languages today are very diverse in biological terms does not require rejection of the high likelihood of a significant migration of less admixed Austronesian speakers through Taiwan between 5000 and 3000 years ago.

Notes

1. The term "Australo-Papuan" is often rendered "Australo-Melanesian" in other publications, but I hesitate to use this term since the islands of Melanesia as well as parts of coastal New Guinea have witnessed lots of population admixture during the Holocene. The most unmixed Papuan populations in a genetic sense exist today in the interior highlands of New Guinea and all speak Papuan languages.
2. The term "phylogenetic" refers to genetic inheritance through time, with evolutionary modifications occurring in populations due to mutation, selection, and various types of genetic drift, especially small population founder effects in small and relatively isolated islands. The term "phenotypic" refers to physical expression – body features, hair form, skin pigmentation, and so forth. Hence, phenotype is a reflection of both inherited genotype and the impacts of environmental factors following conception.
3. For strong arguments to the effect that the oldest Levantine examples of *Homo sapiens*, at more than 90 kya, were ancestral to those groups who moved east into India and Southeast Asia, eventually Australia, see Schillaci 2008; Boivin et al. 2013; Reyes-Centeno et al. 2014. See also Kuhlwilm et al. 2016 for possible admixture around 100 kya between early Levantine modern humans and Neanderthals. For genetic evidence against early Levantine survival into modern populations see Fu et al. 2014.
4. Kaifu and Fujita 2012 discuss the modern human mandible fragment from Zhirendong in Guangxi but advise caution on the suggested date of 100 kya. The presence of a few human teeth in the Punung Cave fauna from Java (Storm and de Vos 2006) has led to suggestions that modern humans could have been present there as early as the last interglacial, but the context of these finds leaves much to be desired (Storm et al. 2013:362). The new announcement that human teeth found in Fuyan Cave in Hunan in China date to 80 kya (Liu et al. 2015) is therefore of interest. Three new genomics papers (Pagani et al. 2016; Mallick et al. 2016; Timmermann amd Friedrich 2016) suggest that early modern humans might indeed have left Africa between 120,000 and 70,000 years ago. This is still an area of great uncertainty.
5. The Niah Deep Skull has recently been compared to a Negrito or a modern Iban according to a new analysis of 18 cranial variables (Curnoe et al. 2016), and a very short femur found nearby suggests a stature of only 135 cm. Since the Deep Skull can hardly be a modern Iban (assuming that the uranium series date is correct), then it becomes possible that some aspects of Negrito stature and cranial shape were already becoming differentiated in the Borneo rainforest environment from within the basal *Homo sapiens* population of Island Southeast Asia by 37 kya.
6. See Demeter et al. 2012, 2015 for Tam Pa Ling. For the Niah Deep Skull see Brothwell 1960; Krigbaum and Datan 2005; Hunt and Barker 2014; Curnoe et al. 2016. For Wajak see Storm 1995; Storm et al. 2013. For Tabon see Macintosh 1978; Détroit et al. 2004; Corny et al. 2015.
7. Matsumura and Zuraina 1995 (for Gunung Runtuh); Hanihara et al. 2012; Matsumura and Oxenham 2014, 2015.
8. Thangaraj et al. 2005; Macaulay et al. 2005; Perry and Dominy 2009; Stoneking and Delfin 2010.
9. Sukajadi: Budhisampurno 1985; Bronson and White 1992:508. Lemdubu: Bulbeck 2005. Liangdao: Ko et al. 2014.
10. For Niah see von Koenigswald 1952. Statements exist to the effect that the Niah early Holocene squatting burials were from a "Mongoloid" population (Lloyd-Smith 2012:55), but no convincing statistical evidence is presented. However, see Krigbaum and Manser

2005 for a suggestion of Polynesian and Australian affinities. Bulbeck 2015 notes that the teeth of the Niah Neolithic burials differ in both size and shape from the Paleolthic sample.

11. Fox 1970; Kress 2004.
12. Gua Kimanis: Arifin 2004; Gua Tengkorak: Widianto and Handini 2003.
13. *Song* is Javanese for cave, equivalent to *gua* or *liang* in Malay and Bahasa Indonesia.
14. For Gunung Sewu (especially the caves of Song Keplek and Gua Braholo) see Simanjuntak 2002:109–133; Sémah et al. 2004; Widianto 2006; Détroit 2006; Noerwidi 2012, 2014. For Gua Lawa see Mijsberg 1932; Jacob 1967a; van Heekeren 1972: Plate 53.
15. Jacob 1967a, 1967b; Widianto 2006; Matsumura and Oxenham 2014; Bulbeck 2014, 2016.
16. E.g., van Stein Callenfels 1936; Mijsberg 1940; von Koenigswald 1952; Coon 1962; Jacob 1967a; Bellwood 1987, 1989, 1991, 1993, 1996, 1997; Brace et al. 1991.
17. The authors of the craniometric analysis express sincere gratitude to the following for permission to access comparative dental specimens: Wang Daw-Hwan (AST); Chris Stringer, Margaret Clegg, Robert Kruszynski (BMNH); Robert Foley, Jay Stock, Maggie Bellati (CAM); Nguyen Viet (CSPH); Rachanie Thosarat, Sahawat Naenna, Amphan Kijngam, Suphot Phommanodch (FAD); Nguyen Giang Hai, Nguyen Lan Cuong, Nguyen Kim Thuy (IAH); Le Chi Huong, Nguyen Tam (KHPM); Bui Phat Diem, Vuong Thu Hong (LAPM); Philippe Mennecier (MHO); Wilfredo Ronquillo (NMP); John de Vos (NNML); Tsai Hsi-Kue (NTW); Zhang Chi (PKU); Korakot Boonlop (SAC); Michael Pietrusewsky (UHW); Denise Donlon (USYD); Gen Suwa (UTK); Bernardo Arriaza, Vicki Cassman (UNLV); Charles Higham, Nancy Tayles (University of Otago); Bui Chi Hoang (Southern Institute of Social Sciences, Ho Chi Minh City) and Hsiao-chun Hung (Australian National University). The study was supported in part by JSPS KAKENHI Grants No. 20520666 and No. 23247040.
18. In this book these cultures are referred to as Para-Neolithic.
19. Tayles 1999; Pietrusewsky and Douglas 2002; Higham and Kijngam 2010, 2012a, 2012b.
20. Denisovans are named after Denisova Cave in Russian Siberia, where the remains of these archaic hominins were first identified (Krause et al. 2010). Denisovans share a common origin with Neanderthals but are as divergent from Neanderthals as from modern humans. Denisovans and Neanderthals appear to have lived in partly overlapping territories and genetic evidence suggests that Denisovans and modern humans also interacted and intermarried.
21. In *Human Biology* 85(1), 2013, see the papers by Stock, Bulbeck, Jinam, Tommaseo (for New Guinea), and McAllister (for Queensland). All agree on independent origins for short stature.

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Chapter 5
Late Paleolithic Archaeology in Island Southeast Asia

With the demise of *Homo erectus*, whenever that momentous event might have taken place, we enter the era of *Homo sapiens*, commencing with the deep ancestry in Island Southeast Asia of the modern Australo-Papuan indigenous populations of eastern Wallacea, Australia, and New Guinea. Commencing at least 50,000 years ago, many new ocean crossings by humans took place across the Wallace Line, taking settlers far beyond the range attained by *Homo erectus* and *Homo floresiensis*. Humans reached Australia and New Guinea for the first time. We now have our first evidence for the creation of art, the oldest human burials, and the oldest marine fishing – that is, if we can take the absences of such characteristics amongst archaic hominins as real, rather than just epiphenomena of time depth and oblivion. In this chapter we examine the archaeology relevant for discussing the arrival and expansion of *Homo sapiens* in Island Southeast Asia, from about 50 kya down to the beginning of the Neolithic (i.e., between about 3500 BCE in the island of Taiwan[1] and 1300 BCE in eastern Indonesia). When did the first arrival of modern humans occur in Island Southeast Asia and with what kind of cultural equipment?

Before going any further, and returning to matters discussed in more detail in Chapter 2, it is necessary to revisit the paleoenvironmental evidence from the archipelago, particularly that relating to the emergence (better perhaps *submergence*!) of modern Island Southeast Asia out of the relatively open, dry, and widely land-bridged landscapes of the last glacial maximum. The most dramatic environmental changes would undoubtedly have been caused, particularly over the shallow sea beds of the Sundaland region, by the dramatic rise in sea level, between approximately 16 and 8 kya, through about 90 vertical meters. The region thus passed from exposed low-lying continent to drowned archipelago in quite short order. Apart from drowning an unknown number of coastal archaeological sites, to the obvious detriment of modern archaeological studies, this postglacial sea level rise carved the former Sundaland continent into the many separate islands that exist today.

Economically, this change would have offered major benefits from the increased length (virtually a doubling – Dunn and Dunn 1977) and increased environmental

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variety of coastline, very useful for those people who subsisted from mangrove-rich strandlines and salt water or brackish lagoons. But there might also have been some less favorable changes for human population densities, not just through the immediate discomfort posed by a drowning landscape but also through the expansion of equatorial rainforest with the prevailing warmer and wetter interglacial climatic conditions. Terrestrial mammal biomasses decrease dramatically as one moves from optimal savannah conditions through parkland into rainforest. For instance, densities of wild banteng cattle range from about 10 to 15 animals per 100 hectares in Javan savannah grasslands, down to only one to two animals per 100 hectares in closed rainforests (Pfeffer 1974). Rainforest mammals also rarely herd together and are mostly arboreal, making them difficult to hunt without trapping technology or blowpipes. Furthermore, not all rainforests are rich in wild yams, other tubers, or edible fruits; many of the Punan hunter-gatherers of the rainforests of interior Borneo did not traditionally eat yams and relied instead on stands of wild sago (Sellato 1994), although wild yams were exploited by the Punan Basap in the rainforests of eastern Borneo (Arifin 2004).

Stephen Oppenheimer (1998) once suggested that mass emigration occurred off Sundaland because of this major postglacial sea level rise, leading to a huge and almost global diaspora of peoples. Superficially this might be an attractive idea, but archaeological and linguistic data suggest otherwise (Bellwood 2000). Indeed, it seems far more likely that the improving Holocene conditions for maritime and coastal food-gathering economies would have led to greater population densities along the rapidly lengthening coastlines, rather than to any major out-of-Sundaland emigration. There is absolutely no convincing pre-Neolithic evidence for such emigration, whether genetic, archaeological, or linguistic. But neither, it must be admitted, is there any good evidence for increasing Sundaland population densities in the early Holocene, and indeed there is a puzzling gap in early Holocene occupation in some Island Southeast Asian cave sites, such as the Niah Caves in Sarawak and other caves in Borneo. Important questions arise here that will need to be tackled by future archaeological research.

We now turn to the Paleolithic archaeology (roughly 50 to 4/3.5 kya) associated with *Homo sapiens* in Southeast Asia (Figure 5.1). There appear to be two major, but rather diffuse, industrial divisions in the late Paleolithic. The first consists of a series of pebble tool-based unifacial or bifacial industries, made on river or beach pebbles, which occur in caves and shell middens on the Southeast Asian mainland and in some regions of Sumatra. The second consists of a series of flake-based industries (albeit often made on river or beach pebble cores) found similarly in caves and shell middens in the islands of Southeast Asia (also including parts of Sumatra), as well as in Paleolithic Australia and New Guinea.

The differences here are of emphasis only – all industries have both core and flake tools in varying proportions. But the Mainland Southeast Asian sites, mostly in caves and rock shelters located near rivers with extensive pebble beds of igneous and metamorphic rock, tend to focus on distinctive pebble tools and to fall within the Paleolithic "Hoabinhian" technological category, named after the cave-rich Hoa Binh Province of northern Vietnam. Conversely, many of the Island Southeast Asian and Australian

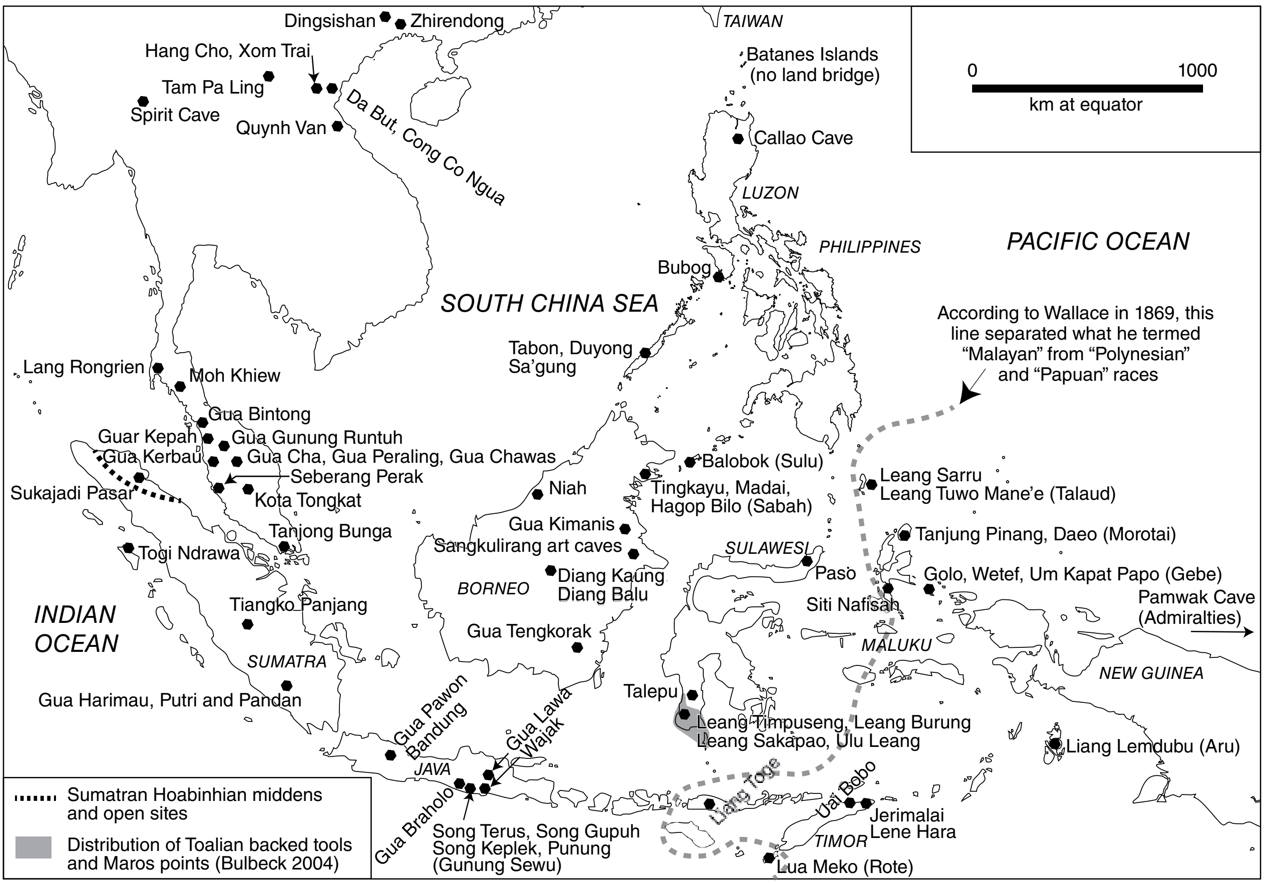

Figure 5.1 Late Pleistocene and early Holocene sites in Southeast Asia. Wallace's division between "Malayan" and "Polynesian/Papuan" people is also shown.[2]

sites are located near sources of finer-grained rock such as quartz, chert, jasper, agate, or obsidian, reflecting in part the volcanic nature of the terrain. Here we find a much greater emphasis on the production of small flake tools.

Mainland Southeast Asia, Peninsular Malaysia, and Sumatra: The Hoabinhian and Its Successors

We commence briefly with Mainland Southeast Asian developments since these do hold a certain significance for developments in the islands to the east. Southern China and Mainland Southeast Asia were occupied by the makers of Hoabinhian pebble tool industries after about 20 kya, preceded by closely related but more variable Late Pleistocene pebble and flake industries in Guangxi (Ji et al. 2015), northern Vietnam, southern Thailand, and Peninsular Malaysia (Anderson 1990; Rabett 2012). However, the Hoabinhian lithic industry is actually most significant for developments in Island Southeast Asia at the end rather than the beginning of its chronological trajectory. This is because of its terminal association with the very major population change discussed in Chapter 4.

The younger segment of the Hoabinhian was also associated in northern Vietnam and southern China with Para-Neolithic cultural developments contemporary with the rise of Neolithic food production in central China. As defined in Chapter 1, these Para-Neolithic assemblages in southern China and northern Vietnam had both edge-ground and polished axes and pottery, but so far lack any evidence for food production. They appear to have formed an Australo-Papuan hunter-gatherer "halo" to the immediate south of the core regions of agricultural development in the middle and lower Yangzi and Yellow river basins, prior to the southwards migration of the Asian Neolithic populations.

Hoabinhian into Para-Neolithic in Mainland Southeast Asia

The term *Hoabinhian* has been in use since the 1920s to refer to a postglacial stone tool industry characterized by distinctive pebble tools flaked over one or both surfaces (Figure 5.2). Hoabinhian sites are found in caves and rock shelters all over the mainland of Southeast Asia, westward to Burma and northward into the southern provinces of China. There are also a few riverine and coastal open-air shell middens in Guangxi, northern Vietnam, Peninsular Malaysia, and northern Sumatra. The greatest density of Hoabinhian occupation, particularly in southerly regions such as Thailand and Malaysia, occurred during the terminal Pleistocene and early Holocene, during a period of maximum sea level, temperature, and rainfall. Population densities during the LGM appear to have been lower, perhaps because the excavated caves and rock shelters would have been much further inland then than they are now. This was especially true for the Thai-Malaysian Peninsula, where a relative hiatus in radiocarbon-dated LGM occupation is well attested (Bulbeck 2003: Table 4.6; Bulbeck 2014). Another possibility is that many caves with human occupation are close to rivers and

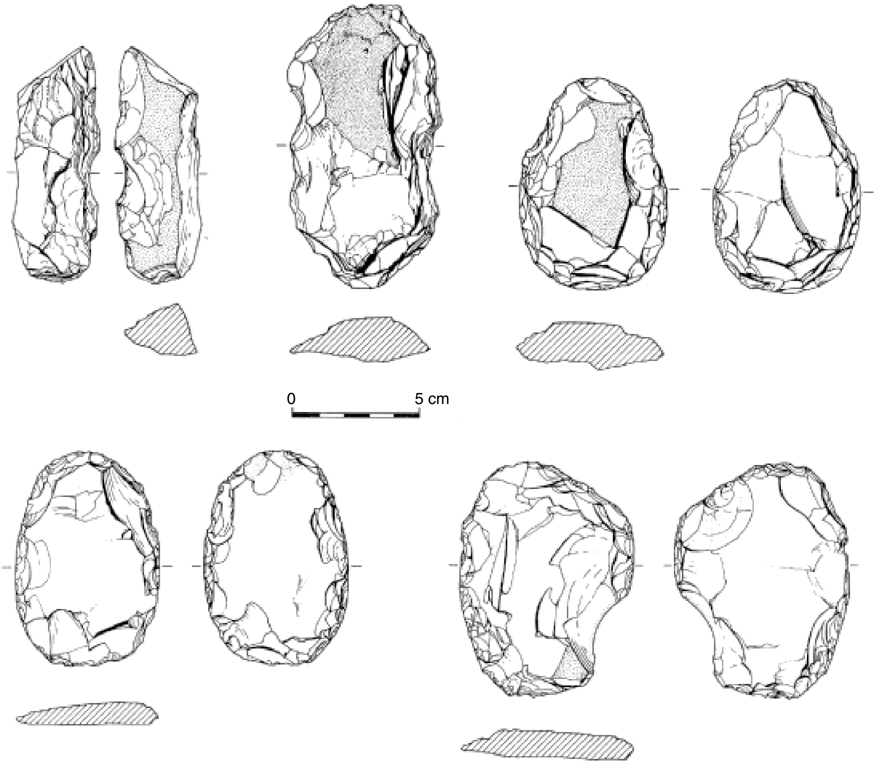

Figure 5.2 Bifacially flaked middle Holocene Hoabinhian pebble tools from Gua Cha, Kelantan, Peninsular Malaysia. Note that some have incipient waists, perhaps for hafting. Source: drawn by Joan Goodrum.

therefore have been subject to fluvial disturbance and scouring under the wetter Holocene climatic conditions, meaning that older occupations that might once have existed could have been washed out by river action.

The Hoabinhian industries of Vietnam, Thailand, and Peninsular Malaysia were described in some detail in my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007:158–169). Suffice it to say here that the classic Hoabinhian unifacial industry has been excavated most prolifically in the limestone massifs of northern Vietnam, where it is associated with flake tools, stone mortars and pounders of various sizes, bone points and spatulas, and flexed Australo-Papuan burials often dusted with red ochre (hematite). Some sites have edge-ground tools, claimed to date back to 18 kya in Xom Trai Cave in Hoa Binh Province (Ha Van Tan 1997). In the Thai-Malaysian Peninsula, most Hoabinhian industries had a dominance of bifacial pebble tools, rather like ovate hand-axes (Figure 5.2).

As stated, the antecedents and finer details of the mainland Hoabinhian are not of direct relevance for Island Southeast Asia, but what happened towards its termination represents a different story. Developing directly from the Hoabinhian in southern China and northern Vietnam there is a Para-Neolithic cultural assemblage, long

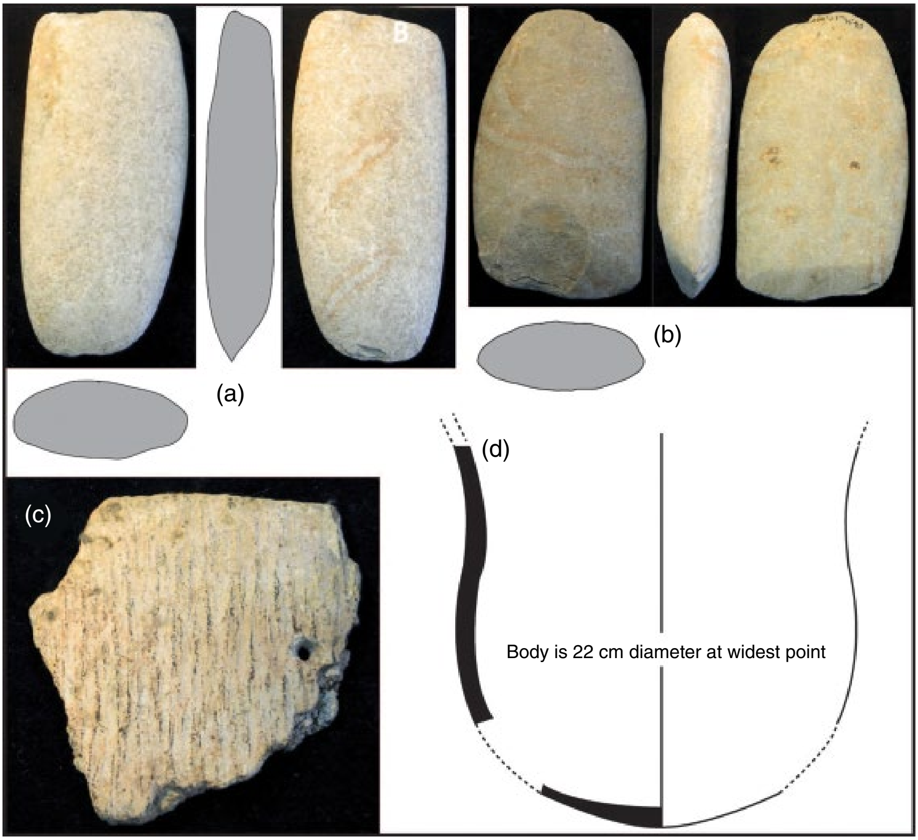

Figure 5.3 Middle Holocene (c. 4000–3500 BCE) polished pebble axes (a, b) and vine-impressed pottery (c, d) from Con Co Ngua, Thanh Hoa Province, northern Vietnam. (a) 15.5 cm long; (b) 19 cm long. Source: courtesy of Institute of Archaeology, Hanoi. Photos and drawing by the author.

known as the Bacsonian, named after the former Bac Son Province in northern Vietnam and characterized by the manufacture of coarse pottery and edge-ground or fully polished pebble axes. The Bacsonian is recognized separately from the Hoabinhian by Vietnamese archaeologists and dates to the early and middle Holocene. In northern Vietnam, Bacsonian assemblages also occur in large open-air shell middens such Da But and Con Co Ngua in Thanh Hoa Province, and these shell middens (as opposed to cave assemblages) are often specifically distinguished by the name Dabutian (Nguyen Viet 2005). Con Co Ngua has already been discussed in Chapter 4 owing to its huge cemetery of more than 250 Australo-Papuan hunter-gatherers buried in squatting and seated postures, without grave goods, dating between 4000 and 3500 BCE. The site has yielded many edge-ground and polished axes with lenticular cross-sections, together with sherds of tall round-based pottery vessels with coarsely tempered fabrics and outer surface decoration rolled vertically with a rod wrapped with a supple vine or rattan (Figure 5.3).

These northern Vietnam shell middens denote a very significant and innovative Para-Neolithic culture associated with Australo-Papuan populations in northern Mainland Southeast Asia, with close relatives in nearby Guangxi Province in southern China. They are associated with wild water buffalo, pig and deer hunting, fishing and shellfish collection, "folded" burial postures without grave goods, and perhaps a relatively sedentary settlement pattern. The Con Co Ngua burials are so numerous that one is forced to suggest either a long time period of placement, or a bringing in of the dead from a large hinterland into a sacred burial site, or perhaps a mixture of both explanations. The site certainly has no stratigraphic signs of occupation on the scale of a large permanent food-producing village. Indeed, there are no signs of food production in any Hoabinhian or Para-Neolithic contexts in Mainland Southeast Asia, despite their contemporaneity with the Yellow and Yangzi rivers Neolithic, and also despite long ago claims from Spirit Cave in northern Thailand (Gorman 1971), where remains of a number of edible fruits and legumes appeared in terminal Pleistocene Hoabinhian levels. However, none of these remains was from a definitely domesticated species (Yen 1977), and current opinions on the status of the Spirit Cave Hoabinhian economy regard it as part of a foraging lifestyle that might have continued in remote valleys in northern Thailand until well into the Neolithic.

The significance of the Para-Neolithic of southern China and northern Vietnam is that it represents an adoption of Neolithic artifact technology by indigenous Hoabinhian populations, without clear signs of food production, but with a likelihood that some developments in resource management were under way. One possibility would be a management of plants such as sago palms for starch, or the tubers of wild yams or aroids (taro), as discussed by Yang and colleagues for the Neolithic site of Xincun in Guangdong Province (Yang et al. 2013). But, whatever the full economy of the time, the fact remains that the Australo-Papuan populations behind the Para-Neolithic were not the instigators of Neolithic migration into Mainland or Island Southeast Asia, even if some degree of population admixture did take place during these events.

As well as southern China and northern Vietnam, Para-Neolithic sites might also once have existed far to the south in Peninsular Malaysia. It has been known since 1860 that large middens of marine/estuarine bivalves once occurred on old beach ridges in the mainland portion of the state of Pulau Pinang, and at Seberang Perak in Perak State (Adi 1983:53). The remains of three at Guar Kepah on the Muda estuary in Pulau Pinang were excavated long ago by van Stein Callenfels (1936; the sites were then called Guak Kepah). According to him, these middens were originally up to 5 m high and contained hearths, secondary burials dusted with red ochre (one jaw was classified as "Palae-Melanesian" by Mijsberg 1940), pig and estuarine fish bones, Hoabinhian tools, ground or hammer-dressed pebble axes with "necks," and small quantities of pottery (Bellwood 2007: Plate 19). No stratigraphic order for these items was clearly established and Tweedie (1953:69) thought that the pottery may have post-dated the Hoabinhian tools. A Singapore Masters thesis by Foo Shu Tieng (2010) on Guar Kepah materials stored in Singapore illustrates two thick sherds with apparent vertical ribbing similar to the Para-Neolithic sherd shown in Figure 5.3 from Con Co Ngua, but most of the other sherds illustrated by Foo look more recent. However, she also notes that pottery was found to the base of the Guar Kepah middens and mentions an unpublished C14 date of 5700±50 uncal. bp[3] on marine shell for one of them (Foo 2010:87).

Tweedie (1953: plates 9 and 10) also illustrated several edge-ground pebble axes, found apparently without pottery (at least, none was mentioned by him) at Tanjong Bunga in Johore, just opposite the island of Singapore. There have also been a few finds of edge-ground axes from old excavations at Gua Madu in Kelantan, and from Gua Baik (Gol Ba'it) and Gua Kerbau in Perak.[4] At the last two sites they were reported as occurring down to the undated bases of the cultural deposits. A few are recorded also from the Holocene Hoabinhian layers in Gua Peraling in Kelantan (Adi 2007).

These discoveries make it highly likely that edge-grinding and hammer-dressing of pebble axes occurred before the Neolithic in Peninsular Malaysia, as in northern Vietnam, but the issue of pottery in pre-Neolithic contexts in the Guar Kepah middens clearly needs further research. Nevertheless, the Guar Kepah axes and sherds are potentially important Para-Neolithic indicators, although there are so far no similar indications from Island Southeast Asia. Perhaps we can expect them to emerge one day, should the relevant sites survive, and the most likely place would be Sumatra, separated from the Southeast Asian mainland only by the Strait of Melaka.

The Hoabinhian of Sumatra

Within Indonesia, the best-known Hoabinhian sites lie inland from the northeastern coast of Sumatra along a stretch of about 130 km between Lhokseumawe and Medan.[5] Many are large shell middens up to 100 m in diameter and up to 10 m high, with interstratified lenses of shells, soil, and ash. Most appear to be located at approximately present sea level on an early Holocene strandline that now lies between 10 and 15 km inland, although some have their bases well below present sea level and most have been buried under the sediments deposited along this rapidly aggrading coast during the past few millennia. None have been systematically excavated or dated, although a radiocarbon date of around 7.5 kya has been reported from the lower half of the midden of Sukajadi Pasar III (McKinnon 1991:138).

Many archaeological collections have been made from the Sumatran middens over the years, as described by van Heekeren (1972). The majority of the tools appear to be unifacially flaked oval or elongated pebbles, often flaked all over one surface. Bifacial tools and edge-ground tools are not mentioned, so this industry thus gives the impression of being technologically simpler than that of the Para-Neolithic and Peninsular Malaysian sites, although the paucity of information urges caution. Grindstones, mortars, red ochre, and human burials (12 at Sukajadi) also occur in the middens, and faunal remains include elephant, rhinoceros, bear, deer, and presumably many smaller species. The bivalve shellfish illustrated by van Heekeren (1972: Plate 36) appear to belong to the same estuarine species that formed the Pulau Pinang middens. Pottery appears to be universally absent, at least in confirmed association with the Hoabinhian deposits.

Unfortunately, most of the Sumatran middens have now been quarried for their shells to make cement, leaving behind huge holes in the ground that fill with water (Bellwood 2007: Plate 20). This lowland alluvial region has no caves or shelters, but other Hoabinhian open sites have been reported in the same region from inland terraces and flat limestone rises to about 150 m above sea level. Recent research in the lower layers in Tögi Ndrawa Cave on Nias Island, to the west of Sumatra, and in Gua Putri, Gua Pandan, and Gua Harimau caves in southern Sumatra has yielded more assemblages of Hoabinhian unifacial pebble tools, in the Nias site in association with shell midden and in Gua Harimau in association with four folded Australo-Papuan burials. The occupation in Gua Harimau commenced by at least 15 kya.[6] So this archaeological complex probably once extended over much of Sumatra and adjacent islands, although the Hoabinhian tool types are also found with large numbers of flake tools.

Many other sites of late Pleistocene to early Holocene date in Sumatra lack Hoabinhian lithic elements, including the cave of Tianko Panjang in the Sumatran highlands near Lake Kerinci (Bronson and Asmar 1975), which has yielded unretouched obsidian flakes and chips dating from about 11 kya onwards. Some surface-collected but presumably Holocene obsidians from sites around Lake Kerinci and Jambi in south-central Sumatra (van der Hoop 1940) may also contain points and microliths. Glover and Presland (1985) reported backed crescents from some of these sites, although such forms were absent in the excavated Tianko Panjang Cave.

The Sumatran industries of Hoabinhian type, with their large hand-held unifacial or bifacial pebble tool "hand axes" or "Sumatraliths," to use two descriptive terms rather prevalent in the literature, do not occur in the strict sense in the Indo-Malaysian islands beyond Sumatra. Naturally, many Paleolithic industries of these islands have flake tools that were struck from large pebble cores, for instance in eastern Taiwan, parts of the Philippines and Borneo, and on Morotai Island in the northern Moluccas, indeed anywhere where rivers or beaches in concert with the local geology provided suitable raw materials. However, having undertaken field research in all of these regions over many decades, I can vouch for the fact that the Hoabinhian was something very distinctive in technological terms from anything found in the islands beyond Sumatra, as indeed were the Para-Neolithic lenticular- or oval-sectioned polished pebble axes that emerged from it in southern China, northern Vietnam, and the Malay Peninsula. Robert von Heine-Geldern (1932) would have been pleased to find that his celebrated *Walzenbeil* (the Para-Neolithic form of oval- or lenticular-sectioned axe or adze) was so firmly anchored at the base of the polished stone axe/adze sequence in Mainland Southeast Asia!

Beyond Sumatra – the Late Palaeolithic in the Islands of Southeast Asia

The skeletal evidence presented in Chapter 4 suggests an arrival of *Homo sapiens* in Island Southeast Asia at about 50 kya. Before this event (or events), archaic hominins presumably dominated the landscape in the personages of *Homo erectus* and *Homo floresiensis*. In Java and Flores, stone tools date back more than 1 million years, as we saw in Chapter 3, and Sulawesi now has stone tools dated to more than 100 kya from the site of Talepu in the Walanae Valley. Also in Java, new discoveries in the Gunung Sewu limestone caves are pushing backwards the younger end of the stone tool record to almost 300 kya and into the apparent time span of later *Homo erectus* (Simanjuntak et al. 2015), but the lithics do not occur here with human remains. We also have the 67 kya hominin metatarsal found without stone tools in Callao Cave on Luzon. For this, Mijares (2015) refers to butchering of deer and pig bones, perhaps using bamboo knives, so the hominin concerned was apparently a tool-user.

Despite the above, and whatever hominins were responsible for these assemblages, it is clear that in none of the above locations can archaeologists point to specific changes in stone tools and state "at this point we witness the arrival of *Homo sapiens*." Unlike the classic European succession, from the Mousterian (Middle Paleolithic) of the Neanderthals to the Aurignacian (Upper Paleolithic) of the oldest modern humans in that continent, the lithic industries in Island Southeast Asia reveal no reliable diagnostic features that can be used to separate the handiwork of *Homo erectus* or *Homo floresiensis* from that of modern humans. In this part of the world, stone tools are inconclusive about such matters and we must rely on genes, bones, and rock art for the answers.

The only way to date the arrival of modern humans, barring the finding of cranial remains, is to date the beginning of the archaeological record in those islands where archaic hominins can be inferred to have been non-existent. Thus, in Wallacea beyond Sulawesi and Flores the record of flaked stone tool production goes back to about 50–48 kya or less, as it does in the New Guinea and Australian regions beyond (Summerhayes et al. 2010; Allen and O'Connell 2014). The absence (so far!) of archaic hominin remains in Australia and New Guinea suggests that the first humans to reach these regions were indeed *Homo sapiens*. Similar dates still represent the lower limit for the island of Borneo, for instance in the Niah Caves, although here the hidden possibility of an earlier Sundaland occupation by *Homo erectus* must be acknowledged.

The stone industries of Island Southeast Asia beyond the Hoabinhian orbit belong to a widespread non-Hoabinhian series of flake industries that were also carried by the first populations to settle in Australia and New Guinea. These Paleolithic industries are characterized by varying proportions of simple pebble tools, cores of varying shapes (but never fully prismatic), and flakes with non-standardized shapes. Bone and shell tools also occur, as do shell middens and flexed or squatting burials of Australo-Papuan cranial affinity, and there is some extremely interesting rock art including hand stencils and animals in red pigment, especially in South Sulawesi and eastern Borneo. Attached to these Paleolithic industries we sometimes find sporadic and short-lived occurrences of bifacial lanceolate, backed flake/blade and microlithic technologies, each in a restricted region and over a different period of time, and especially in the Holocene. Edge-grinding but never full polishing of stone axes is sometimes present but so far there is no Para-Neolithic pottery, and indeed nothing in Island Southeast Asia that can be defined as Para-Neolithic in the sense used above for southern China and northern Vietnam. There are, however, some intriguing pre-Neolithic cut and ground shell tools in Wallacea, especially *Tridacna* or *Hippopus* shell adzes, one-piece fish-hooks, and small disc beads.

In organizing the following sections I have decided to commence with Borneo and Java since they are part of Sundaland, and so one can presume that modern humans reached them from the Asian mainland first. Then I move into Wallacea, commencing with the Philippines in the north, then Sulawesi, the Moluccas, and Timor.

The Niah Caves, Sarawak

The huge West Mouth of the Niah Caves in Sarawak contains the longest stratified record of human occupation in Island Southeast Asia. The caves themselves form a network of high and awe-inspiring passages, with an area of about 10.5 hectares, surrounded by swamp forest and located about 11 km inland within the Gunung Subis limestone massif near Niah in northern Sarawak. The system has many outlets, of which the West Mouth is the largest, being about 250 m across and 60 m high (Bellwood 2007: Plate 21). Most of the system is floored with continuously deposited wet guano, but an area high and dry at the northern end of the West Mouth was used sporadically for Paleolithic habitation from about 50 to 8.4 kya and then, after a long virtual abandonment, for burial by non-resident Neolithic and Metal Age populations from about 1500 BCE onwards. More recently, the caves have been frequented by the Penan hunter-gatherers who still hold rights today for the harvesting of edible birds' nests from the cave walls, as well as by Malay traders and recently Iban rice farmers who migrated in from western Sarawak in the nineteenth and early twentieth centuries. The Niah Caves were excavated on a fairly massive scale by Tom Harrisson between 1954 and 1967 (Harrisson 1970), then by Zuraina Majid (1982), and finally between 2000 and 2004 by a UK–Malaysian team led by Graeme Barker (Barker 2013; Barker et al. 2007; Barker et al. 2011).

The recent detailed publication of the results of the 2000–2004 excavations (Barker 2013) means that the Niah Caves now have perhaps the best archaeological record of Paleolithic cave-based affairs anywhere in Island Southeast Asia. Many stratigraphic problems caused by sloping or slumped layers have been sorted out by re-excavation, and the "Deep Skull" from the basal layers in the front of the cave now has a confirmed age of 37–36 kya (Hunt and Barker 2014). Pollen records suggest that this region of Borneo was impacted after 50 kya by alternating phases of cool dry montane forest and grassland with warmer phases when closed canopy lowland rainforest was present, although the rainforest never disappeared entirely from the region (Hunt et al. 2012). After many fluctuations in vegetation cover, postglacial lowland rainforest dominated by 11.5 kya, lasting until now.

The Niah Caves have by far the greatest number of radiocarbon dates for any single site complex in Island Southeast Asia (Higham et al. 2009; Barker 2013). When the available sample of 175 that relate directly to human activity in the whole series of excavated Niah Caves (eight caves in all) are plotted, they indicate clearly that human use of the caves fell into three quite sharply delineated time periods (Table 5.1). The first, between 47.5 and 37.5 kya, witnessed Late Paleolithic occupation associated with the Deep Skull, when people lived at the front of the cave above a stream that flowed 30 m below the cave mouth. Behind the living area was a channel drained by an inferred sink hole at the back of the cave and the Deep Skull, together with fragments of a tibia and

Table 5.1 Distribution of 175 calibrated C14 dates from the Niah Project (note that the time interval reduces at 5000 bp; bp = before present). These dates reflect human activity, and are mostly on wood/charcoal or human bone. Environmental samples are excluded. They are taken to be a proxy for the intensity of human activity in the Niah cave system (West Mouth, Gan Kira, Gua Samti, Kain Hitam, Lobang Hangus, Lobang Jeragan, Lobang Magala, Upiusing). Periods of relatively intensive usage of the cave system are shaded. Source: Barker (2013: Appendix, pp. 367–372).

Radiocarbon date cal. bp	Number of dates
50,000–47,500	3
47,500–45,000	9
45,000–42,500	4
42,500–40,000	7
40,000–37,500	4
37,500–35,000	3
35,000–32,500	1
32,500–30,000	2
30,000–27,500	0
27,500–25,000	2
25,000–22,500	5
22,500–20,000	6
20,000–17,500	8
17,500–15,000	5
15,000–12,500	5
12,500–10.000	8
10,000–7500	10
7500–5000	2
Note decreased time intervals below this point	
5000–4000	5
4000–3000	29
3000–2000	41
2000–1000	7
1000–0	9
Total	175

femur, was found in deposits associated with this channel. The Niah Paleolithic industry was mainly made on fairly coarse-grained rocks and comprises an unretouched array of flakes, pebbles, chunks, and chips, without regular core forms, and there is little systematic retouch. The inhabitants throughout the pre-Neolithic occupation hunted mainly wild pigs, but bones of an extinct giant pangolin are also found, together with other animals as discussed below by Philip Piper (and see Piper and Rabett 2014). Phytoliths indicate a presence of yams, aroids, and palms, no doubt exploited from the wild. A pollen signature of *Justicia*, a genus that propagates after fire, suggests a use of fire in all the humanly occupied layers in the cave. The excavators also claim that pits dug in the cave floor were used to leach toxins from nuts of the tree *Pangium edule*.[7]

Between 37.5 and 25 kya, occupation at Niah was reduced in intensity, but it was boosted anew by an episode of LGM to early Holocene occupation lasting from 25 kya until 8.7 kya (the end date for this phase given in the report), during which time the caves appear to have been used by people practicing a similar economy to those of the first phase. Because Niah was never far from the LGM coastline, it seems that the lowering of sea level had less impact here than in the deep interior Hoabinhian sites of the Malay Peninsula, where occupation during the LGM was virtually absent. Indeed, in the later part of this phase, after 16 kya, there are increasing numbers of bone tools, some with traces of resin for hafting. Several edge-ground axes have also been found, but there is no Para-Neolithic pottery. A trapping technology for nocturnal and/or arboreal animals has been suggested (see Philip Piper's contribution below), and use of the bow and arrow is an undemonstrated possibility, the blowpipe being less likely at this early date.

At the end of this phase, between 11.5 and 8.7 kya, the cave was used for the placement of about 25 burials in flexed or seated postures (Figure 4.3b), of indeterminate biological affinity due to loss of the facial regions (Lloyd-Smith 2012; and see the discussion by Matsumura et al. in Chapter 4). Some had skulls removed, one had a rhino radius under its skull, and some showed signs of burning. Actual cremation of at least seven individuals, followed by collection and burial of surviving bone fragments, some with percussion and cutting marks, is attested in contemporary layers in Ille Cave on northern Palawan, southwestern Philippines (Lewis et al. 2008), and it was practiced even before 30 kya in the burial of Mungo I in western New South Wales in Australia.

After the placement of these late Paleolithic burials the Niah Caves appear to have been little visited, and evidence for actual living in the caves virtually ceased after 8.7 kya. By 1500 BCE they were being used again, but only for human burial – we return to this phase in Chapter 7.

Eastern Sabah

Between 1980 and 1987, an excavation project carried out in eastern Sabah under the aegis of the Sabah Museum in Kota Kinabalu documented a number of cave and open sites with deposits extending back to about 30 kya (Bellwood 1988, 2007:175–185). Although these sites are near the coast now, the low sea level conditions of the LGM may have placed them up to 150 km inland at that time. The caves and shelters are found in the Madai and Baturong limestone massifs, both of which contain networks of solution tunnels like those in the Niah Caves, some emerging into the open air as dry habitable locations. Baturong is in turn surrounded by a large area of water-laid deposits that are presumed to have been laid down initially in the bed of an extinct lake formed by the damming of an old course of the Tingkayu River by a lava flow. In 1982, a radiocarbon determination of 28 kya was received from charcoal sealed beneath the end of this lava flow, where it outcrops into the side of the exit gorge. By 18 kya the dam had been breached by the river and the lake appears to have been partly or wholly drained.

The potential date for the lake is highly significant because a number of open sites lie directly on its shoreline; on locational grounds they may be considered as contemporary with the lake and thus dating between 28 and 18 kya. This, at least, was my chronological conclusion when the sites were excavated almost 30 years ago (Bellwood 1988), not an insignificant age given the refined nature of the associated biface industry. Unfortunately, however, the acid clay soil in which these sites lie has left no traces of bone or charcoal, so there are no direct dates for the archaeological layer itself.

If the Tingkayu stone industry (Figure 5.4) really does belong to the Tingkayu lake-full stage before 18 kya, it shows a remarkable level of skill for its time period in Southeast Asia. The tools are mostly made on a locally quarried tabular chert; the precise source is not known and may no longer exist, or it may be buried somewhere in the vicinity. Many of the tabular blanks were apparently being worked into large bifaces and into smaller and quite remarkable lanceolate points/knives when they

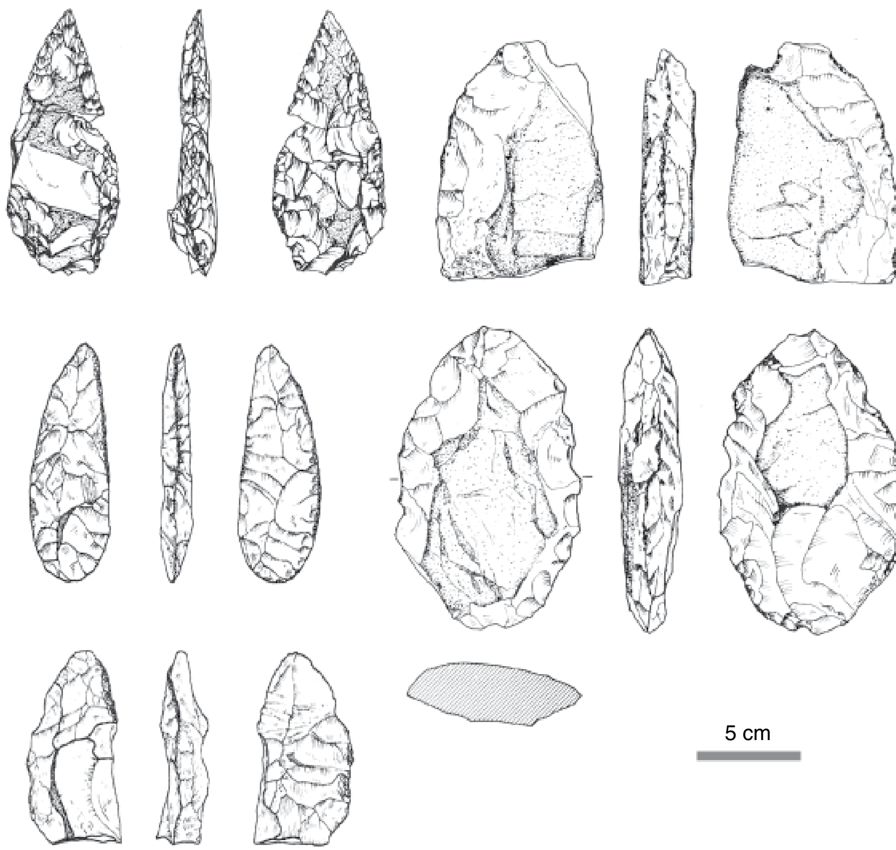

Figure 5.4 The Tingkayu chert biface industry. The specimen at top left was broken during manufacture, but flaking continued on the larger lower portion. The specimen at middle left is the only complete one, and was actually a surface find before the excavations began. All the other pieces appear to have been discarded unfinished, although the two large ones at right show use-wear.

were discarded, the latter apparently representing the main goal of the manufacturing process. The finished specimen (Figure 5.4, middle left) has very fine surface flaking, but broken segments and points with varying degrees of finish are also common. In fact, most of the bifaces in the site were found broken, occasionally in two parts that could be refitted; most complete specimens were presumably taken away for use elsewhere. In TIN 2 one excellent biface 14 cm long broke during manufacture and an artisan tried to continue flaking one of the parts into a smaller tool, but eventually gave up (Figure 5.4, top left). The use-wear that occurs on a few bifaces suggests utilization of mainly the side edges, despite the overall pointed shapes. Hence, they could have served combined functions as both projectile points and knives. The Tingkayu site has also yielded large numbers of bifacial reduction flakes, plus a steep-edged thumbnail scraper and a few flaked cores. Nevertheless, Tingkayu can be considered as a specialized biface production site, as little else occurs there.

At present, this bifacial industry is quite unique in the whole of Southeast Asia. At first, I considered that it was developed locally, perhaps to meet a specific need in this rather unusual lacustrine environment. Subsequently, I have also considered the possibility that they are in fact of Holocene date, rather like the Toalian microliths in Sulawesi (below). But the main problem is that such tools have never been found in any other Holocene sites or cave sequences in Island Southeast Asia, and there are nowadays many such sites to choose from. I am beginning again to suspect that they are not Holocene at all, or even totally indigenous, but truly pre-18 kya Pleistocene as I thought originally. My belief is bolstered slightly by the finding of somewhat cruder biface industries of a similar date or older at Lang Rongrien and Moh Khiew in southern Thailand (Anderson 1990; Pookajorn 1996), as well as in the succeeding Malay Peninsular Hoabinhian (Figure 5.2). In addition, biface industries are well recorded further north in Asia – in northern China, eastern Russia, and Japan – from about 30 kya onwards. After all, the First Americans migrating through Beringia around 16 kya used bifacial projectile points. But these occurrences are so distant that they can be no more than noted at the present time. All I can do is to recommend to future archaeologists that they try to find more of these enigmatic tools in datable contexts (see Saidin 2001).

We move now to the Sabah cave sequences. During the Lake Tingkayu period, the Baturong massif formed a towering limestone island, and the rock shelters along the base of its southern cliff were all drowned. After the lake drained away these shelters were occupied by late Paleolithic populations. In the shelter of Hagop Bilo, the basal and culturally sterile alluvial sediments were overlain by midden deposits in alluvial soil dating between 18 and 12 kya. These midden layers contain three species of lacustrine gastropods and marine shells are absent, not surprisingly given the distant location of the coast at that time. The stone tools of this period lack any Tingkayu bifaces and comprise a fairly typical Island Southeast Asian pebble tool and core / flake industry of chert with single- and multi-platform cores, utilized flakes and a few blade-like flakes, and flat-based and steep-edged scrapers. Glossy patches on the working edges of some tools suggest cutting of silica-rich vines or grasses. Another tool of interest from Hagop Bilo is a large bone spatula similar to those from Niah. Tablets of scratched red ochre were also recovered.

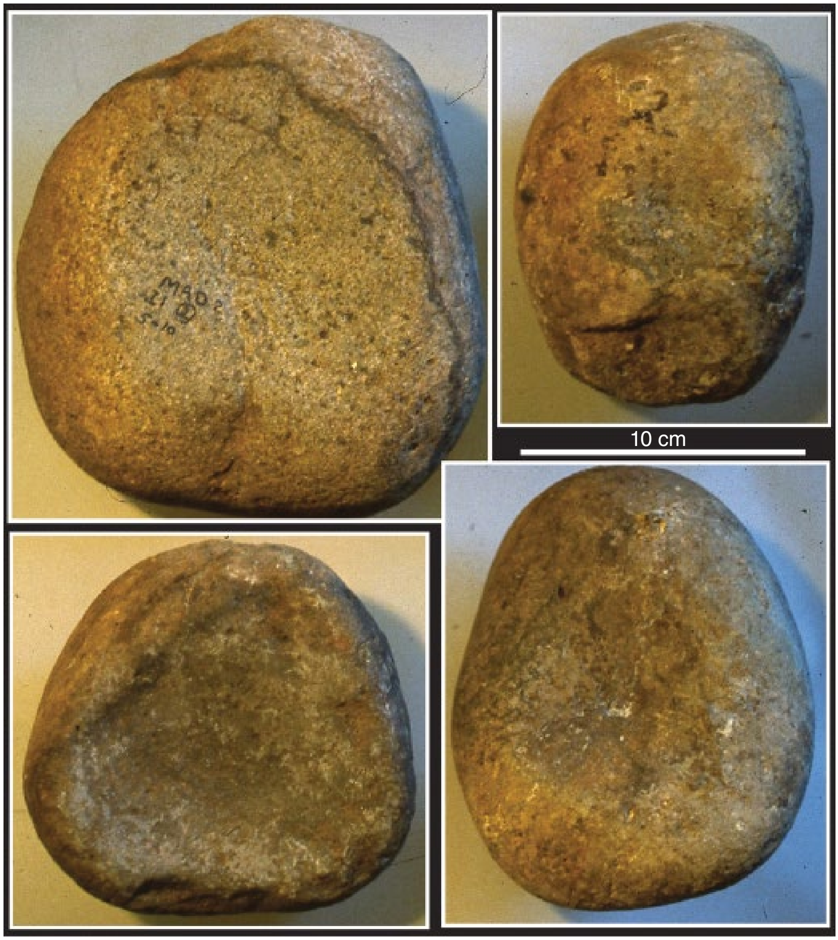

Figure 5.5 Hollowed mortars made on volcanic river boulders from Agop Sarapad.

Soon after 12 kya the Hagop Bilo shelter appears to have been abandoned, and occupation moved east into the Madai Caves, which by 10 kya were coming within easier reach of approaching coastal resources and were intensively inhabited by hunters during the early Holocene, between about 10 and 7 kya (see Harrisson 1971 for earlier excavations). The Agop Sarapad shell midden in the upper part of the Madai Caves has yielded thousands of stone tools of local river-pebble chert, an industry similar to that from Hagop Bilo. There is a heavy emphasis on pebble tools (not reduced all over one or both surfaces in Hoabinhian fashion and never edge-ground), large steep-edged tools, multi-platform and horse hoof (single-platform) cores, and utilized flakes, many of which have glossed edges.

A number of large pitted mortars made on large river boulders occur in Agop Sarapad, some coated with red ochre (Figure 5.5) and perhaps also used for food preparation, although no residue analysis has ever been undertaken on them. Hammer stones are also common, either for stone tool making or for food or ochre preparation on the mortars. The food remains in the midden include many shells of the estuarine mangrove shellfish genera *Batissa* (a bivalve) and *Anadara* (a gastropod), so the inhabitants were clearly now visiting the encroaching coastline fairly frequently. Most shells, however, are of the three same riverine shellfish species that were eaten earlier at Hagop Bilo. The animals hunted in the Madai Caves were also similar, with the addition of larger creatures such as the orangutan, cattle, tiger, and Sumatran rhinoceros; these appear to have been absent at Hagop Bilo, but the small sample size makes this uncertain (Harrison 1998).

After 7000 years ago the Madai Caves were abandoned, rather like the Niah Caves. High Holocene sea levels alone cannot be the answer since the Madai Caves are much too high above sea level, as indeed is Gunung Subis at Niah. For about 4000 years they remained unoccupied, until a new and totally different Neolithic cultural assemblage made its appearance. I return to this rather strange hiatus in the early and middle Holocene occupation of Borneo caves below.

Eastern and Central Kalimantan

Indonesian Kalimantan and Malaysian Borneo provide excellent regions about which to discuss the question of whether or not hunters and gatherers could ever have lived in interior equatorial rainforest without regular access to agricultural foodstuffs via trade. According to Headland (1987, for the Philippines), Rambo (1988) and Kuchikura (1993, both for Peninsular Malaysia), they could have done so only with difficulty owing to the restricted quantities of easily gatherable protein and carbohydrates. The debate was given worldwide significance by Bailey et a1. (1989), who suggested that interior wet rainforests in Africa, Asia, and South America were generally uninhabited before agriculture began.

However, the archaeological records for Niah and Sabah, as reviewed above, indicate that foragers did inhabit such regions (as accepted for Peninsular Malaysia by Bailey et al. 1989), albeit in small numbers with high mobility, and have done so over the past 50,000 years (Endicott and Bellwood 1991; Rabett 2012:209–210). Remarkably, hunter-gatherer human occupation was sometimes at its most intensive when rainforests were enjoying very warm and wet conditions, as in the terminal Pleistocene and early Holocene in the Thai-Malaysian Peninsula. Any idea that hunters and gatherers were completely unable to occupy deep interior rainforests has now definitely been superseded, although for much earlier Pleistocene occupation there always remains a possibility that what are now rainforests were once incorporated within glacial-era dry-season corridors, as discussed in chapters 2 and 3. Nevertheless, it is apparent that deep interior regions of equatorial rainforest were less densely settled than coastal regions, just as they are nowadays and as we can perhaps see if we compare coastal sites such as the Niah Caves with the deeply interior ones that I discuss next.

In 1998, one of my former PhD students, Karina Arifin, undertook research in the upper Birang Valley in the Berau region of east Kalimantan, an area now 60 km inland from the sea and perhaps more than 100 km inland during the LGM (Arifin 2004). Kimanis Cave was occupied from about 20 kya and contained a hunter-gatherer occupation dating to about 10 kya with flexed human burials, similar to the terminal Pleistocene burst of activity at Niah. The Kimanis lithics were all simple flakes and cores, with no signs of edge-grinding, and the inhabitants hunted and collected a similar range of resources to the inhabitants of the Niah Caves. Arifin suggested that her results contradicted the hypothesis that hunters and gatherers were unable to inhabit interior rainforest, a conclusion also reached by another of my former graduate students, Armand Mijares (2007), for inland regions of the Cagayan Valley in northern Luzon.

Human occupation of similar terminal Pleistocene age (c. 10 kya) is also well reported from a series of caves in the Sangkulirang limestone massifs that occur inland across the base of the Mangkalihat Peninsula, about 50–100 km inland and not far from the Berau region. The main interest here has been in the many negative hand stencils found on the walls of at least 38 separate caves, made by blowing red hematite powder against a hand pressed flat on the wall. Calcite sealing such a hand stencil in the cave of Gua Saleh (also called Ilas Kenceng) has been uranium series dated to over 9.9 kya (Plagnes et al. 2003), this being so far the oldest dated example of rock art in Borneo.[8]

The art in the Sangkulirang caves is most remarkable (Plate 2) and can be seen in its full photographic glory in the pages of the wonderful book by Luc-Henri Fage and Jean-Michel Chazine (2010). A whole series of high-level and fairly inaccessible caves (especially Gua Masri, Gua Saleh or Ilas Kenceng, Gua Tewet, Gua Tamrin, Gua Ham, Gua Jufri, Liang Karim, and Gua Harto) have red hematite decoration that includes paintings of bovines, deer, a possible tapir (extinct in Borneo), human stick figures with massive headdresses, and honeycombs hanging on tree branches. The hand stencils and animal motifs in particular are very similar to those in caves in South Sulawesi, to be discussed below, whence much older uranium series dates back to 40–35 kya for ochre cave paintings have recently been recorded. Many of the Sangkulirang hand stencils are decorated with dot and line motifs, perhaps representing decoration originally painted or scarified on the backs of living hands and fingers. Gua Masri has 181 hand stencils, Gua Tewet an ensemble of 159, and all of the Sangkulirang caves a total of 1938, with a total of 265 other paintings. There are also a few undated charcoal drawings, possibly of Neolithic origin, but this is uncertain. Indeed, the whole question of age is important, since it would be quite remarkable if the whole hematite group is actually Paleolithic, but so far only the Gua Saleh stencil has been dated directly. Evidence of actual human occupation comes from the lower-lying and more accessible rock shelters of Liang Jon, Liang Abu, and Pemalawan (Grenet et al. 2016), stated to have been occupied since 12 kya and containing late Paleolithic stone tools, and also perhaps Gua Keboboh, which has a tightly flexed burial of presumed preceramic date.

Another cave called Gua Tengkorak in the Meratus Mountains of southeastern Kalimantan has Paleolithic occupation of presumed early Holocene date, associated with a tightly flexed burial of Australo-Papuan cranial affinity (Widianto and Handini 2003). However, of rather more powerful significance for the rainforest debate will be the current ANU PhD research by Vida Kusmartono, another Indonesian archaeologist based in the Archaeological Research Centre (Balai Arkeologi) in Banjarmasin. She is currently analyzing materials recovered from the caves of Diang Kaung and Diang Balu, located 400 km inland as the crow flies (almost 1000 km by river) in the absolute heart of Borneo, within Punan territory in the upper reaches of the Kapuas basin. Her results (Kusmartono et al. in press) confirm a small human presence there between 14 and 9 kya, long prior to the Neolithic, although the most intensive occupation occurred within the past 3000 years, when Neolithic populations penetrated the inland river systems of Borneo and presumably began to send regular hunting expeditions into the deep interior of the island. Perhaps this Neolithic settlement relates to the origins of the hunting-gathering yet morphologically Asian (and Malayo-Polynesian-speaking) Punan populations of central Borneo (Figures 4.2c and 4.4). This population has long been a key one in the debate over the antiquity of hunting and gathering populations in Borneo ethnography. Are the Punan of local Paleolithic origin, or were their ancestors part of a food-producing society? I suspect the latter, and return to this topic in Chapter 8.

My own interpretation of all this Borneo material is that Pleistocene and early Holocene hunter-gatherers could indeed have occupied wet rainforests at any distance from the coastline, if and when they wished to. But the fact remains that coastal sites such as the Niah and Madai-Baturong caves have much more intensive and long-term occupation than the upper Kapuas sites. Presumably, to reach the latter from the coast by walking or rafting upstream would have taken a month or more, not easy in the upper reaches of fast-flowing rivers such as the Kapuas or Mahakam and their tributaries. As during the LGM in Peninsular Malaysia and Thailand, hunters could have penetrated hundreds of kilometers from the sea on rare occasions, but most likely only in small numbers and on a temporary basis.

There is one final Borneo matter, touched on above, that I think will entertain the imaginations of future researchers. This concerns the virtual absence of any traces of human occupation in so many regions – Niah, Sabah, Berau, upper Kapuas – between around 8000 and 3500 years ago; that is, during the first half of the Holocene and immediately prior to the start of the Neolithic. The suggestion that modern Island Southeast Asian populations owe their origins to becoming expelled from the Sundaland surface by rising postglacial sea levels (Oppenheimer 1998; Soares et al. 2016) does not work for Borneo because, were this to be true, we would expect to find continuous and growing archaeological signs of human activity in this time span, especially in caves above Holocene sea levels in the coastal regions of the island, such as those at Niah and Madai-Baturong. Instead, the record decreases, at least in Borneo.

However, this relative early Holocene absence is not so strongly attested in the remainder of Island Southeast Asia, for reasons that still remain unclear. Perhaps our understanding is skewed by sample bias in terms of site numbers, and it is also possible that deposits have been lost through erosion in some caves and rock shelters, a topic discussed in detail by O'Connor et al. (2017). However, why so many "lost" deposits should date to between 8000 and 3500 years ago is not so clear, unless it reflects an increased tendency by rivers to flow into or through such limestone cavities in the higher rainfall conditions of the early Holocene. This apparent hiatus still poses unsolved problems.

Java

The Gunung Sewu region along the central south coast of Java, southeast of Yogyakarta, contains large numbers of limestone caves (Simanjuntak et al. 2015; Simanjuntak and Asikin 2004). Some, with deposits extending down for more than 15 m, have been subjected to intensive archaeological excavation in recent years. Luminescence and uranium series dates from Song Terus and Song Gupuh suggest a presence of Paleolithic stone industries from almost 300 kya at the former site and 70 kya at the latter, hence presumably associated with *Homo erectus*.[9] There are few published details on the Pleistocene lithic assemblages from these sites and occupation seems nowhere to have been very dense, but the pace quickened, as in the Niah Caves, with more intensive post-LGM occupation during the terminal Pleistocene and early Holocene. Unlike Niah and Madai-Baturong, however, where occupation appears to have ceased during the middle Holocene, late Paleolithic occupation in this dry region of Java seems to have been continuous until the arrival of the Neolithic about 3500 years ago. Perhaps this reflected the easier hunting of large mammals in more open monsoonal forests.

The early Holocene contents of many of the Gunung Sewu Caves, especially Song Terus, Song Gupuh, Song Keplek, and Gua Braholo, include squatting or flexed burials with Australo-Papuan craniofacial affinities, marine shell scrapers, bone points or spatulas, grindstones, red ochre, retouched flake tools, and lots of charred canarium and candlenut shell. There was also a peculiar faunal concentration on monkeys amongst the animal bones, especially langurs (70% of the fauna at Song Keplek), sufficient to induce Thomas Ingicco (2010) to suggest that they were tamed and eaten, and also had their hands removed for ritual purposes. Indonesian and French archaeologists (Simanjuntak and Asikin 2004; Borel 2010) refer to this early Holocene period of intensive cave dwelling as the Keplek Phase, and suggest a commencement for it around 12 or 10 kya.

A similar material culture with a focus bone and antler points and spatulae, similar to those of the Keplek phase in the Gunung Sewu Caves, was excavated by van Stein Callenfels in 1931 in the cave of Gua Lawa, near the village of Sampung, located northeast of Gunung Sewu between the Lawu and Liman volcanoes (van Heekeren 1972:92). While this site is poorly understood and appears to have been disturbed (bronze was apparently found to the base of the sequence!), flexed burials, at least one under a stone slab and including one child with a shell necklace, were stratified with the bone tools. All were classified at the time as Australo-Papuan (or "Melanesoid" in the terminology of the day). The Gua Lawa and Keplek types of late Paleolithic industry, as well as traces of folded burial, are also known from old excavations in caves and rock shelters scattered all over the eastern end of Java, but unfortunately in contexts involving admixture with Neolithic assemblages (van Heekeren 1972).

The Gua Lawa fauna is of interest because it contains a number of large Javan mammal species that have since become extinct in this island, including the deer species *Cervus eldi*, elephant, clouded leopard, and wild water buffalo (Dammerman 1934). The Late Pleistocene layers in Wajak Cave also contained bones of locally extinct tapir and *serow* (a goat-like species, *Capricornis sumatrensis*). A range of related Holocene extirpations (tiger, two species of deer, and possibly the dog-like *Cuon alpinus* or dhole) has also been reported from Ille Cave on Palawan (an extension of Sundaland) in the southern Philippines (Storm 1992; Piper et al. 2011). Paleolithic Sundaland does not have an extinction horizon in the sense proposed for human arrival in formerly unoccupied sea-girt landmasses such as the Americas or Australia, and any local extinctions prior to the Holocene would presumably have been rectified by new immigrations as soon as land bridges reappeared in glacial periods. But many mammalian species somehow disappeared throughout the Philippines and Indonesia, including Sundaland, in the millennia between the LGM and the beginning of the historical era. We cannot really be sure whether they occurred because rising sea levels separated breeding populations, or because sinking sea levels allowed in new predators, or because forest cover thickened into the Holocene, or more likely, of course, because *Homo sapiens* played a major role in their local extirpation or complete extermination. This is partly because of chronological imprecision.[10]

My own view (and see the contribution by Philip Piper below) is that some of these extinctions, as we will see later for wallabies in the Moluccas, probably occurred without record in Neolithic times and later, as growing human populations increased their impact on landscapes through forest clearance and hunting pressure (to feed more people) and released feral pigs and dogs where they had no native competitors. Apart from rare situations such as the final extinction of stegodons on Flores (it is hard to imagine a reason for this without involving hominins), we have no absolutely secure evidence for a humanly caused extirpation or extinction during Paleolithic times of any species anywhere in Island Southeast Asia. During and since the Neolithic, of course, the pace has quickened disastrously.

Also in Java, a large number of open sites around the shores of an ancient lake on the Bandung Plateau have produced an undated but presumably preceramic industry of obsidian (Bandi 1951; van Heekeren 1972:133–137; Anggraeni 1976), although the existence of a definite blade element here seems to be rather uncertain. In the cave of Gua Pawon this industry is dated to the early Holocene, but available photographic illustrations (Yondri 2010) only show simple cores and flakes. However, many thousands of obsidian flakes were collected from the open sites around the Bandung lake before the Second World War (Bandi 1951) and a survey of the material is given by van Heekeren (1972:133–137). Available drawn illustrations for these sites by Bandi suggest a presence of backed flakes, round-based and unifacially retouched projectile points, and perhaps a few microliths (although van Heekeren claimed the latter were absent). Without detailed research it is impossible to state more. The Bandung tools certainly do not appear to be as well defined as the Toalian backed flakes and microliths to be described below, which so far remain unique to South Sulawesi within Island Southeast Asia.

The Philippines

In the Cagayan Valley of Luzon, the bones of the small Callao Cave hominin were not associated with any stone tools at all, but cut marks do occur on the associated pig and deer bones. As noted in Chapter 3, there is a likelihood that stone tools will soon be attributed to a pre-*sapiens* antiquity in open sites in the Cagayan Valley, as claimed originally in the 1970s, but details of the new findings are not yet available. The actual first dated appearance of chert and andesite flakes in the Cagayan Valley is still around 28 kya in Callao Cave (Mijares 2007). Further south, the long industrial sequence of chert core and flake tools dating back to at least 35 kya from Tabon Cave on Palawan has long been known (Fox 1970, 1978; Patole-Edoumba 2009), and Pawlik (2015) reports similar lithics in combination with a use-wear study from Ille Cave in northern Palawan. The modern human populations who created these assemblages should have entered the Philippines from Borneo, via Palawan or Sulu, given that archaeological investigations in the Batanes Islands between Luzon and Taiwan have so far revealed no traces of Paleolithic occupation there (Bellwood and Dizon 2013).[11] On present evidence, the Batanes appear to have been reached first by Neolithic settlers around 4000 years ago.

Other examples of terminal Pleistocene and Holocene flake industries in the Philippines come from several other Cagayan Valley caves (e.g., Thiel 1988–1989; Mijares 2007), from Duyong and Sa'gung caves on Palawan, and from Balobok shelter in the Sulu Archipelago (Ronquillo et al. 1993). These Philippine industries all fit well within the Island Southeast Asian pebble and flake tool repertoire. Most recently, excavations in the Bubog shelters on Ilin Island, just off southern Mindoro, have revealed a shellfish sequence that attests the postglacial rise in sea level and a switch from mangrove to coral reef shells at about 8 kya, as Ilin Island became surrounded by warm sea (Pawlik et al. 2014). The inhabitants of these shelters broke open the shells with pebble hammers and used a few flakes of obsidian from the same source, exact location unknown, as that used by the contemporary inhabitants of Ille Cave on Palawan (Neri et al. 2015). There is also a single edge-ground axe of flaked *Tridacna* shell from Bubog, directly dated to about 7 kya (Pawlik et al. 2015) and believed in this instance to have been made on fresh shell.

Sa'gung Cave on Palawan is especially relevant for questions of pre-Neolithic stone and shell technology because it yielded five preceramic flexed burials, three associated with edge-ground stone axes and three also with perforated crocodile teeth and many perforated circular bases of *Conus* shell (up to 32 per burial; Kress 2004). Kress only illustrates the edge-ground axes and crocodile teeth, not the shell items, but he does note the similarities with another single flexed burial in nearby Duyong Cave (Fox 1970), buried again with *Conus* discs but this time also with four large edge-ground *Tridacna* adzes and a Neolithic quadrangular-sectioned stone adze (Figure 5.6).

I discuss the Duyong burial in more detail in Chapter 7, but it is important to note here that these burial assemblages from Sa'gung and Duyong are all preceramic (or at least aceramic) and that the Duyong burial pit contained loose charcoal radiocarbon dated to about 5 kya. However, this date is of little value since the grave was dug into a preceramic shell midden below, the presumed source of the charcoal, which leads me to ask if it was dug during the Neolithic (hence the Neolithic stone adze) to inhume an indigenous hunter-gatherer of possible Australo-Papuan ancestry. The bones are insufficiently preserved to tell us, but perhaps it is necessary for archaeologists to

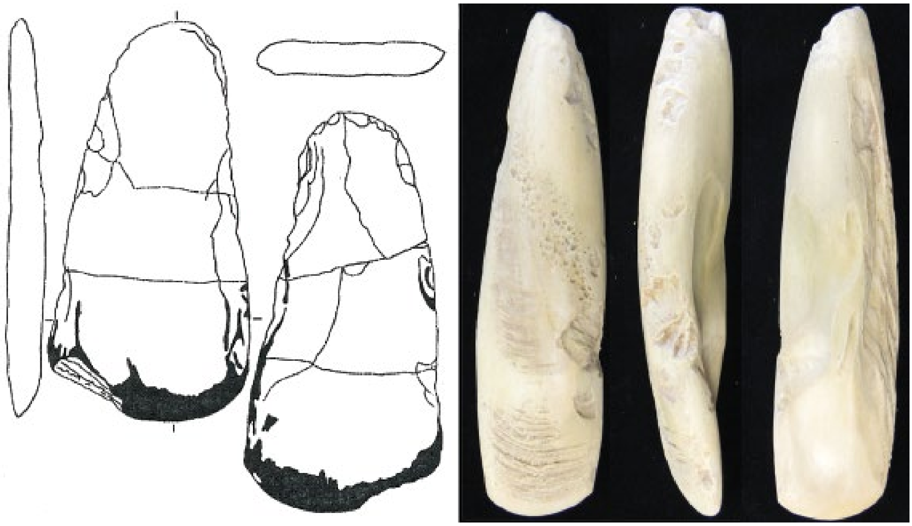

Figure 5.6 Edge-ground stone axe from Sa'gung Cave, 20.1 cm long (Kress 2004: Figure 6), and a ground *Tridacna gigas* shell axe from Duyong Cave, 24.5 cm long (see Fox 1970: Figure 19b). Similar edge-ground stone axes to those in Sa'gung Cave occur in the Niah Caves in Sarawak. Source: courtesy of University of the Philippines Press and National Museum, Manila.

reckon with the possibility that hunter-gatherer communities continued to survive independently, and especially to use caves, long after the arrival of land-taking agricultural populations. Hoover and Hudson (2015) provide a good demonstration of this for the Jomon to Yayoi transition in Kyushu, Japan.

Sulawesi and the Talaud Islands

In the southwestern arm of Sulawesi, the new discovery of stone tools more than 100,000 years old at Talepu in the Walanae Valley extends the time range for hominin occupation back considerably, as discussed in Chapter 3. This southwestern arm of the island has also produced one of the best Paleolithic sequences of late Pleistocene and Holocene cave art and stone tool working in the whole Indo-Malaysian Archipelago. Tower-like karst topography is particularly well developed in the Maros region north of Makassar, and many caves here have extensive panels of rock art applied with red ochre (van Heekeren 1972; Taçon et al. 2014). Fourteen examples of this art from seven different caves were dated in 2014 by uranium series analysis of the calcite skins, up to 10 mm thick, which seal them, similar to the dating method applied to the calcite-covered hand stencils in Gua Saleh in Borneo (above). The results suggested a range of dates for the selected examples between 40 and 18 kya, with a hand stencil and a babirusa at Leang Timpuseng being dated to 40 and 35 kya respectively (Aubert et al. 2014). These are so far the oldest dates for rock art anywhere in Southeast Asia. Other red ochre paintings in these caves depict the other native Sulawesi suid *Sus celebensis* and the endemic anoa (*Anoa depressicornis*). The analysts were careful to differentiate this early red ochre animal art, which is similar in date to that in caves in Upper Paleolithic Europe, from the much younger and probably Neolithic black charcoal drawings depicting humans, animals, and geometric designs. The similarities between the Maros cave art in red ochre and that in the Sangkulirang caves in eastern Borneo have already been remarked upon. We could be looking here at an impressive body of Paleolithic cave art similar in date to that in the Upper Paleolithic of western Europe (Plate 2).

The immediate environs of Sulawesi also reveal some of the oldest direct evidence for voyaging out of sight of land to settle very small islands, in this case to the Talaud Islands located 300 km to the northeast of the Minahasa Peninsula of Sulawesi. The cave of Leang Sarru, on Salebabu, contains a lower layer with chert flakes and marine shells dated to 35–32 kya (Tanudirjo 2005; Ono et al. 2015). This is significant because Salebabu could only have been reached by one or more sea crossings of at least 100 km from Mindanao or Sulawesi via the Sangihe Islands, even at periods of low Pleistocene sea level. This distance was perhaps greater than that necessary for the first humans to reach other Wallacean islands, and also Australia and New Guinea. It represents one of longest voyages of Paleolithic modern humans on record.

The southwestern peninsula of Sulawesi also contains several Paleolithic stone tool assemblages, of which that from Talepu has been mentioned. Others are reported from a later time span in the Maros shelters of Leang Burung 2 and Leang Sakapao 1 (Glover 1981; Bulbeck et al. 2004). These sites have produced an industry characterized by unretouched flakes and small multi-platform cores of chert from levels that appear to date back to around 35 kya, according to radiocarbon determinations on freshwater and marine shell. Some flakes from Leang Burung 2 have blade-like proportions (Bellwood 2007: Figure 6.11), and others have an edge gloss of a type found widely in this region, suggesting the cutting of stems or leaves (Sinha and Glover 1984), possibly for mats or baskets.

Also found in Leang Burung 2 are pieces of red ochre, but fish bones and marine shells are absent as the sea was presumably very far from the site at this time. The industry seems to continue (after a possible gap in both sites corresponding to the LGM) into the lower levels of the shelter of Ulu Leang 1 (Glover 1976; Presland 1980). These date from the early Holocene and now contain rare estuarine shells from the coast (as in the Holocene layers in Leang Sarru in Talaud), which had approached to within 35 km of Ulu Leang by 6000 years ago (Glover 1990). The site contains a distinctive range of steep-edged domed tools and horsehoof-shaped cores of white chert, similar to the Agop Sarapad industry of the same date from Sabah. Bone spatulae also appear in basal Ulu Leang 1; this bone tool tradition was elaborated in the succeeding Toalian industry, to be described below.

Elsewhere in Sulawesi there is not a great deal of well-stratified and dated late Paleolithic material, although cave and rock shelter excavations in various regions are currently being undertaken by Adam Brumm of Wollongong University and Sue O'Connor of the Australian National University. These excavations include further work at Leang Burung 2 and a new site called Leang Bulu Bettue. Detailed results are understood to be in press.

A final late Paleolithic Sulawesi site that deserves mention is the Paso shell midden (Bellwood 1976), which lies close to the shoreline of Lake Tondano, in the inland volcanic terrain of the northern Minahasa Peninsula. The midden is about 30 m in diameter, averages 1 m in depth, and consists of lenses of loose freshwater lacustrine shell interstratified with occupation layers. The latter contain a flake industry of local Tondano region vesicular obsidian, bone points, red ochre, and prolific faunal remains. There are no pebble tools; one would perhaps not expect them in a raw material of this type. A few chunks and flakes were retouched, often into steep-edged and high-backed forms like those of Agop Sarapad and basal Ulu Leang 1. The site is radiocarbon dated to about 6500 BCE.

The faunal remains from Paso and from the contemporary (pre-Toalian) layers at Ulu Leang 1 were identified by Clason (1986, 1987). Pigs (*Sus celebensis*) were most popular in both sites and occurred with babirusa, anoa, macaque monkeys, rodents, and the two Sulawesi species of marsupial tree-dwelling cuscus. The lake-edge situation of Paso allowed for considerable hunting of water birds (rails, coots, geese, ducks), pigeons, and doves, while the karst-riverine situation of Ulu Leang led to more frequent catches of tortoises, snakes, and occasional fish. In neither assemblage are there indications of animal domestication.

The Toalian of South Sulawesi – a Localized Revolution in Small Tool Technology

In parts of the Philippines, Sulawesi, Timor, and Java there are a number of assemblages dated to after 7000 years ago that demonstrate regionally varied emphases on the production of small blade-like flakes with elongated proportions (Figure 5.7). The possible Bandung Plateau examples from Java have already been discussed. In a previous book (Bellwood 1978:71), I quoted a definition by Morlan (1971:143) of true blades as "elongate parallel-sided flakes with parallel arrises or parallel-sided facets on their dorsal faces. Blades are struck (by indirect percussion) from prepared, polyhedral cores." The Upper Paleolithic industries of much of the Old World were focused on the production of blades of this type from prismatic cores and they were quite widespread in Japan and northeastern Asia by about 45–40 kya, as were much smaller "microblades" with the approach of LGM cold conditions. Forms of both industries were taken through Beringia into the Americas after 16 kya (Bellwood 2013).

In Island Southeast Asia, and also in Australia, true blades form only a small minority component of most assemblages in which they occur and true cylindrical or conical blade cores are generally very rare. Many of the "blades" found in these regions fall into a category of blade-like flakes, which are less symmetrical than true blades and which lack the two or more parallel dorsal ridges. Nevertheless, cores of a sub-prismatic shape do occur, and I suspect that both blades and blade-like flakes were produced intentionally in some sites, especially during the Holocene. Their distribution, however, is rather spotty, and may reflect availability of suitable raw materials.

The most remarkable late Paleolithic industry with very dominant backed blade-like flake and microlith components in Indonesia is the Toalian of South Sulawesi. This has remarkable parallels in turn with the backed blade-like flake and microlith industries that date to within the past 3500 years in the southern two-thirds of Australia. I do not

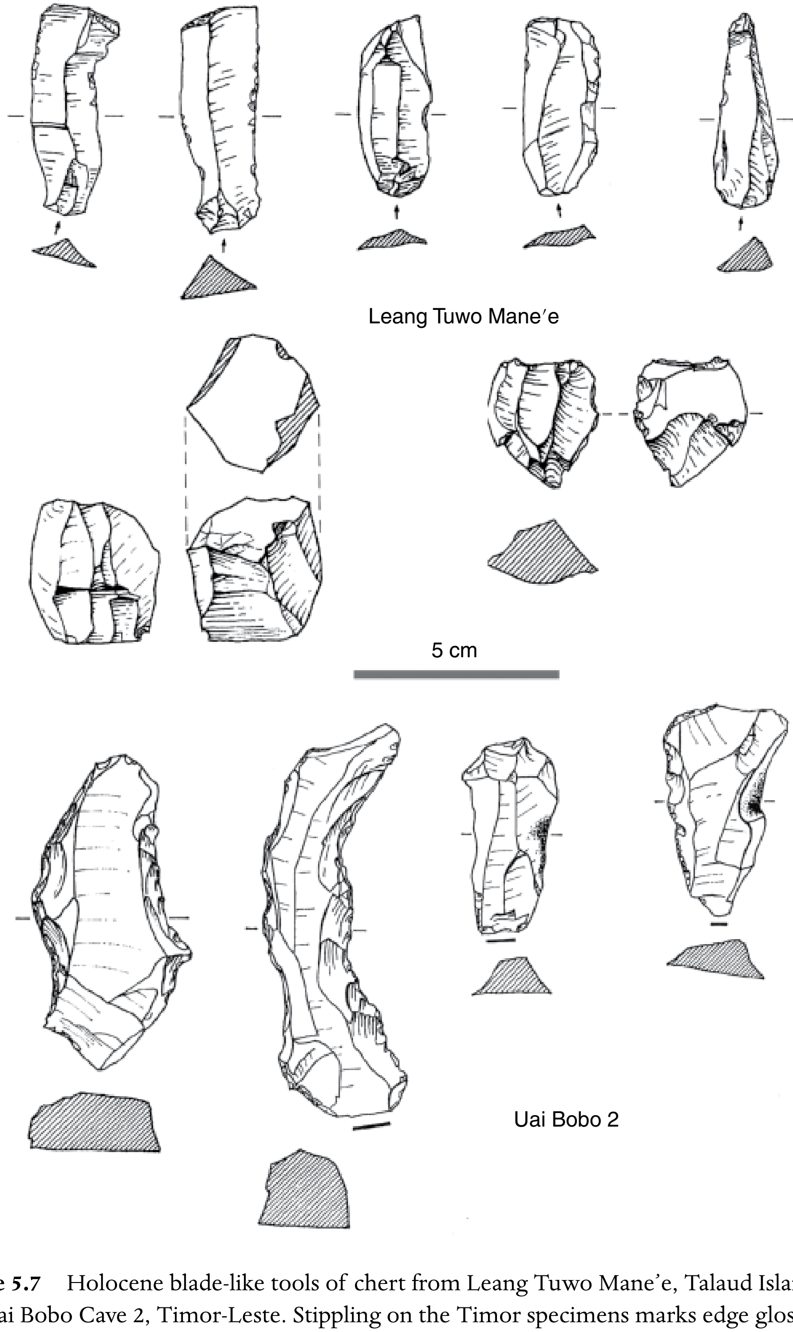

Figure 5.7 Holocene blade-like tools of chert from Leang Tuwo Mane'e, Talaud Islands, and Uai Bobo Cave 2, Timor-Leste. Stippling on the Timor specimens marks edge gloss. Source: Uai Bobo courtesy Ian Glover.

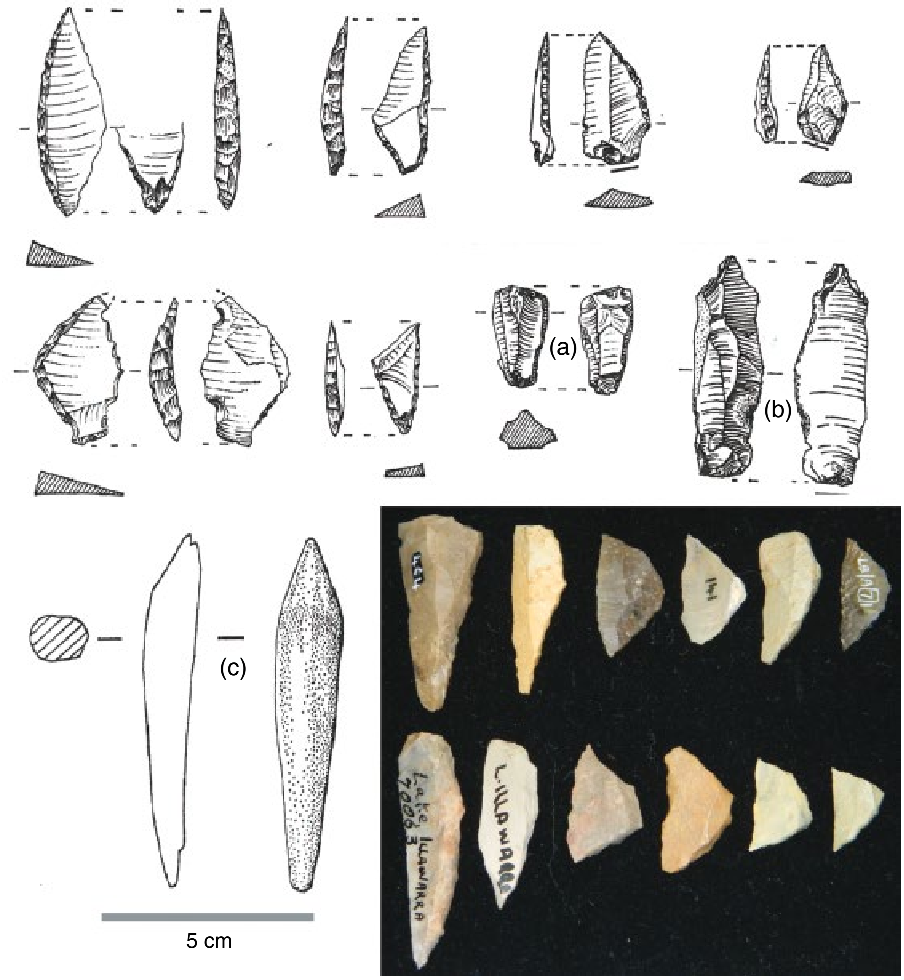

Figure 5.8 Drawing – Toalian tools from Ulu Leang: six backed blade-like flakes and geometric microliths, a bipolar microcore (a), a blade with edge gloss (b), and a bone point (c). One scale fits all. Source: Courtesy of Ian Glover. Photo – backed blade-like flakes and geometric microliths from Leang Burung shelter 1 (top) and Lake Illawarra, New South Wales (bottom).

intend to look into those Australian parallels here, but they are discussed in some detail in my recent *First Migrants* (Bellwood 2013:113–121). I believe them to be significant, and to be involved with the arrival of the dingo in Australia, together with a different stone tool focus and a spread of new languages.

The Toalian was discovered in 1902 by Swiss naturalists Fritz and Paul Sarasin when they were investigating caves inland from Makassar. They named the industry after the local Toala population, whom the Sarasins believed, rightly or wrongly, to be the direct descendants of the makers (van Heekeren 1972:109). Today, we know that the Toalian commenced about 7 kya with an array of small backed blade-like flakes and geometric microliths (Figure 5.8), of types seemingly unique in Southeast Asia but rather typical of Mesolithic assemblages in western Eurasia, perhaps quite coincidentally. Toalian assemblages occur in caves and shelters scattered across the southern two-thirds of the southwestern peninsula of Sulawesi and in open sites down the western side of the peninsula; excavations in caves elsewhere on the island have failed to find any trace of them (Bulbeck et al. 2000; Bulbeck 2004). It was thus highly localized, for reasons at present rather obscure.

During the 1930s and 1940s some rudimentary typological successions were established for the Toalian by van Stein Callenfels (1938) and van Heekeren (1949). In van Heekeren's last major summary (1972), by which time about 20 sites had been excavated, he felt justified in supporting a three-phase sequence based on research by Callenfels in the cave of Panganreang Tudea, near the southern tip of South Sulawesi. This commenced with "blades" and flakes at the base, followed by a second phase with "beautifully struck blades and bladelets with, or, more often, without marginal retouches, arrow-heads with rounded base and numerous geometric microliths." The third phase above contained "barbed stone arrow-heads, many of them winged at the base, Muduk bone points,[12] shell scrapers and some potsherds" (van Heekeren 1972:113–114).

The essence of this sequence is that backed flake/blades and microliths preceded in appearance the serrated and hollow-based stone points known as "Maros points," the latter placed by van Heekeren in his third and last phase above. This aspect of the sequence has stood the test of time; the backed forms and microliths appeared around 7000 years ago or after. The Maros points overlapped with the Neolithic, or possibly even belonged to it, as I will discuss in Chapter 8. David Bulbeck (2004) notes that backed forms and Maros points occur separately in open sites, but are often found together in caves where the disturbance factor may have been higher.

Two key Toalian rock shelter sites, Leang Burung 1 and Ulu Leang 1, are located in the Maros limestone region north of Makassar.[13] Ulu Leang 1 has the most complete sequence. I have already discussed the basal industry of flakes and steep-edged tools in this site, dated to the early Holocene. The Toalian tool types appeared in higher levels dated before 6000 years ago and within a continuing industry of flake tools and bone points. The most important new Toalian tool type was the small flake or blade-like flake with straight or oblique blunting down one side and often around the butt, similar to a "backed blade" in Australian terminology (Figure 5.8). Some of these backed forms have distinctly crescentic or trapezoidal shapes and are commonly referred to as geometric microliths. Other artifacts that occur throughout the Ulu Leang sequence include glossed flakes (Di Lello 2002), small bipolar cores, bone points, and bivalve shell scrapers (Willems 1939).

The Maros points presumably served as arrowheads or spearheads and became common after pottery had already made its appearance in the Toalian caves (as at Ulu Leang 1). From a regional perspective the possibility thus arises that the Maros points were used by indigenous hunters living in some kind of exchange relationship with adjacent Austronesian-speaking cultivators, similar to the ethnographic relationships between Agta hunters and adjacent Luzon farmers in the Philippines (Peterson 1978). It is not clear whether the Maros points represent indigenous innovation from a Toalian matrix or whether they represent an imported technology. If the latter, the source is unknown.

The economic evidence from the Toalian sites includes a range of hunted and gathered resources. Riverine shellfish are very common and Glover (1977b:52) found remains of wild seeds and nuts at Ulu Leang, although carbonized rice grains appeared in the site only after 500 CE (Glover 1985). The faunas from Toalian sites (Hooijer 1950) include two species of cuscus (Phalangeridae), macaque monkeys, civets, anoa, *Sus celebensis*, and babirusa. Domesticated animals were not present prior to the Neolithic and a recent suggestion by Fillios and Taçon (2016) that the dingo was introduced into Australia by Toalians prior to the arrival of Austronesian-speaking populations in Sulawesi is not supported by the Sulawesi archaeological record.

The Northern Moluccas

Research between 1991 and 1996 on the islands of Halmahera, Morotai, and Gebe in the northern Moluccas has helped to fill in some of the gaps that currently exist for late Pleistocene human activity between Sulawesi and New Guinea (Bellwood et at. 1998; Szabó et al. 2007; Bellwood forthcoming). On Gebe, a sequence of human activity extending back to 35 kya has been recovered from the adjacent coastal sites of Golo Cave and Wetef rock shelter (for locations see Figure 5.1). The lowest levels of both caves contain stone flakes and burnt marine shells, and Golo has worked *Turbo* opercula (Szabó et al. 2007), but unfortunately no animal bones occur in the lower layers in either site. Around 12–10 kya, according to adjacent dates from marine food shells, at least two stone settings of coral blocks were placed on the floor of Golo Cave, the larger one semicircular (Figure 5.9) and the smaller

Figure 5.9 Semicircular setting of coral blocks in Golo Cave, inner diameter 80 cm, dated c. 12–10 kya.

circular, both with one or more elongated and smooth-surfaced beach pebbles placed directly under or next to the stones. Three other more fragmentary coral stone settings with some stones removed also occurred, in two cases again with smooth pebbles, and this recurrent association of elongated beach pebbles of volcanic rock with circular coral block arrangements on the cave floor is most interesting. Such pebbles are not common in the site as a whole and the association cannot be coincidental. Since no bone survived at this level we cannot know if these structures were associated with human burial or some other kind of mortuary commemoration, but this does seem likely.

Animal bones made their first appearance in the upper layers in both Gebe caves at around 7000 years ago, predominantly of a wallaby (*Dorcopsis* sp.) and cuscus (*Phalanger alexandrae*), together with occasional bones of fish and reptiles. Both marsupial species were present at the same time in another Gebe cave called Um Kapat Papo, and the wallaby also occurred (with a bandicoot) in mid-Holocene layers in Gua Siti Nafisah on Halmahera. Both the wallaby and bandicoot are extinct in the northern Moluccas now and only the nocturnal cuscuses survive, but a direct date of about 750 years ago on a wallaby bone from Wetef suggests that their demise could have been very recent, albeit historically unrecorded.

When the Moluccan sites were first reported, the wallaby was thought from its tooth measurements to have been introduced to Gebe from Misool Island off western New Guinea by human agency (Flannery et al. 1998), the Siti Nafisah bandicoot being uncertain since so few remains were found. Human translocation still remains possible for the wallaby, but observation of the increasing degree of bone decay with depth in Golo and Wetef raises the contrary possibility that the absence of all bones in the lower layers of these caves could reflect geochemical factors, as discussed further below by Philip Piper. Siti Nafisah and Um Kapat Papo only contain Holocene not Pleistocene occupation, so this possibility cannot be checked in these two sites. The cuscus has been suggested to be an endemic Gebe species (Flannery and Boeadi 1995). Unlike the wallaby it also occurs, both today and in the Holocene archaeological record, on the island of Morotai, off the northern tip of Halmahera, although like the wallaby there is no evidence for its presence anywhere in the Pleistocene. However, wallabies can swim. In 1999, an Australian wallaby was spotted "dog-paddling" 7 km offshore from Queensland (*Canberra Times* 14 October 1999), and since sea gaps between Halmahera/Gebe and the islands just off western New Guinea do not extend beyond 30 km today, and were less during the LGM, natural dispersal of these animals by swimming must be considered a possibility.

The precise history of these marsupials in the northern Moluccas thus remains a little obscure, and human translocation cannot be taken for granted. However, as noted by Tim Flannery (Flannery et al. 1998), the Gebe wallaby was closest in its dental measurements to another living wallaby species on Misool, so whatever the origin of the Moluccan species it is likely that speciation on Gebe and Halmahera never had time to proceed very far. This naturally implies a relatively recent arrival, whether or not by human translocation.

In Golo and Wetef, these Holocene marsupial bones are found in association with many stone flakes and cores of volcanic rock and chert (Szabó et al. 2007), volcanic cooking stones, and many small wallaby bone points (Pasveer and Bellwood 2004). Surprisingly, contemporary layers in Gua Siti Nafisah produced no flaked stone tools at all, despite their presence in all other pre-Neolithic contexts in the northern Moluccas, only manuports (mainly cooking stones) and a few bone points. It is puzzling that a site visited for at least three millennia should lack any flaked lithic technology and the circumstance is a little hard to explain. Stone tools do occur, however, in two caves adjacent to each other on the southern coast of Morotai – Daeo 2 and Tanjung Pinang – that have a sequence extending back to 14,000 years ago. But here there are no wallabies or bandicoots, indeed absolutely no ground-dwelling marsupials at all, only cuscuses, fish (interestingly confined to the Holocene layers when the sea was close), and rodents. The Morotai sites have a fairly amorphous stone industry made on flaked beach pebbles, again with volcanic cooking stones and bone points.

These Moluccan site complexes give much food for thought, partly because they are so variable in their marsupial records and their stone industries. There is no good evidence for stone tool transport between islands, which gives an impression of small, isolated groups of hunter-gatherers, perhaps with economies based on sago and canarium nut exploitation, as well as coastal fishing and mammal hunting. Although the northern Moluccan islands are to some degree intervisible, we must beware of assuming that visibility need always mean frequent accessibility. Some of the smallest islands like Gebe might only have been intermittently occupied, especially prior to the Neolithic, when people became better equipped for inter-island travel on a regular basis. It was also at about 14 kya that we have the first evidence of a human presence on Morotai, much later than Gebe, although sampling factors might be in part responsible for this.

However, there are hints of external contacts reaching Gebe Island during the middle Holocene in the form of two ground shell adzes made from the ventral hinge regions of large *Tridacna* shells (*T. maxima* or *T. gigas*) from Golo Cave, and one from another Gebe site called Buwawansi. These are paralleled closely by *Tridacna* adzes with similar hollow backs in contemporary layers in Pamwak Cave in the Admiralty Islands (Figure 5.10), located to the north of Papua New Guinea and about 2000 km due east of Gebe (Fredericksen et at. 1993). Alfred Pawlik and colleagues (2015) have recently published information on other ground shell adzes of a similar Holocene and pre-Neolithic date from the Philippines and eastern Indonesia, although the Golo–Pamwak parallel appears to be the closest at present in terms of actual shape, especially in the choice of shell used and the emphasis on the hollow back. The Golo and Pamwak specimens are indeed almost identical.

The Golo adzes were found in a level dated between 12 and 9 kya based on C14 dates from nearby food shells, together with three smaller *Hippopus* shell adzes, and indeed I gave them this date in the second edition of my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007: Plate 25). But since the majority of these tools were

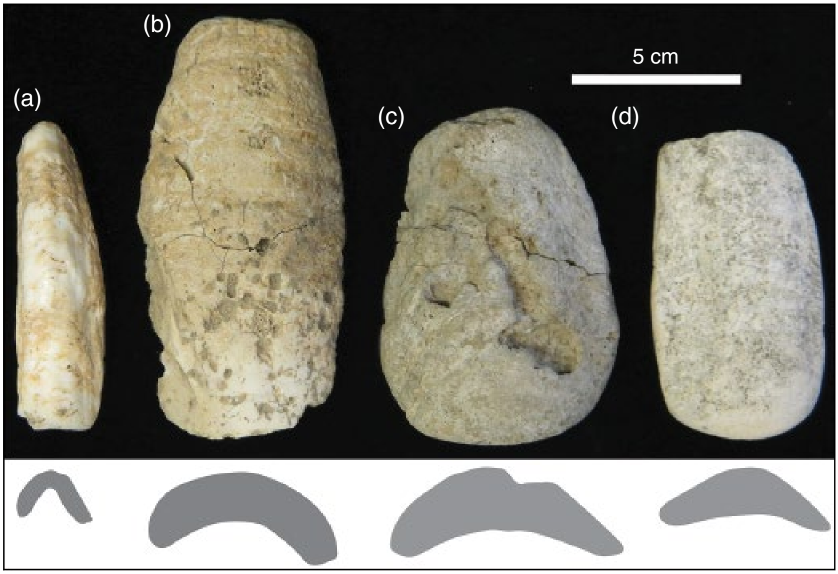

Figure 5.10 Middle Holocene shell adzes with hollow backs (shown in cross-section) from Golo Cave (Gebe) and Pamwak Cave (Admiralty Islands). (a) Golo Cave adze made on a longitudinal ridge cut from a *Hippopus hippopus* large bivalve shell. (b) Golo Cave adze made from the hinge (ventral) region of *Tridacna* sp., perhaps *maxima* or *gigas*. (c) and (d) two adzes similar to (b) from Pamwak Cave, Admiralty Islands. Source: Pamwak, courtesy of Matthew Spriggs.

complete and undamaged, a moment's thought will indicate that they were all cached in holes in the cave floor, presumably by itinerant visitors who intended to reuse them during some future visit to the site. Therefore, they must have been younger than the stratigraphic dates just given, perhaps by several millennia. So, exactly how old were these adzes?[14]

The obvious course of action, applied some years after the excavations finished, was to radiocarbon date the actual shells from which the Golo adzes were made. The results came as something of a surprise. One of the *Tridacna* adzes gave a reading of 32800±950 uncal. bp (OZD775), indicating that the maker did not use a new shell but found one either in a beach deposit or eroding from one of the many uplifted segments of Pleistocene coral reef that line the Gebe shoreline, especially on the northern side of the island. The same applied to one of the Neolithic *Cassis* adzes from the site discussed in Chapter 8, found with pottery in the surface layers and certainly younger than 3500 years on comparative grounds, yet with a direct C14 date on the shell of 9580±70 uncal. bp (OZD773). A third *Hippopus* specimen actually gave a younger date than expected, of only 6480±80 uncal. bp (OZD774), confirming that it had been cached in a hole. This one was quite possibly made of fresh shell.

What can we conclude from these dates? That for the *Hippopus* specimen calibrates to about 7 kya and this seems a reasonable estimate for its manufacture, given that the Golo *Tridacna* and *Hippopus* adzes predated the appearance of pottery in the site and lay a little below the oldest animal bones, which also apparently commenced around 7 kya. These shell adzes were certainly not Neolithic – they document indigenous late Paleolithic enterprise and no doubt ocean crossing as well if we are to explain the Gebe and Admiralty parallels. But it is interesting that absolutely no other crafted (as opposed to simply flaked) shell artifacts occurred in the Moluccan pre-Neolithic – no beads, no bracelets, no fish-hooks. This becomes most intriguing when we move to examine the archaeological record in Timor.

Eastern Nusa Tenggara and Timor-Leste

From four caves in the former Portuguese Timor (now Timor-Leste), Ian Glover (1977a, 1986) excavated in the 1960s an industry with basal dates of about 13 kya. The tools were primarily chert flakes (there was also some obsidian) and the retouched forms were mainly steep-edged scrapers. A number of the unretouched flakes had an edge gloss and there were also a few long, thick blades (Figure 5.7, Uai Bobo). Basically, this Timorese industry had much in common with those described for Sabah and Sulawesi, but it did seem to be a little distinctive in its predilection for long blade-like artifacts. The Timor fauna of the period prior to the Neolithic was dominated by several extinct species of giant rat, fruit bats, snakes, and other reptiles; other mammal species such as cuscus, pigs, and deer were introduced into Timor during the Neolithic or later.

More recently, an Australian team working in Timor-Leste, led by Sue O'Connor, has extended Glover's sequence back to around 40 kya in Lene Hara and Jerimalai caves, although unlike Flores the human record in Timor was not associated with Komodo dragons or stegodons, even though the latter are known from the island in Pleistocene fossil form. Close to Timor, Mahirta (2009) has also documented a human presence with large pebble tools by 30–24 kya in the Lua Meko rock shelter on Rote Island. There is no sign so far in Timor of any hominin occupation prior to the arrival of *Homo sapiens*.

The first settlers in Jerimalai Cave made a good living from the sea, with many bones initially claimed to be of fast-swimming pelagic fish such as tuna accounting for more than 50% of all fishbone in the lower layers. These were dated from associated marine shell C14 to 42–38 kya, although no fishbone could be directly radiocarbon dated owing to lack of collagen (O'Connor et al. 2011; O'Connor 2015a). This claim for open-sea canoe-based fishing has led to controversy, with Anderson (2013) claiming that the fish vertebrae in question were from small tuna and mackerel that could be caught inshore. The excavators also agree now that the Jerimalai people were able to catch these fish from rock platforms when they came inshore to feed (Balme and O'Connor 2014), so visions of Polynesian-like open-sea trolling for tuna behind sailing canoes might be a little optimistic. However, this evidence for fishing at 40 kya is significant on a world scale and predates any such evidence recovered elsewhere in Island Southeast Asia.

Another interesting Timor discovery, especially in view of recent dates for early rock art from Borneo and Sulawesi (above), is an engraved human face on a stalagmite in Lene Hara Cave, dated through uranium series analysis of overlying calcite to between 12.5 and 10 kya (O'Connor et al. 2010). Traces of red ochre artwork in Lene Hara have also been uranium series dated to between 29 and 24 kya (Aubert et al. 2007). A serrated bone projectile point tip from Matja Kuru Cave 2 (Figure 5.11c) was also found in a level dated to 35 kya (O'Connor et al. 2014).

However, engraved faces, ochre, and bone tools are not all that late Paleolithic Timor has to offer. Shell one-piece fish-hooks used for angling (with bait) could date from 23 to 16 kya in Jerimalai Cave, and similar fish-hooks together with cut and ground disc-shaped shell beads from 11 to 7.5 kya in nearby Lene Hara

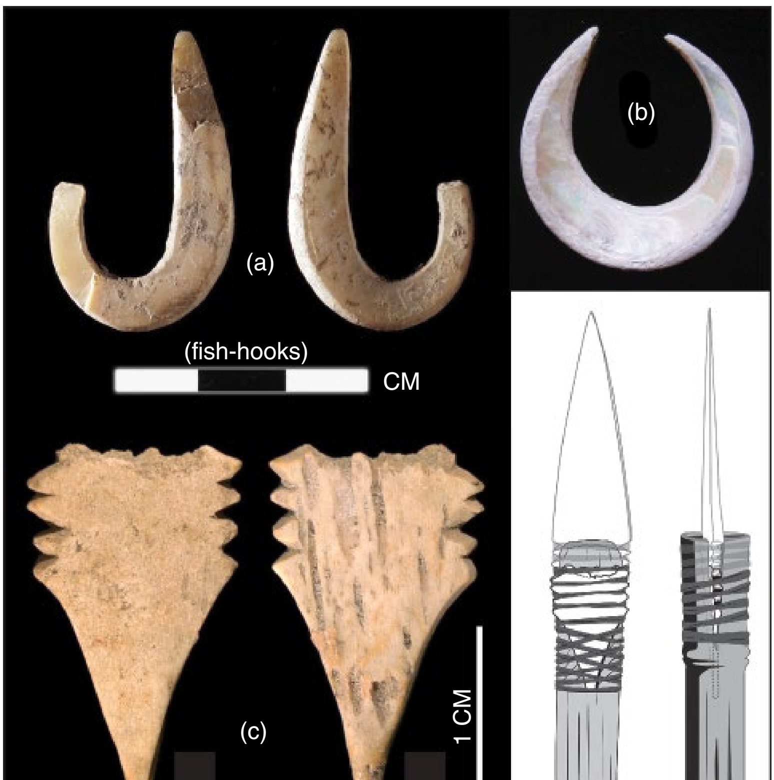

Figure 5.11 Two late Pleistocene/early Holocene shell fish-hooks (one shown from both sides) and the base of a side-notched bone projectile point. The line drawing shows how the point might have been hafted. (a) Lene Hara Cave, Timor-Leste. (b) Tron Bon Lei Cave (Alor). (c) Matja Kuru Cave 2, Timor-Leste. Source: courtesy of Sue O'Connor, Cambridge University Press, and *Journal of Human Evolution* (O'Connor and Veth 2005; O'Connor et al. 2014).

(Figure 5.11a).[15] In Tron Bon Lei Cave on Alor, six circular one-piece fish-hooks were placed against a human skull, perhaps as a form of body ornamentation (Sue O'Connor and Sofia Samper Carro, pers. comm.; Figure 5.11b). Publication of these new Alor (and also Kisar) finds is awaited, but together with the finds from Timor it is apparent that shell-working techniques could have been introduced into Timor and its immediate vicinity with the initial arrival of *Homo sapiens*. Jerimalai has also produced pieces of worked nautilus shell that are claimed to date from 42 kya onwards (Langley et al. 2016).

Assuming these dates are correct (they are mainly based on stratigraphic correlations in caves and direct dating of charcoal and marine shell), all of these late Paleolithic discoveries from Timor and adjacent islands suggest a localized focus of innovation in fishing and shell/bone working with so far no parallels elsewhere, except perhaps in the mid-Holocene ground shell adzes from the Philippines, Moluccas, and Admiralty Islands. However, during the late Pleistocene, sea levels around Timor were generally low (as everywhere else) and carnivorous pelagic fish were available closer to the coastline than in the fringing reef situations that developed during the Holocene (Carro et al. 2015). Nevertheless, exactly how the bait hooks and projectile point were used, and for which species, remains uncertain. So far, no trolling lure hooks of the types used by Pacific peoples to hunt open-sea pelagic fish have been found in the Timor sites.

All of this new Timor region material is potentially very exciting and could revolutionize our understanding of the technological capacities of late Paleolithic humans in Island Southeast Asia. However, I am a little cautious of some of the chronological claims currently being made for such shell items owing to a proven use of ancient shell for artifacts in other regions (e.g., the Golo Cave shell adzes, above), also because caves and rock shelters are always to some degree stratigraphically disturbed and subject to removal of deposit (as pointed out by the excavators themselves: O'Connor et al. in press), and also because no such serrated bone points, fish-hooks, or disc beads have ever been found in Paleolithic contexts in other Island Southeast Asian caves. Ian Glover only reported shell fish-hooks and disc beads in much younger Neolithic contexts from his 1960s cave excavations on Timor (Glover 1986). Ancient shells are also easy to find in uplifted coral reef terrain such as that which occurs widely in Timor, often with ancient coral limestone still adhering to them.

On the positive side, however, we do have the pre-Neolithic shell adzes described above from the Moluccas and Philippines, as well as the 35 kya working of *Turbo* opercula in Golo Cave in the northern Moluccas. There can be little doubt that *Homo sapiens* populations elsewhere in the world were working shell in Paleolithic times, especially for body ornaments, and shell fish-hooks are now reported from Paleolithic cave deposits on Okinawa Island dated to around 22 kya (Fujita et al. 2016). So Paleolithic shell working *per se* is not an issue. Should shell beads and fish-hooks one day turn up in Pleistocene sites in other regions of Island Southeast Asia, the potential mystery will perhaps be solved.

Changing Patterns in Hunting Across Island Southeast Asia Before the Neolithic

An Invited Perspective by Philip J. Piper

The Late Pleistocene (45–14 kya)

Many Late Pleistocene sites across Island Southeast Asia demonstrate the range of foraging strategies employed during the early phases of regional colonization by *Homo sapiens*, from the hunting of a diversity of vertebrate faunas within tropical rainforests and open woodlands on the Sunda Shelf, to fishing and mollusk collection on small islands devoid of large game in Wallacea.

During the Late Pleistocene in Borneo, Gunung Subis at Niah in Sarawak would have been a large karst limestone outcrop rising above the extensive low-lying northwestern coastal plain of Sundaland. Environmental analysis of sediments excavated from the West Mouth at Niah, dated between 52 and 45 kya (Hunt et al. 2007), suggests that the caves were located within an ideal ecotone between tropical rainforest and more open environments that would have allowed Late Pleistocene foragers to take advantage a broad range of resources.

From the earliest phases of human occupation at Niah, the inhabitants utilized a variety of techniques to capture and collect a diversity of arboreal and terrestrial fauna. The principal prey was the bearded pig (*Sus barbatus*), which accounts for almost 50% of all the vertebrate bones recovered from Late Pleistocene contexts (Reynolds et al. 2013). Bearded pigs move through the undergrowth in varying-sized family groups, along trails that they create and maintain naturally. Traps set along these trails would have been an effective method not only to ensnare pigs but also for trapping a range of other large and small ungulates that utilize the pig trails. Baited traps were likely used to capture small diurnal and nocturnal prey like civet cats (Viverridae) and monitor lizards (*Varanus* spp.). Resources were also obtained from an array of different aquatic environments, including hard-shelled (Geoemydidae) and soft-shelled turtles (Trionychidae) and mollusks with varying freshwater and brackish water tolerances collected from streams and *nipah* swamp forests. Traps require preparation, construction, and maintenance and this likely indicates occupation of the cave over an extended period rather than just a few days. The diversity of hunting, trapping, and collection strategies employed imply certain divisions of labor, with various parts of the community tasked with acquiring different resources (Piper and Rabett 2014). The visitors to Niah also had the capabilities to capture arboreal taxa such as orangutan (*Pongo pygmeaus*), leaf monkeys (*Presbytis* sp.), and bear cat (*Arctictis binturong*) occasionally, although there is no archaeological evidence for composite range weapon technology at this early date.

Another feature of the Niah bone accumulations is the presence of predatory birds, hornbills, and members of the pheasant family. The bat hawk (*Macheiramphus alcinus*), crested goshawk (*Accipiter trivigatus*), brahminy kite (*Haliastar indus*), rhinoceros hornbill (*Buceros rhinoceros*), bushy crested hornbill (*Anorrhinus galeritus*), wrinkled hornbill (*Rhyticeros corrugatus*), buffy fish owl (*Ketupa ketupa*), and crested fireback (*Lophura ignita*) have all been identified in the Late Pleistocene bone accumulations (Barton et al. 2013). Although it is possible that these magnificent birds were simply caught for food, it is also conceivable that their plumage and bills were utilized for decoration or self-adornment, as is common across Island Southeast Asia and Melanesia today (Bennett et al. 1997).

Moving south from Borneo, the island of Java was located during glacial climatic conditions at the southeastern end of a large savanna and open-woodland corridor that extended through Sundaland to as far as the Thai-Malaysian Peninsula (Wurster et al. 2010; and see Chapter 2). At Song Gupuh, a cave site in central Java with deposits dated to between 70 and 3 kya, these more open environments are reflected in the predominance of hunted grazing and browsing animals such as cattle and deer, as well as pigs (Morwood et al. 2008). The capture of these large mammals within open woodlands would probably have required a greater focus on encounter hunting rather than the remote trapping more commonly applied at Niah.

Crossing open sea into Wallacea, beyond the eastern margins of the Sunda Shelf on the way to Australia, presented its own particular challenges. The numerous islands and archipelagos that smatter the region are extremely varied in size, topography, and degree of remoteness. In the past some contained a relatively high vertebrate diversity that included species of large mammals, whilst others were almost completely devoid of all but rats, bats, and small reptiles. For example, little adjustment in foraging strategy would have been required to hunt effectively the bovines, deer, and pigs inhabiting the Philippine archipelago and Sulawesi. This is evident at Callao Cave in northern Luzon, where the bone accumulation found with the hominin metatarsal dated to between 67 and 54 kya is dominated by deer bone, some pig, and a few tooth fragments of an extinct bovine (Mijares et al. 2010). In contrast, Timor had a very depauperate terrestrial vertebrate fauna, with the largest mammal at the time of initial human colonization being the giant rat *Coryphomys musseri* (Aplin and Helgen 2010). Here, in the absence of a large and diverse terrestrial vertebrate community to hunt, there was a greater reliance on coastal and lake resources. The cave sites of Jerimalai (42 kya) and Lene Hara (43–30 kya), located close to the northeastern coast of Timor-Leste, have produced evidence for the collection of marine mollusks from the inter-tidal zone and rocky platforms. At Jerimalai they also captured marine turtles and a variety of inshore reef fishes, and possibly some species found further offshore (O'Connor et al. 2011). In the Talaud Islands, between the southern Philippines and northern Sulawesi, the earliest evidence of human colonization comes from Leang Sarru (35–32 kya), where inter-tidal and sub-tidal marine mollusks were collected (Ono et al. 2009). At Golo Cave on Gebe Island in the Moluccas, marine mollusks, initially collected for subsistence purposes, were subsequently utilized as unmodified tools (Szabó and Koppel 2015).

It is unlikely that these coastal procurement strategies were only learned once human populations arrived in Wallacea. More likely, the archaeological record from the preserved coastlines of Wallacea provides us with insights into aspects of the diverse foraging strategies that formerly existed around the fringes of the Sunda Shelf, now lost to rising postglacial sea levels.

Terminal Pleistocene to Mid-Holocene (14–4.5 kya)

Coinciding with the postglacial sea level rise and the climatic amelioration towards the end of the last glaciation, tropical rainforests expanded and the open woodland and savanna corridor through the center of Sundaland retracted. The mobile hunter-gatherer populations that roamed the lowlands of the Sunda Shelf were forced to retreat inland ahead of the rising oceans. At Niah (Sarawak), Song Gupuh, and Song Terus (Java), caves that had been occupied during the preceding millennia, there was an abrupt increase in the intensity of occupation after 14 kya. Additional caves and rock shelters that were previously uninhabited, such as Ille Cave in Palawan, were now occupied for the first time.

There was also a marked change in hunting strategies during this period. In contrast to the Late Pleistocene prior to 14 kya, when large mammals were the principal focus of hunters on Sundaland, there developed a much greater focus on primates and other intermediate and small-sized terrestrial and arboreal taxa such as civet cats and squirrels. This was, in part, related to the postglacial expansion of the rainforests and the increasing availability of such smaller prey, especially at sites like Song Terus and Song Gupuh, where more open environments had previously existed through most of the last glaciation.

New forms of bone artifact also emerged after 14 kya and new technologies spread across Island Southeast Asia during the early Holocene. Use-wear on bone implements resulting from hafting and breakage patterns that suggest a composite projectile technology was present at Niah from 14 kya and at Liang Nabulei in the Aru Islands from 11 kya onwards (Rabett and Piper 2012). At Niah, for example, the mouth of a cave called Lobang Hangus, located 43 m above the forest floor and hence level with the surrounding tree canopy, contains a large midden where the bones of leaf monkeys, macaques, and other arboreal taxa predominate, associated with numerous broken projectile points and accumulated between 12 and 10 kya. It is possible that this site, strategically located at tree canopy level, was ideal for the projectile hunting of arboreal prey (Piper and Rabett 2009).

The larger, better-preserved bone assemblages of this period also highlight some human behavioral traits for which evidence was previously lacking. For instance, within the faunal assemblages of Lobang Hangus and Gan Kira at Niah there are disproportionately low frequencies of pig mandibles compared to skulls, and monkey skulls compared to mandibles. A possible reason could be a deliberate retention of pig mandibles and monkey skulls as hunting trophies or other kinds of signaling behavior (Barton et al. 2013).

The emergence of new social relationships and ideologies that incorporate a belief in the afterlife also became manifest during the early Holocene, especially with the first-time appearance in the archaeological record of flexed, squatting, and seated human inhumations, and secondary unburnt burials and cremations, placed in special cemeteries for the dead across many regions of Southeast Asia (Figure 4.4). Animals were potentially incorporated into these belief systems; burial B27 in Niah West Mouth was an early Holocene flexed inhumation with a rhinoceros radius strategically placed as a "pillow." The adjacent flexed burial B83 also contained rhinoceros teeth (Rabett et al. 2013). At Song Terus in Java, an early Holocene flexed burial had a complete Javan leaf monkey (*Trachypithecus auratus*) skull placed between its left arm and rib cage (Sémah and Sémah 2012).

During the early Holocene, the encroachment of coastal resources with the postglacial sea level rise is recorded by large mangrove and brackish-water shell middens, some already described for Vietnam, Peninsular Malaysia, and Sumatra. Shell middens also appear in Niah West Mouth at 8 kya and at Duyong and Ille Caves on Palawan between 9 and 6 kya. Although these assemblages generally contain some fish bone, the hunting of terrestrial game, along with shellfish collection, appears to have remained the primary focus.

An excellent example of a changing foraging strategy after the last glaciation comes from Bubog I and II shelters on the south coast of Ilin Island, southern Philippines. During the final stages of the Pleistocene these rock shelters overlooked lowland swamp forest, lakes, and rivers located between Ilin and the larger island of Mindoro. During the early Holocene, large shell middens were deposited in these shelters as the sea level rose to inundate the formerly exposed lowlands. Nearby aquatic environments changed from mangroves and *nipah* palm swamps at 11 kya to open lagoon conditions by 6 kya. The inhabitants of Ilin also hunted the endemic *Sus oliveri* and several endemic species of rat (Pawlik et al. 2014).

A subsistence strategy that is commonly believed to have emerged during the Late Pleistocene, and escalated during the early to mid-Holocene, was the translocation of mammals from their native habits to resource-poor islands around New Guinea and across Wallacea, For instance, it has been suggested that the northern common cuscus (*Phalanger orientalis*) was transported from New Guinea to New Ireland as early as 24 kya (Allen et al. 1989). This same species was then introduced to the Solomon Islands, the Bismarck Archipelago, and islands in the Moluccas (Heinsohn 2003). The furthest location of the northern common cuscus was to Timor-Leste, where it was originally reported as having arrived around 10 kya (O'Connor and Aplin 2007).

Recent research, however, is now starting to question seriously the likelihood of animal translocations before 4 kya. For example, direct dating of northern cuscus from Timor-Leste has demonstrated that it was more likely introduced after 3 kya (O'Connor 2015b). On Gebe Island, Flannery et al. (1998) had argued that the appearance of the now-extinct forest wallaby (*Dorcopsis* sp.) in the archaeological record of Golo and Wetef caves at 8 kya was an indication that it had been introduced to the island around this date. A taphonomic study has now demonstrated that the first appearance of forest wallaby is a relict of bone preservation rather than a true reflection of its initial arrival and it could be have been a natural introduction to Gebe (Hull 2014).

Furthermore, it has been argued that the Sulawesi warty pig (*Sus celebensis*) was translocated from Sulawesi to various offshore islands during the mid-Holocene. This supposition currently hangs precariously on one indirect C14 date from deposits in Liang Bua (Flores) associated with a warty pig bone, identified as such through ancient DNA analysis (Larson et al. 2007). Until claims for early translocation are more securely supported by direct dates on bone and tooth, caution suggests that animal translocation only gathered momentum in the Late Holocene, and especially during the Neolithic.

Some Final Thoughts on *Homo sapiens* and the Late Palaeolithic in Island Southeast Asia

The basic core, flake, and pebble characteristics of the late Pleistocene and early Holocene lithic industries of Island Southeast Asia, including the Hoabinhian, find fairly close parallels in the oldest lithic industries found in Australia and the New Guinea Highlands, both of which were first settled from Indonesia before or around 50–45 kya (Hiscock 2008; Summerhayes et al. 2010). These similarities are not surprising. However, one might ask if the localized variations that are sometimes visible (e.g., between the mainland Hoabinhian and the island pebble and flake industries) relate mainly to availability of raw materials, or if they represent different kinds of human intention. The latter explanation surely applies to the technologies represented by bifacial reduction in the Peninsular Malaysian Hoabinhian and at Lake Tingkayu. Farther east there was also an unusual focus on large-waisted axe-like pebble tools in the Huon Peninsula of Papua New Guinea and in the Papua New Guinea Highlands, dating back in the case of the former location to perhaps 40 kya (Groube et al. 1986). Such waisted tools have not yet been found in the Indo-Malaysian islands, although they do appear occasionally and perhaps independently in some Hoabinhian sites (see Figure 5.2).

A major question about the lives of Paleolithic *Homo sapiens* in Island Southeast Asia concerns the existence, or otherwise, of sedentary life. It is normally assumed that mobility was the norm, with people moving between resources frequently during the course of the year as resources shifted in concentration. This is certainly what most cave sequences suggest, in that even the largest cave mouths, such as Niah West Mouth, appear to have been occupied periodically rather than with continuous high intensity. Mobility is also suggested by the lifestyles recorded in the comparative ethnographic record for hunter-gatherers in the region, although we must ask if the modern hunter-gatherers have only survived because they have been mobile, and so have not concentrated resources that would have attracted invasion and take-over by more numerous farmers. They have also only survived in agriculturally marginal environments such as dense rainforest.

Indeed, one must also ask, given the vast time spans being considered, if we can really know anything at all about issues of settlement stability. After all, while Niah might have 175 radiocarbon dates, we must remember that the span of time they cover is an awe-inspiring 50,000 years. Where does reality fade into the randomness of archaeological survival and positioning of excavation trenches in such a situation? Could a gap in one location, such as the early Holocene gap in most Borneo sites, be filled by continuing but archaeologically undocumented occupation in another location? Searching for "the whole universe" of past activity will always be a frustrating exercise since so much of it has been destroyed or is inaccessible.

But let us not dwell too long on the negatives. The late Paleolithic in Island Southeast Asia witnessed a quickening of the pace in terms of an appearance of ground shell tools, new lithic expressions such as the Toalian, and probably an increase in the degree of inter-island contact. However, I stop short of promoting the latter to the extent that it can be used to downplay the significance of Neolithic population incursion. In fact, rather few direct signs of inter-island contact in Island Southeast Asia are available for the late Paleolithic. Even the apparent northern Moluccan instance of marsupial translocation to Halmahera and Gebe is now under review (not to mention the much older claims for translocation in Island Melanesia). The Tingkayu bifaces, the Toalian, the shell fish-hooks and disc beads of Timor, and the edge-ground axes of Niah and Sa'gung were all remarkable creations, yet also remarkably localized in space, even if the ideas that they represented were widespread in so many other parts of the world during the terminal Pleistocene and early Holocene. Was this isolation real? Only many more archaeological findings will tell us.

Nevertheless, as we can see so clearly from the genetic record summarized in Chapter 4 by Murray Cox, the indigenous and pre-Neolithic hunter-gatherers of Island Southeast laid down an Australo-Papuan genetic foundation that has survived very strongly amongst many modern Austronesian-speaking populations, especially amongst Philippine Negritos and in the southern and eastern regions of Indonesia. The human past in Island Southeast Asia was a palimpsest, not a set of impervious layers.

Notes

1. Taiwan possesses islands in the Jinmen and Matsu groups, just offshore from the Chinese province of Fujian, that have archaeological assemblages of Chinese mainland affinity. References to "Taiwan" in this book are to the main island only, plus its nearby island dependencies such as Penghu (Pescadores) and Lanyu (Botel Tobago).

2. Paradoxically, the Polynesians are now known to be of predominantly Asian and not Australo-Papuan genetic ancestry. If one reads Wallace carefully, especially on page 15 of his book (Wallace 1962), it becomes clear that his real intention was to distinguish between what he there termed Malay and Papuan races, the reference to Polynesians evidently being a casual afterthought. As Wallace also noted, this human dividing line was not to be confused with his "Division of Indo-Malayan and Austro-Malayan regions," more famously known today as the Wallace Line.
3. Uncalibrated radicarbon years before present.
4. On these very old excavations see van Stein Callenfels and Evans 1928; Tweedie 1940; van Stein Callenfels and Noone 1940.
5. See van Heekeren 1972:85–92; Brandt 1976; Glover 1978a; McKinnon 1991; Wiradnyana 2016.
6. Forestier and Patole-Edoumba 2000:37; Forestier et al. 2005; Simanjuntak 2016.
7. Hunt et al. 2012 discuss *Justicia*. There is a recent claim by Hunt and Rabett (2014) to the effect that people in Sarawak were cultivating rice between about 11 and 8 kya, based on phytoliths recovered from a core drilled in a non-archaeological swamp context (Loagan Bunut) located 40 km inland from Niah. This date even exceeds the dates for rice agriculture in the homeland regions of central China and northern India. Within the Niah Caves themselves, rice remains (in pottery) date from the Neolithic and onwards only. An associated claim for sago exploitation is perhaps more believable, as of course are the Niah claims for exploitation of wild yams, aroids, palm fruits, and other nutritious food sources that hunters and gatherers across the world have no doubt eaten since the time of *Homo erectus* or earlier.
8. See Taçon et al. 2014 for a general discussion of Southeast Asian cave art.
9. Sémah et al. 2003; Hameau et al. 2007; Morwood et al. 2008.
10. Louys et al. 2007 offer a review, and see Cooper et al. 2015 for dating precision in northern Eurasia
11. This issue is under investigation at present and hopefully a tightly flexed skeleton excavated in Diosdipun Cave on Batan Island in 2002 can soon be directly C14-dated and tested for ancient DNA. But the fact remains that, so far, there is no evidence for a pre-Neolithic presence in the Batanes Islands.
12. A Muduk bone point in Australian terminology was pointed at both ends, for use as a fish spear barb.
13. See Mulvaney and Soejono 1970, 1971; Glover 1976, 1977a, 1978b; Glover and Presland 1985; Chapman 1986.
14. I am ignoring here a Neolithic series of 14 *Cassis* adzes cached in the sub-surface layers in Golo and Wetef – these are discussed in Chapter 8.
15. O'Connor et al. 2002; O'Connor and Veth 2005; O'Connor 2015a.

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Chapter 6
The Early History of the Austronesian Language Family in Island Southeast Asia

Once they had split up each group forgot the past customs
they had enjoyed together and developed different languages
because some had short tongues and others long tongues.
Each group found a new name for itself.

From a story related by a Penan headman, Sarawak (Arnold 1958)

A very fundamental change in the prehistory of Island Southeast Asia commenced about 3500 BCE, when Neolithic populations from southern China made an appearance in Taiwan. Around 2200 BCE they spread from Taiwan south into the northern Philippines, then further southward to Borneo and Sulawesi by 1600 BCE, and rapidly onwards into the remainder of Island Southeast Asia to reach most of southeastern Indonesia, Sumatra, and Java by 1300 BCE. Cousinly groups spread eastwards, to the north of New Guinea, to reach the Mariana Islands by 1500 BCE and the Bismarck Archipelago by 1300 BCE. Peninsular Malaysia and Vietnam had their own Neolithic populations of Mainland Southeast Asian ancestry who probably kept Austronesian settlers at bay until after 1000 BCE. The mountainous interior of New Guinea also offered considerable resistance to Austronesian settlement and only coastal pockets of the island were directly affected by these Asian Neolithic movements, which reached the Bird's Head at the western end of the island and the Papua New Guinea coastline, in the latter case from the Bismarcks or other islands to the immediate north and east of New Guinea.

We examine the archaeology of all of this in chapters 7 and 8, but it is extremely important to remember that the archaeological record is about artifacts, economies, and skeletons. It cannot deal with language history before the invention of writing. Yet language is arguably the most significant cultural creation of any human community, essential for purposes of communication, identity, social structure, and religion. Without languages, humans would not be human.

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

The importance of language in tracing human history and migration in recent millennia cannot be denied. I stress "recent millennia" because all languages change over time, and if two dialects of a single language become separated for long enough they will diverge so far that their genetic commonality will no longer be evident, or at least too eroded to be amenable to coherent linguistic analysis. After perhaps 10,000 years of elapsed time, faint similarities between far-apart languages, especially in lexicon, can be due as much to chance as to common inheritance or contact. Within the past 10,000 years, however, and increasing in clarity as we approach the present, we have the comparative linguistic reconstruction of the proto-languages, family trees, and expansion geographies of many of the major language families of the world, of both food producers and hunter-gatherers alike (Bellwood 2005, 2013).

In this book our main concern is with the Austronesian family of languages. It has always struck me how significant is the correlation between a Taiwan origin for the Neolithic in Island Southeast Asia and the corresponding Taiwan origin for the Austronesian language family, as it exists today. This, surely, is not coincidence. Of course, Austronesian languages did not evolve in the mouths of formerly speechless hominins in Taiwan. Obviously there were once ancestral languages for the Austronesian family spoken on the mainland of southern China, now erased by the total dominance of Sinitic ("Chinese") languages in the coastal Zhejiang, Fujian, and Guangdong provinces. This domination was a result of conquests that commenced during the Warring States period after about 500 BCE, but which were driven home very decisively by huge Sinitic migrations from the central provinces into southern China during the Qin, Han, and later dynasties. In southern China, indigenous populations who speak languages related to Thai (Tai-Kadai, Daic, or Kra-Dai family) continue to exist in Hainan Island and Guangxi, Guizhou, and Yunnan Provinces, but not in the coastal regions close to Taiwan.

However, the point I want to drive home is that not only did Neolithic cultures and ancestral Austronesian languages in Island Southeast Asia both emanate from Taiwan, in terms of completely independent archaeological and linguistic data sets, but both also share earlier and fainter origins within the mainland of China. This coincidence in the archaeological and linguistic significance of both Taiwan and southern China has always been strongly apparent. So too has the rather obvious historical observation that language spread on the continental scales of the mega-families of the world – Austronesian, Indo-European, and Sino-Tibetan for instance – can only have taken place mainly through movement of the populations who spoke early dialects within those families. Some linguistic admixture undoubtedly occurred, and linguistic borrowing and language shift on the part of indigenous peoples into Austronesian languages may well have been quite commonplace, for instance amongst Philippine Negritos and many Papuan-speaking populations in western Oceania, as of course has occurred with modern expansive languages such as English and Spanish. But language shift alone would not have been enough to give rise to the universal presence of Austronesian languages throughout virtually the whole of Island Southeast Asia, apart from a few small islands located near Papuan-speaking

New Guinea. In this book I take this observation as given, having dealt with it at some length in many previous publications.[1]

Our first task is to survey the extent and size of the Austronesian language family and to introduce some of its neighbors. The online linguistic data source termed *Ethnologue*[2] offers 1257 languages for the whole family, exceeded only by the Niger-Congo languages of Africa with 1545. However, Austronesian was certainly the largest family in terms of precolonial extent – over halfway around the world from Madagascar to Easter Island and in latitudinal terms from temperate Taiwan to temperate New Zealand (Figure 6.1). Over half of the Austronesian languages are spoken in Oceania, from New Guinea eastwards. Present-day indigenous Austronesian speakers are roughly distributed as follows: Indonesia 255 million, Philippines 100 million, Malaysia and Brunei 30 million, Madagascar 22 million, central Vietnam (Chamic speakers only) 1 million, Taiwan (Formosan-speakers only) 500,000, and Island Oceania (excluding Papua New Guinea) perhaps 3 million.[3]

The Austronesian languages have a geographical distribution in Island Southeast Asia that is today relatively unbroken. Located around it we find speakers within four other major language groupings (Figure 6.2). The first is the Austroasiatic family of Mainland Southeast Asia, a scattered group of about 150 languages that includes the Aslian languages of Peninsular Malaysia (spoken by the Semang and Senoi peoples of the interior), Mon-Khmer (including Khmer, the modern national language of Cambodia), Vietnamese (a member of the Viet-Muong subgroup), Nicobarese, Khasi of Assam, and the Munda languages of northeastern peninsular India. Second is the Tai (or Daic, or Kra-Dai) family of the central and northern Southeast Asian mainland, including Thailand, Laos, interior northern Vietnam, and extending up into the Tai homeland provinces of Guangxi, Guizhou, Yunnan, and Hainan in southern China. Third is the large Sino-Tibetan family, with Tibetan and Burmese as well as Sinitic ("Chinese") languages, although the main historical contact between Sinitic and Austronesian languages occurred in Taiwan after Chinese settlement there from about 1660 CE onwards (but see below for suggestions of very deep ancestral relationships between Austronesian and Sino-Tibetan). Fourth comprises the Papuan complex, which has about 750 languages in many separate families in New Guinea, western island Melanesia, and a few islands in eastern Indonesia (Timor, Alor, Pantar, Halmahera).

Almost all the indigenous peoples of Island Southeast Asia today thus speak languages within the Austronesian family, except in pockets of eastern Indonesia close to New Guinea where a few Papuan languages are spoken. Otherwise, all other spoken vernaculars in Island Southeast Asia arrived or developed in the colonial era. These include Taiwanese (a Sinitic language) in Taiwan, other Sinitic and Indic languages in Malaysia and Singapore, and English in Malaysia and the Philippines. Indonesia no longer needs a colonial language because of the wisdom of the government of independence and its advisors in choosing a trader language, Malay, rather than the Javanese language of the ruling class as the national lingua franca (Bahasa Indonesia) in 1945.

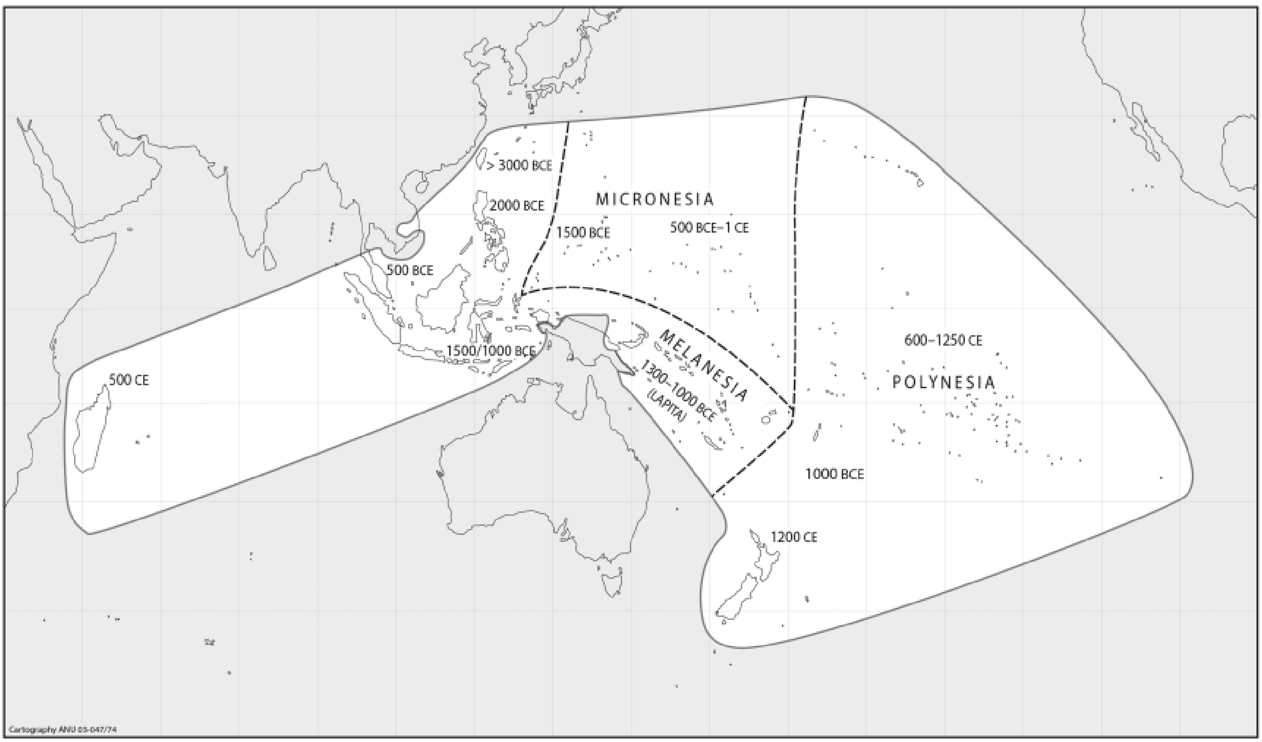

Figure 6.1 The overall distribution of the Austronesian languages (unshaded), and likely archaeological dates for their establishment. Source: drawn by Jenny Sheehan.

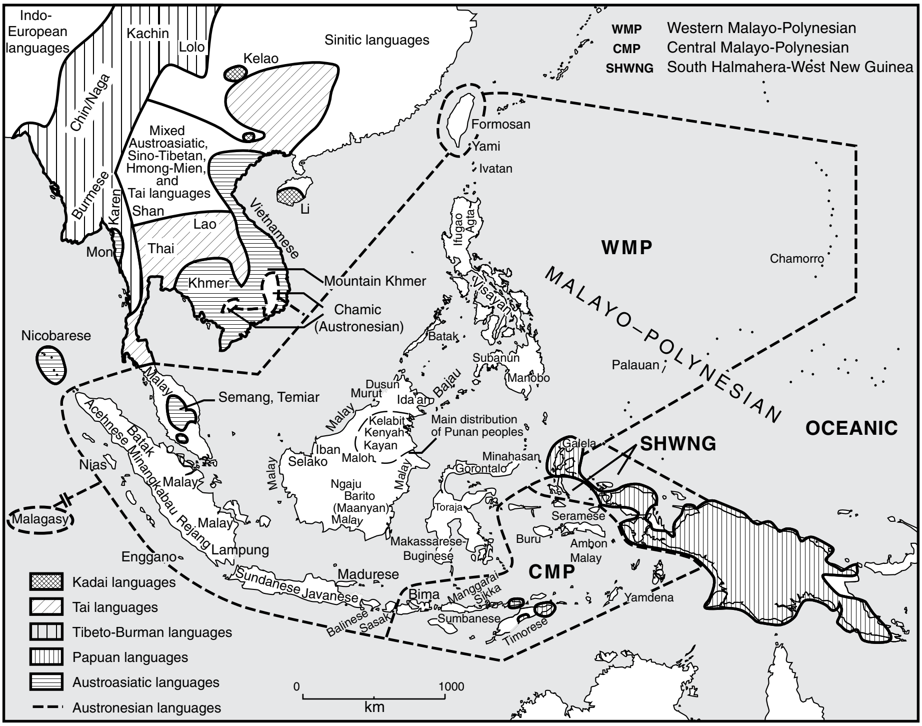

Figure 6.2 Peoples, languages, major Austronesian subgroups, and other language families in Southeast Asia. The Central-Eastern Malayo-Polynesian subgroup discussed below by Robert Blust includes the CMP, SHWNG, and Oceanic subgroups shown on this map. Source: drawn by Jenny Sheehan.

What is a Language Family, and Why are Language Families Important?

Language families such as Austronesian are defined by lexical items and grammatical features that the constituent members have inherited directly from a period of common ancestry situated far back in time. Within each language family there will usually be a hierarchy of subgroups, with each larger subgroup incorporating two or more smaller ones. Each subgroup at any level will consist of a number of related languages deemed to relate more closely to each other than to any outsider language, and each subgroup will be defined by a series of innovations shared only by its members. "Sharing" in this sense depends, of course, on a demonstration through linguistic methodology that the item was inherited (*cognate* in linguistic terminology[4] – for examples within Austronesian see Table 6.1), rather than borrowed from another language. Such subgroups develop as a language family radiates from an origin region and as the speakers of individual dialects move beyond the range of frequent communication and so develop linguistic innovations unique to themselves, their immediate neighbors, and their descendants, as related metaphorically in the opening quote for this chapter.

Table 6.1 Some widespread Austronesian cognates. Absences indicate either that no cognate form exists or that the item concerned did not exist at European contact in that location. PAN = Proto-Austronesian; Rukai is a Taiwan language; Tagalog is the national language of the Philippines; Rapanui is Easter Island. Source: Courtesy of Malcolm Ross.

	PAN*	**Rukai**	**Tagalog**	**Javanese**	**Fijian**	**Samoan**	**Rapanui**
two	*duSa	dosa	dalawa	lo-ro	rua	lua	rua
four	*Sepat	sepate	apat	pat	vā	fā	hā
five	*lima	lima	lima	limo	lima	lima	rima
six	*enem	eneme	anim	enem	ono	ono	ono
bird	*manuk	—	manok	manuʔ	manumanu	manu	manu
head louse	*kuCu	koco	kuto	kutu	kutu	ʔutu	kutu
eye	maCa	maca	mata	moto	mata	mata	mata
ear	*Caliŋa	caliŋa	taiŋa	—	daliŋa	taliŋa	tariŋa
liver	*qaCay	aθay	atay	ati	yate	ate	ʔate
road	*zalan	ka-dalan-ane	daan	dalan	sala	ala	ara
pandanus	*paŋudaN	paŋodale	pandan	pandan	vadra	fala	—
sugarcane	*tebuS	cubusu	tubo	tebu	dovu	—	—
rain	*quzaN	odale	ulan	udan	uca	ua	ʔua
sky	*laŋiC	—	laŋit	laŋit	laŋi	laŋi	raŋi
stone	*batu	—	bato	watu	vatu	—	—
cooking pot	*kuden	—	—	—	kuro	ʔulo	—
eat	*kaen	kane	kaʔin	ma-ŋan	kan-ia	ʔai	kai

* Blust and Trussel 2014.

The origins of language families pose important questions for human migration since it is obvious that most people speak a language (sometimes more than one) that they inherit from their parents and peers and that they normally do not change during their lifetimes. Of course, people and populations can change languages from time to time and languages can become extinct. But the use of a language as a marker of ethnic identity is a property of all human groups recorded in ethnography and in our modern world. Language possession and trans-generational transmission are fairly stable features of most human societies, except perhaps in circumstances of major conflict, translocation (e.g., slavery) or large-scale depopulation. It follows that migrating humans are a major source of language spread, and have also perhaps served as the major source of such spread throughout human prehistory.

Furthermore, most of the language families of predominantly agricultural populations (e.g., the Austronesian-speakers) have large reconstructible ancestral vocabularies that suggest that their initial spreads occurred amongst early populations of food producers rather than full-time hunter-gatherers (Diamond and Bellwood 2003; Bellwood 2005, 2009, 2013). Of course, hunter-gatherers migrated too, especially in pre-agricultural eras, but the major agriculturalist language families of the world, such as Indo-European, Sino-Tibetan, Niger-Congo (including the Bantu languages), and Uto-Aztecan and Arawak in the Americas, arguably spread predominantly through the mouths of food-producing populations.

One very striking fact about all of the major language families, including Austronesian, is that they originated and began to spread long before any relevant written history was recorded. Furthermore, all of the major language families had already attained territory close to their present limits when regional histories started, and certainly long before European colonization started after 1500 CE. Of course, a small number of Indo-European languages such as English, Spanish, Portuguese, Russian, and French have spread widely since 1500 through colonial conquest, disease-related depopulation of native peoples, and outright settlement by colonists. However, these are all single languages within the much vaster Indo-European family, simply the tips of branches within the historical complexity of the Indo-European genealogical tree as a whole. These languages also belong in a recent world of nations and conquest states that incorporate large numbers of unrelated and sometimes hostile ethnolinguistic groups, with varying degrees of literacy, hence the urgent need during the past century or so for national languages that all citizens can learn and understand. Of course, such developments nowadays are hurried along by national language policies, widespread or universal schooling, and all kinds of mass media from the internet onwards.

How can we understand the histories of the major language families in remote times, long before writing was invented, given that the ultimate origins and dispersals of none of them are documented historically? The answer is through linguistic comparison and reconstruction, a scientific procedure (the "comparative method" of linguists – see Blust 2014) that progresses through the comparison of complete languages as they are spoken and recorded today, supplemented from available historical and epigraphic records of extinct or archaic languages spoken in the past. However, only Cham, Malay, Javanese, and Balinese offer inscriptions more than 800 to 1000 years old within the Austronesian family, and many of the words in these inscriptions are in Indic languages such as Sanskrit and Pali.

As Robert Blust explains in his contribution later in this chapter, it has been the application of the comparative method that has told us so clearly that Taiwan was the "homeland" of the Austronesian language family, at least to the degree that a homeland can be traced. Of course, as already stated, the ancestral language for the Austronesian family did not appear fully formed in Taiwan at some instant long ago. Like all language families, it had antecedents that must go far back to the beginnings of language, could we travel in time back to that almost mythological event. The obstacles to tracing Austronesian roots beyond Taiwan into a specific region and linguistic landscape of mid-Holocene China are still rather forbidding, beset with ambiguities caused by the obfuscation through time of traces of genetic connection.

An Introduction to Austronesian Linguistic History

The vast majority of modern linguists accept that Proto-Austronesian (henceforth PAN), the ancestral language for the whole family, originated in Taiwan and that all the Austronesian languages spoken beyond Taiwan belong to a very widespread but lower-order subgroup termed "Malayo-Polynesian," as conceived by my co-author and linguist Robert Blust (1976, 1995, 1999, 2013a). PAN itself is a reconstruction that includes the ancestral vocabulary for the whole family (see Table 6.1), as well as its ancestral phonology and many grammatical features. It has been reconstructed by linguists from inherited cognates shared by living languages across the whole Austronesian world.

The most widely agreed reconstruction of early Austronesian linguistic history, prior to the settlement of Taiwan by Austronesian speakers, favors a Pre-Austronesian homeland in coastal China with a source region somewhere south of the Yangzi River, according to most linguists. This early mainland ancestral phase was followed by the spread of an Initial Austronesian language into Taiwan, then by the subsequent breakup of PAN within Taiwan itself into the ancestors of some or all of the existing Formosan primary subgroups. The major subgroup termed Malayo-Polynesian (henceforth MP) does not exist in Taiwan today and is widely agreed to reflect spread out of Taiwan into the northern Philippines, where its speakers underwent linguistic differentiation away from the Formosan languages of the Taiwan homeland. Beyond the Philippines, the ancestral MP languages then spread through Island Southeast Asia, into Oceania (first to the Mariana islands, then a little later from the Philippines or Indonesia, via Island Melanesia, to eastern Polynesia), and later to Madagascar. The end of the road came with the settlement of New Zealand by Polynesians in perhaps the thirteenth century CE (Perry et al. 2014), 4000 years after the breakup of PAN in Taiwan, giving us a trajectory for Austronesian migration that lasted for well over 4000 years and spanned more than half the world.

Since the course of Austronesian dispersal beyond Taiwan is dealt with by Robert Blust below I will not give more details here, but it is necessary at this point to introduce in Table 6.2 the most widely accepted subgrouping structure for the Austronesian family. In my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007: Figure 4.3) I showed this information as a tree diagram with successive bifurcations. However, while the concept of sharp bifurcation might work for some isolated populations on very remote Pacific islands, it does not work so well for Island Southeast Asia. Many populations here, especially riverine and coastal ones (the majority, no doubt), would have maintained contacts in many directions with other groups, thus forming what linguists term "dialect chains" rather than totally discrete languages. Such circumstances would encourage a slow unfolding of overlapping subgroups as innovations tended to cluster and build up in certain regions of interaction, rather than sharp splits by peoples moving into total isolation from one another. Hence, I switch in Table 6.2 to a model of unfolding from Taiwan to eastern Polynesia, rather than a series of total separations.

In terms of the overall shape of the Austronesian phylogeny, it is necessary to draw attention to the relative homogeneity of the far-flung MP languages when compared to the substantial heterogeneity within Taiwan. All linguists agree on this, even if they disagree about how many subgroups of Formosan there are. For instance, Blust (Table 6.2) recognizes 10 Formosan subgroups. Malcolm Ross (2009) favors only four in terms of verbal morphology, these being Puyuma, Tsou, Rukai (all in Taiwan), and

Table 6.2 A standard subgrouping of the Austronesian languages (after Blust 2014: Table 7). Note that this table lists major subgroups as part of an unfolding process from Taiwan to eastern Polynesia. Individual subgroups that developed behind the main fronts of Austronesian migration, for instance within the huge Western Malayo-Polynesian geographical division (not a single subgroup), are not listed.

1. Atayalic
2. East Formosan
3. Puyuma
4. Paiwan
5. Rukai
6. Tsouic
7. Bunun
8. Western Plains
9. Northwest Formosan
10. Malayo-Polynesian (MP)
    - Western Malayo-Polynesian (WMP)
    - Central-Eastern Malayo-Polynesian (CEMP)
        - Central Malayo-Polynesian (CMP)
        - Eastern Malayo-Polynesian (EMP)
            - South Halmahera-West New Guinea (SHWNG)
            - Oceanic (OC)
                - Admiralties
                - Residual Oceanic
                    - St Matthias Family
                    - Yapese
                    - Western Oceanic Linkage
                        - Sarmi/Jayapura Family
                        - North New Guinea Cluster
                        - Papuan Tip Cluster
                        - Meso-Melanesian Cluster
                    - Central-Eastern Oceanic
                        - Southeast Solomonic Family
                        - Micronesian Family
                        - Utupua-Vanikoro
                        - Southern Oceanic Linkage
                        - Central Pacific Linkage
                            - Rotuman-Western Fijian
                            - Eastern Fijian-Polynesian
                                - Tongic
                                - Nuclear Polynesian
                                    - Northern Outliers-Eastern PN
                                    - Non-Northern Outliers
                                    - Residual Nuclear Polynesian

Nuclear Austronesian, with MP being just one of eight branches of the latter. However, very deep Formosan diversity is agreed upon, and whatever the final conclusion on how many subgroups might exist it is undeniable that Austronesian languages have been spoken for very much longer in Taiwan than in other parts of the Austronesian world. It therefore comes as no surprise to find that the Neolithic in Taiwan, which was when so much reconstructed PAN material culture appeared for the first time in the Island Southeast Asian archaeological record, began perhaps 2000 years before it began anywhere to the south.

The Linguistic History of Austronesian-speaking Communities in Island Southeast Asia

An Invited Perspective by Robert Blust

For some years there has been general agreement amongst Austronesian (AN) historical linguists that the most plausible site for the AN homeland is Taiwan. The reason for this consensus is the extreme diversity of the Formosan languages, and the widely accepted principle in both linguistics and botany that phylogenetic diversity correlates with time-depth *in situ*. Needless to say, the choice of Taiwan is not meant to be restrictive: Proto-Austronesian or its immediate antecedent may well have been spoken both on Taiwan and on the adjacent coast of China, but since no members of this language family survived into historical times on the Chinese mainland this remains an open question.

At least 24 aboriginal languages ("Formosan languages") were spoken on Taiwan at the time of first Western contact. Some 14 or 15 of these are still spoken, although several are on the verge of extinction. Most debates concerning the Austronesian homeland in recent years have focused on details of where the first language splits occurred on the island, ranging from the northwestern corner (Sagart 2004:437) to the southern part of the central mountains (implicit in Ross 2009, 2012; Aldridge 2014; Zeitoun and Teng 2014), to the entire coastal zone (Ho 1998; Blust 1999, 2013a). From an archaeological perspective the last position can perhaps more readily be reconciled with known patterns of primary settlement for two reasons. First, populations that relied heavily on marine resources were unlikely to abandon the coast until pressured to do so by increasing population and more intense competition for a favored habitat. Second, it is extremely unlikely that an immigrant population would settle a single location on an island with about 600 miles of coastline and not move on to unsettled areas for generations, although this is exactly what is implied by nested subgroups at the highest levels of the family tree.

All non-Formosan AN languages, collectively called "Malayo-Polynesian" (MP), exhibit certain exclusively shared features that are most simply explained as the residue of innovations in a single ancestral language, Proto-Malayo-Polynesian (PMP). Given the radiocarbon chronology for the Neolithic in

Taiwan and the Philippines (Chapter 7) two questions immediately arise: (1) what explains the long pause that separated the settlement of Taiwan around 3500 BCE from that of the Philippines around 2200 BCE? (2) why do the languages of the Philippines show less diversity than the history of settlement would seem to imply (as shown in Figure 6.3 below)?

The first of these questions is perhaps more properly archaeological than linguistic, although the answer to it may depend on features of navigational technology that have left linguistic clues, but are not easily retrievable from the archaeological record. In particular, although reflexes of PAN *layaR 'sail' extend from eastern Taiwan to Hawai'i (Blust and Trussel 2014), known reflexes of PMP *saReman 'outrigger float' are limited to MP languages, suggesting that the outrigger canoe complex, which enabled the Austronesian diaspora, was an innovation in one group of AN speakers that left Taiwan to settle the Philippines without leaving this technological innovation behind.

Since the Philippines was the first landfall in the AN world outside Taiwan, we would expect it to have the highest level of linguistic diversity after the homeland. Surprisingly, however, it does not. All languages of the Philippines apart from those of the intrusive Sama-Bajaw boat nomads, and possibly the Bashiic languages of the far north, form a single, rather well-defined subgroup that also includes the Sangiric, Minahasan, and Gorontalic languages of northern Sulawesi. The simplest explanation for this mismatch between expectation and reality is that Philippine languages experienced a major leveling event at some point in the past (Blust 2005). Language leveling is well-documented in some parts of the world, as with the expansion of Latin at the expense of Etruscan, Oscan, Umbrian, Faliscan, and other languages that were spoken in the Italian peninsula 2500 years ago. We know that the expansion of Latin and its adoption by populations that originally spoke other languages was due to the military and political success of the Roman Empire, but we have few clues regarding what might have given a similar advantage to one early AN language in the Philippines. Nonetheless, something of this kind almost certainly occurred to "reset the clock" as Diamond (1992) has put it, since the high order of diversity that is expected from the known settlement history of this region is not matched by the modern languages.[5]

Reid (1982) questioned the reality of a Philippine subgroup, but his attempt to show that the languages of the Philippines fall into several primary branches of the AN family was contested by Zorc (1986), Blust (1991, 2005), and Blust and Trussel (2014), who have drawn attention to hundreds of lexical items shared exclusively by Philippine languages, a number of which are clear replacement innovations. More recently, Ross (2005) has concluded somewhat tentatively that the Bashiic languages of the Babuyan and Batanes Islands north of Luzon and Orchid Island off the southeast coast of Taiwan may be a primary branch of Malayo-Polynesian, and indeed, the rather abundant lexical evidence for a Philippine subgroup rarely includes Bashiic cognates, suggesting a long history of separation from languages to the south (Blust and Trussel 2014).

It is too soon to say whether this uneven distribution of exclusively shared lexical innovations indicates that the Bashiic languages are a primary branch of MP, or less dramatically, a primary branch of the Philippine group as against all other Philippine languages. Regardless of which interpretation is adopted, the unexpectedly low linguistic diversity of all other non-Sama-Bajaw languages of the Philippines has important implications for prehistory, as it implies a major linguistic leveling event after the initial differentiation of languages introduced by the founding Neolithic population. And, one might add, the extremely close relationship of all Bashiic languages suggests that a similar and much more recent leveling event occurred in the island chain between Luzon and Taiwan as well.

The Chamorro language of the Marianas shares none of the linguistic innovations that define the Philippine group, whether this group includes Bashiic or not. However, Chamorro has a native word for 'typhoon' (*pakyo*] PAN *baRiuS), and since the Pacific typhoon zone stretches from roughly the latitude of the central Philippines to southern Japan, and Chamorro shares the distinctive innovations of MP languages, it is difficult to escape the conclusion that the Marianas were settled from the central or northern Philippines. But if Chamorro reached the Marianas from the central or northern Philippines, why doesn't it share the linguistic innovations that define Proto-Philippines? The simplest answer appears to be that Proto-Philippines did not yet exist when the ancestral Chamorros departed by at least 1500 BCE to make the first open-sea voyage of more than 1000 km (possibly over 2000 if they sailed direct to the Marianas) in the history of Pacific voyaging (Blust 2000b; Rainbird 2004; Hung et al. 2011; Carson 2014). Rather, given the radiocarbon chronology for the Luzon Neolithic we can assume that AN languages had already been in the Philippines for several centuries before the Chamorro migration, but that these were only slightly differentiated forms of PMP.

At some point after the ancestral Chamorros departed, therefore, the linguistic diversity that had developed from the founding MP population in the Philippines was leveled as a result of the expansion of a single group at the expense of others. It can be noted further that most of the central Philippines shows less linguistic diversity than northern and central Luzon or Mindanao, suggesting an even more recent leveling event that gave rise to the Greater Central Philippine language group, probably no earlier than 500 BCE (Blust 1991).

Apart from the settlement of the Marianas, the generally north–south orientation of the Philippine islands must have channeled migration southward through Palawan and the Sulu Archipelago to Borneo, through the Sangir-Talaud Islands to Sulawesi, and through Talaud to the northern Moluccas. The differing land formations in these three areas almost certainly conditioned migration patterns, and hence the patterns of language splits.

It was long believed that there is a Western Malayo-Polynesian (WMP) subgroup of AN languages that includes the languages of the Philippines, Borneo (and Madagascar), Sulawesi, Mainland Southeast Asia, Sumatra, Java, Bali, Lombok and western Sumbawa, and Palauan and Chamorro in western Micronesia, but not the languages of eastern Indonesia or other languages of the Pacific. However, the radiocarbon chronology for the Marianas, indicating a landfall not long after the initial Neolithic settlement of the Philippines, as well as the difficulty of subgrouping either Palauan or Chamorro with other so-called WMP languages, is difficult to reconcile with the view that WMP formed a single genetic subgroup rather than many. Consideration of likely migration routes south of the Philippines also suggests that there is no *a priori* expectation for the languages of Sulawesi to subgroup with those of Borneo or other areas of western Indonesia–Malaysia, so it now appears likely that WMP is not a valid linguistic group and that WMP cannot be distinguished from MP. An archaeological corollary of this observation is that the WMP region was probably not settled by a single migration that unfolded in a single direction, but by multiple movements of people speaking closely related MP founder languages (as implied in Figure 6.4 below).

In moving from the Philippines into Borneo, the sheer size of the island, together with the preferred coastal orientation of MP speakers, would almost certainly have produced a population split, with one migration stream following the South China Sea coast to the southwest and the other following the coast southwards along the Makassar Strait. There is some evidence that the western group in Borneo is descended from an ancestral language called Greater North Borneo, whose descendants include the languages of Sabah, most of the languages of central and western Borneo, and the Malayo-Chamic languages that settled southern Sumatra and the littoral of mainland Southeast Asia from the Malay peninsula north to central Vietnam, probably between 500 BCE and CE 1 (Blust 1994, 2010). The history of the Makassar Strait group is less clear, but this population may have moved southwards rapidly, settling Java and its satellite islands and much of Sumatra before the front line of the western (Malayo-Chamic) group independently reached Sumatra and the Malay Peninsula. The languages of northern Sumatra and the Barrier Islands (Simeulue, Nias, Mentawai, and Enggano), apart from Acehnese, which appears to be a back-migration from Champa (Thurgood 1999), were evidently in place before the Malay penetration of Sumatra. They presumably derive, along with Javanese, Balinese, and Sasak, from the eastern migration stream that originated in Borneo.

Another language that clearly derives from this eastern Borneo stream, but which was strongly influenced by Sriwijayan Malay contact, is Malagasy (Dahl 1951; Hudson 1967; Adelaar 1989). In recent years it has also become apparent that the widely distributed dialects or closely related languages of the Sama-Bajaw maritime populations (*orang laut*), who are scattered over much of Indonesia and reach northward into the Sulu Archipelago and Capul Island off the west coast of northern Samar, subgroup with the Barito languages of southeast Borneo, the group to which Malagasy also belongs. In both cases, it appears that Sriwijayan Malay contact in connection with trade led to movements out of the Barito basin. In the one case this involved one or more movements across the Indian Ocean to Madagascar, where contact with Southeast Asia eventually ceased, and in the other it led to an ongoing maritime association with Malay speakers in managing the Moluccan spice trade until European competition cut this short in the seventeenth century, leaving the Sama-Bajaw as boat nomads who eventually settled down on land again in most locations (Blust 2005, 2007).[6]

Despite the efforts of Larish (1999) to link it with Malayo-Chamic, the position of Moken/Moklen, spoken by sea nomads in the islands of the Mergui Archipelago of southern Thailand and Burma, remains to be determined (Thurgood 1999:58–59). Unlike the Sama-Bajaw, who almost certainly played a major role alongside Malays in the pre-European spice trade, the Moken and their settled compatriots the Moklen appear to have adopted a roving life at sea for protection rather than commercial gain.

At some point after the initial AN settlement of Borneo, the expansion of Greater Central Philippines gave rise to large numbers of loanwords in the languages of Sabah, which show roughly equal degrees of lexical similarity to Greater Central Philippines languages and to the non-Philippine languages of northern Sarawak. Presumably at about the same time, and as part of the same population expansion, Proto-Gorontalic left the central or southern Philippines and settled northern Sulawesi, bypassing the Sangiric and Minahasan subgroups of Philippine languages that were already *in situ* and perhaps displacing other AN groups that had populated the area earlier (Blust 1991). Since Sulawesi lacks the geographical bulk of Borneo and has a particularly long and complex coastline, its topography probably gave rise to a more complex pattern of migration than the rather simple east–west split that seems to be supported by the linguistic data in Borneo, but this pattern is yet to be worked out in detail. The remaining languages of Sulawesi appear to fall into two large groups: Celebic (Mead 2003) and South Sulawesi (Mills 1975). The time-depth of their respective proto-languages remains unclear, as does the migrational history which led to their attested distributions (South Sulawesi languages, which include Buginese and Makasarese, are confined almost entirely to the southwestern peninsula of the island). Adelaar (1994) has argued that the Tamanic languages, in the upper Kapuas basin of West Kalimantan, are prehistoric immigrants from southern Sulawesi, with specific resemblances to Buginese, but this remains to be confirmed by further research.

The third significant landfall for populations moving south from the Philippines was the northern Moluccas, where the experience of AN speakers probably differed significantly from areas further to the west. It is apparent that the incoming Austronesians experienced considerable contact influence in both language and culture from pre-existing populations in this area. Indeed, the AN languages of eastern Indonesia and the Pacific show radical changes in structure that distinguish them sharply from those further to the west. For instance, the Philippine-type voice or "focus" morphology typical of the verb systems of many Formosan languages, nearly all Philippine languages, most languages of Sabah, northern Sulawesi, and Malagasy, were transformed in various ways in western Indonesia, in central and southern Sulawesi, and in Palauan and Chamorro, but these transformations at least maintain a generic similarity to the ancestral type. By contrast, Central-Eastern Malayo-Polynesian (CEMP) languages have a fundamentally different ground plan, suggesting extensive contact-induced change, much as the Chamic languages of Mainland Southeast Asia were radically transformed by centuries of heavy contact with their Mon-Khmer neighbors. What distinguishes these two cases is that we have fairly detailed evidence for the areal adaptations that transformed a pre-Chamic language that was structurally very similar to Malay into a set of descendants that now look much more like their Mon-Khmer neighbors, while the contact history of languages in eastern Indonesia is quite obscure.

Papuan languages of the North Halmahera language family dominate the northern half of the island of Halmahera, and AN languages the southern half (van der Veen 1915). However, the Papuan-speaking peoples of Halmahera are physically more typical of Austronesian speakers further west, while the AN-speaking peoples are much more like many populations in coastal New Guinea. These mismatches of language and phenotype suggest a complex history of contact and probable language replacement – one that is also seen in Timor amongst speakers of the Papuan language Fataluku. Neither the North Halmahera (Papuan) language family nor the South Halmahera-West New Guinea subgroup to which the AN languages of southern Halmahera belong has a time-depth much greater than that of the Romance or Germanic languages. This can only mean that the linguistic diversity on Halmahera, which might be expected to resemble that of New Guinea given that both Papuan and Austronesian languages are represented on the island, was reduced within the past two or three millennia by a major extinction event. AN languages from the region of Cenderawasih Bay then evidently moved back and repopulated this part of the northern Moluccas.

So far as the linguistic evidence permits us to infer, then, the migration stream coming south from the Philippines settled northern Borneo, northern Sulawesi, and the northern Moluccas at about the same time. Smith (n.d.) has correctly observed that this tripartite view of the Austronesian migrations south of the Philippines is more consistent both with the archaeological record and with the problematic nature of Western Malayo-Polynesian than the binary split model of Malayo-Polynesian languages into WMP and CEMP which has prevailed since Blust (1977).

Just as the southward movement of peoples in Borneo was split into western and eastern streams by the bulk of the island and the initial coastal orientation of the people, the movement into the northern Moluccas appears to have split very early into a stream that proceeded southward through the central Moluccas to the Lesser Sundas, and another that moved by an uncertain route (via the Admiralty Islands?) into the Bismarck Archipelago. Although this second population stream, which is widely associated with the Lapita culture complex in the Pacific, reaches beyond the confines of the present volume, the first stream is very relevant.

Most of the AN languages of eastern Indonesia have been assigned to a subgroup called "Central Malayo-Polynesian," or CMP (Blust 1982, 1983–1984, 1993). Both the CMP group, and the CEMP group of which it is a part, have been contested (Donohue and Grimes 2008; Schapper 2011), but objections have been raised against each of these critiques in turn (Blust 2009, 2012). The CEMP group, which includes all languages of eastern Indonesia and the Pacific apart from Palauan and Chamorro, is rather clearly defined by the introduction of two new vowels, PCEMP *e and *o, partly as irregular lowerings of *i and *u in inherited AN forms, and partly in apparent lexical innovations. The most important of the latter are cognate sets for marsupial mammals, including the phalanger (cuscus) and bandicoot, which are widely distributed in eastern Indonesia and the Pacific, as far east as the central Solomons in the case of PCEMP *kandoRa 'cuscus', and as far east as Fiji in the case of PCEMP *mans(aə)r 'bandicoot'.[7] If AN speakers originated west of the Wallace Line they would have encountered marsupials only during the penetration of Sulawesi (the cuscus) and the northern Moluccas (the cuscus, wallaby, and bandicoot – see Chapter 5), and if this had been the result of separate migration streams we would not expect the names for these novel fauna to be cognate. This is true for Sulawesi, where none of the recorded words for the phalanger or cuscus is related to any word recorded in eastern Indonesia. Thus, the widespread cognate sets reflecting *kandoRa and *mans(aə)r can only be explained as products of single innovations in a language ancestral to the AN languages of eastern Indonesia and the Oceanic languages of the Pacific.

CMP languages share many innovations that do not cover the entire group, implying that they spread through eastern Indonesia very rapidly, forming a dialect chain hundreds of miles long. Innovations then evidently spread along this chain, affecting the more central regions, but in some cases not reaching the eastern or western extremities. The question has also been raised whether the CMP languages spread through eastern Indonesia from east to west, or from west to east. Given the geography and the clear evidence for CEMP it is difficult to see how a west-to-east movement can be justified, since it would require CEMP languages to enter the western Lesser Sundas from Sulawesi. Yet there is no linguistic evidence linking any of the languages of Sulawesi to those of eastern Indonesia, occasional claims to the contrary (Donohue and Grimes 2008) notwithstanding. Such a migrational direction would also imply that the highest-order splits within CEMP would be in the western area occupied by these languages (hence in the western Lesser Sundas), not in the northern Moluccas, as implied by the primary split between CMP and EMP (South Halmahera-West New Guinea and Oceanic) languages. In short, both the evidence of geography (southward movement from the Philippines into the northern Moluccas) and the evidence of subgrouping (CMP and EMP as coordinate branches of CEMP) support the inference that the languages of eastern Indonesia entered the area from the northern Moluccas, and then spread south and west until they eventually met their distant linguistic congeners from eastern Borneo in the western Lesser Sundas (Figure 6.4).

One last issue will be touched on briefly. At various times it has been suggested that the Austronesian diaspora did not involve a major movement of people at all, but rather the adoption of Austronesian languages by pre-Austronesian populations who remained *in situ*. It is difficult to fathom the logic of this position. While it is true that languages can spread by conquest, as witnessed by the imposition of Latin over large areas that had previously been linguistically distinct, this is hardly possible with small-scale Neolithic populations who would have been in search of new lands to occupy rather than large-scale military conquests. If such an improbable situation as massive language shift had prevailed in the early Neolithic of insular Southeast Asia, it is difficult to see why it did not continue into historical times. What we actually find instead *as the major pattern* is continuing dialect differentiation, even amongst communities that have been long united within a common polity, as on the island of Java (Nothofer 1981).

Some of the questions raised by language distributions that have been discussed here do imply either language shift or language extinction, as with the less-than-expected linguistic diversity in the Philippines, especially the central Philippines, or the surprisingly shallow time-depth for languages in the Batanes Islands, or for both the Papuan languages of northern Halmahera and the AN languages of southern Halmahera. However, these are local eddies in a much broader current that is more plausibly explained, both archaeologically and linguistically, as the result of a millennia-long population expansion that almost certainly began on the island of Taiwan, and led in time to a collection of related languages that extend across an extraordinary 206° of longitude from Madagascar in the west to Rapanui in the east, and 72° of latitude from Taiwan in the north to New Zealand in the south.

Further Questions of Austronesian Linguistic History

Before Taiwan: The Antecedents of Proto-Austronesian

The cultural and linguistic ancestry of the Pre- (or Initial) Austronesians who settled in Taiwan more than 5000 years ago are universally agreed to lie in or very close to southern China, rather than in Indochina or Island Southeast Asia. At this time, both Indochina and the islands to the south of Taiwan were still inhabited by hunter-gatherers whose languages have not survived in any clearly recognizable way, although Donohue and Denham (2010) argue for survival of substratum elements in the modern Austronesian languages of the region. Presumably, such substratum populations spoke languages now extinct, perhaps with Papuan features in eastern Indonesia. Adelaar (1995) has also raised the possibility that a faint linguistic substratum from this older time period has survived in some Peninsular Malaysian (Aslian) and western Sarawak languages, especially Bidayuh (Land Dayak).

This is possible, but only the Philippine Negritos survive today as a distinct biological population of indigenous Pleistocene ancestry in the islands directly south of Taiwan, and they have all adopted Austronesian languages, about 30 in all, related to those of their Filipino neighbors (see Reid 1994a, 1994c, 2013). According to Reid, these language shifts occurred fairly early in the Austronesian dispersal process since many Negrito languages retain quite ancient cognates from Proto-Malayo-Polynesian that have been lost in other languages. Reid suggests that these long-ago culture contact situations involved head-hunting by the Austronesians, a practice that often drove Negrito groups into hiding, hence perhaps assisting their survival into the present as a distinct biological (but not linguistic) population. Interestingly, many Philippine Negrito groups refer to lowland Filipinos by terms meaning "red" (for skin color?) or "rice harvester."

Suggestions that the Austronesian languages belong to a phylogenetic macrofamily together with one or more of the extant language families of eastern mainland Asia go back for more than a century. Claims for apparent cognates are not in short supply in the literature (as discussed by Blust 2014), but often it is difficult to distinguish between true cognacy and instances of early borrowing followed by many millennia of phonological assimilation. Such macrofamily suggestions include Paul Benedict's (1975) "Austro-Thai" genetic hypothesis, demoted to an early borrowing relationship by Thurgood (1999), but since reinstated by Sagart (2004) as a full genetic relationship. Sagart's hypothesis postulates ancestral Tai-Kadai as a sister subgroup to Malayo-Polynesian, hence possibly originating within Taiwan. If correct, this would bring early Tai-Kadai speakers from Taiwan to Guangdong around 4000 years ago.

However, Guangdong for most other linguists lies within the most likely Tai-Kadai homeland region in southern mainland China (e.g., Ostapirat 2005), and it will be interesting to see how Sagart's hypothesis stands up to future linguistic and archaeological scrutiny. It is clearly acceptable to linguist John Wolff (2010), but not to Blust (2014), who incidentally discusses other macrofamily suggestions involving Austronesian that do not withstand linguistic scrutiny. However, there is general agreement amongst linguists that Austronesian and Tai-Kadai do share some faint degree of common ancestry, and the southern Chinese coastal Neolithic prior to 3000 BCE would, for me, be the place to look for any traces of this, at least in terms of archaeology.

Another suggested macrofamily is the venerable "Austric," which groups Austronesian and Austroasiatic at a deep genetic level (Reid 1994b, 2005). This hypothesis was first suggested by Schmidt in 1906 and has had rather a checkered career since that time, although it still lacks positive attestation. As Reid (2005:150) states: "The concept of 'Austric' as a language family may eventually need to be abandoned in favor of a wider language family which can be shown to include both [Austronesian] and [Austroasiatic] language families, but not necessarily as sisters of a common ancestor."

Since 1994, another "Sino-Austronesian" macrofamily involving Sinitic languages within the Sino-Tibetan family has been championed by Laurent Sagart (1994, 2008), who favors an origin in the Chinese Neolithic of Henan or the Yangzi region amongst groups growing rice and millets and practicing incisor evulsion, a trait commonly found in Neolithic cemeteries in China and Taiwan. Sinitic languages and Austronesian are also noted by Sagart to share a large rice vocabulary separate from that of Austroasiatic and Tai-Kadai. As with Austro-Thai and Austric, however, Sino-Austronesian also resists any non-controversial demonstration at the present time.[8]

From the viewpoint of prehistory these macrofamily hypotheses are quite important (Bellwood 1994), even if they cannot be decisively adjudicated. Whether Austronesian relates to Tai, Austroasiatic, or Sinitic (Sino-Tibetan), and whether the observed relationships reflect common genetic origin or ancient borrowing, the conclusions are almost the same in terms of historical significance. Ancestral Austronesian languages, prior to the colonization of Taiwan and the period of Proto-Austronesian, were evidently part of a geographical network of inter-communicating linguistic communities on the mainland of southern China. These languages were still undifferentiated into the clear and separate ancestors of existing families, yet they probably formed a network that also included the seeds of the early Austroasiatic, early Tai, and early Sino-Tibetan language families, especially ancestral Chinese. I discuss this idea in my two recent books (Bellwood 2005, 2013) as part of a farming/language dispersal hypothesis (Bellwood and Renfrew 2002) which will be examined in more detail in Chapter 7. Basically, burgeoning farming populations in the early millennia after the development of agriculture in different parts of the world needed to expand, and in doing so they also spread their languages in different directions.

The ultimate roots of the Austronesian expansion therefore lie in the Neolithic cultures of central and southern China, although this does not mean that all living speakers of the Southeast Asian language families under discussion come from one small region of the Yangzi basin or somewhere nearby. Agricultural development in China was a vast demographic and geographical phenomenon, already by 5000 BCE on a scale far beyond anything that developed in Southeast Asia prior to the time of Christ. Even by 5000 BCE in China, there must have been a network of presumably related languages linking the middle and lower Yellow and Yangzi river valleys of China and the smaller riverine regions in between.

Out of this region ultimately sprang the progenitors of the Austronesian, Tai, and Austroasiatic languages and the genetic ancestors of many of their speakers, although the languages spoken then would not have differentiated into the basal proto-languages that we can reconstruct today until the migrations of established food-producer populations began to enter new landscapes (Bellwood 2009). During the intervening time period, population expansions and "domino effects" on surrounding hunter-gatherer populations might have maintained southern China as a hotbed of population growth, population admixture, and periodic out-migration. Eventually, one group crossed

Taiwan Strait to settle Formosa from Fujian or Guangdong, and thus founded the greatest ethnolinguistic migration in Holocene human history.

How Did the Austronesian Languages Spread Initially throughout Island Southeast Asia?

Bob Blust has asked this question already, and I want to expand a little from my own perspective because the question is extremely important. When considering geographical distribution alone, the extent of the Austronesian languages is very impressive indeed. I agree entirely with Blust that the expansion of this language family involved an actual expansion of Austronesian-speaking founder communities through this vast area (Bellwood 1991, 2013). This may seem self-evident, especially for Remote Oceania (beyond the Solomons), where prior populations simply did not exist. They did exist, however, in Island Southeast Asia, and this is where many disagreements arise.

Nowadays, it is accepted by all linguists that there was widespread adoption of Austronesian languages by members of previously unrelated linguistic groups in western Island Melanesia and amongst the Negritos of the Philippines (Reid 2013). But there have also been recent suggestions that the basal Austronesian languages in Island Southeast Asia spread everywhere *only* by language shift, or at most in the mouths of a few elite males who might also have been spreading a seductive religion (Donohue and Denham 2010; Blench 2012).

In my view, these suggestions receive little support from modern genetics or archaeology, and do not match with other historical situations of language spread, on the huge scale of Austronesian, amongst other societies around the world. Elite dominance and religions do not necessarily spread new languages through whole populations at all. The inhabitants of the former Roman Empire did not all speak Romance languages in 400 CE, just as the peoples of West and South Asia in 1 CE did not all speak languages derived from the Hellenistic Greek used during Alexander's conquests. No major international religion in world history (e.g., Christianity, Islam, Buddhism, Hinduism) has spread in such a way that its living adherents all speak one language, or even a set of closely related languages. Hebrew was no longer a vernacular language at all prior to its deliberate revival in the nineteenth and twentieth centuries. Therefore, most linguists offer little doubt that the Austronesian languages spread essentially (but not entirely) with their native speaker communities. As Malcolm Ross (2008:165) has stated very firmly: "The speakers dispersed, taking their languages with them."

Indeed, the situation that developed as early Austronesian-speaking communities expanded into the islands of Southeast Asia is not too hard to visualize. The genetic data tell us very clearly that Austronesian newcomers and non-Austronesian natives admixed, and thousands of unions must have occurred between couples of different genetic and linguistic backgrounds, as discussed for genetics already by Murray Cox in Chapter 4. However, genetic mixing and language mixing are by no means the same (Hunley et al. 2008). Most linguists hold that truly blended languages such as

Tok Pisin of Papua New Guinea (Melanesian structure, English vocabulary) result from pidginization under unusual and often catastrophic colonial circumstances of population upheaval. True pidgins and creoles were uncommon in precolonial situations, and whole languages have not mixed as readily throughout human history as have genotypes.

In other words, chromosomes recombine with every birth, half from the mother and half from the father, but languages do not mix quite in the same way.[9] *Franglais*, defined by my *Oxford Dictionary* as "a corrupt version of French using many words and idioms borrowed from English," is not structurally half French and half English. The reality of inter-language contact and borrowing amongst pre-state societies is discussed by linguist Malcolm Ross (2001) using his concept of "metatypy." This implies a transference from one language to another of elements beyond simple vocabulary, and often right up to the level of syntax (grammar), in environments of functional multilingualism between the speakers of the separate languages that were brought into contact. Metatypy, however, is not as intensive or catastrophic a mixing process as pidginization. Languages that have undergone metatypy still belong to identifiable language families, whereas modern Tok Pisin of Papua New Guinea is strictly neither Austronesian nor Indo-European.

However, Donohue and Denham (2010) do suggest, quite rightly, that something akin to a metatypic level of interaction occurred right at the start of the Austronesian expansion process, hence their focus on non-Austronesian assimilation and substratum effects. But this focus leads them to reject any actual Austronesian population spread beyond superficial levels of "elite dominance." Given that 4000 years have gone by since Austronesian speakers first began to spread into Island Southeast Asia, and given that they are still spreading today, it seems more realistic to accept that this process of metatypic change has occurred over dozens or hundreds of generations, as demographically more numerous Austronesian-speaking agriculturalist populations gradually assimilated their non-Austronesian and mostly hunter-gatherer neighbors. This assimilation occurred eventually to such a degree that only Austronesian languages are spoken nowadays in Island Southeast Asia west of Timor and the Moluccas, although the possibility that a Papuan language existed in Sumbawa until 1815 has been noted by several linguists (e.g., Donohue 2007).[10]

Directionality and Relative Chronology in the Early Austronesian Migration Process

The overall pattern of Austronesian language dispersal has already been described by Bob Blust. However, as he noted, there are some difficulties in determining exactly in which directions the first speakers of Austronesian languages migrated once they started to move beyond Taiwan. This is because the mesh of spoken dialects had not yet differentiated into the subgroups that exist today, so the precise directions of the very earliest migrations are linguistically masked. A Taiwan origin for PAN might well be acceptable to most linguists, but beyond Taiwan, in the rest of Island Southeast Asia, the picture is not always so clear.

In other words, early migrants traveling at much the same time, in multiple directions, and all speaking very closely related descendant dialects derived from Proto-Malayo-Polynesian (PMP), could have met, mixed, and remixed with linguistic close cousins many times over, all the while adjusting and merging their vocabularies and slowing down any isolationist tendencies. The early spread of MP languages might in this regard have been similar to the recent spreads of colonial languages such as English, Spanish, and French. Even if rates and extents of communication in recent centuries have been far ahead of those of the Neolithic, it is notable that these European languages spread essentially over several centuries as single languages and still retain full intercomprehensibility across vast areas today.

Admittedly, PMP was probably not as homogeneous as modern English, but with both examples a relative degree of isolation between pockets of speakers would be required if well-defined linguistic subgroups were/are to develop. The subgroups of Austronesian (and especially MP) that we can identify today did not form instantly at the first occurrence of migration. The MP languages accumulated their shared innovations progressively through the generations and centuries. English, of course, has not done very much of this yet, but by 3000 CE the situation might be different.

Isolation, whether relative or absolute, thus leads to loss of mutual comprehension and encourages linguistic subgroup formation. We might, therefore, ask how long it could take for intercomprehensibility in lexicon, phonology, and grammar to dissipate between pairs of languages of common source. We have two windows from which to approach this question.

First of all, Captain James Cook made a very significant observation while in Poverty Bay, New Zealand, in October 1769. He had sailing with him a Raiatean (Society Islands) man who had inherited a deep knowledge of the locations of many islands across central Polynesia. On meeting a group of Maoris, Cook recorded: "Tupia spoke to them in his own language and it was an [a]greeable surprise to us to find that they perfectly understood him" (Beaglehole 1955:169).

Given that New Zealand lies almost 5000 km southwest of the Societies, Cook's surprise was understandable, since Polynesian vocabularies had not yet been collected and compared to the level attained during his second voyage (1772–1975). Cook also did not know that New Zealand had been first settled by Polynesians around the thirteenth century CE, only 500 years before his arrival. We will never know just what "perfectly understood" meant to Cook, but it is likely that Maoris and Raiateans had preserved so many cognate terms within their basic vocabularies that understanding between them was not seriously impaired, even if a few words had become different.

The second window on ancient rates of language change comes from comparisons of successive reconstructed proto-languages in terms of their shared percentages of inherited cognates. Andrew Pawley (2002) notes that the development from PAN to PMP involved a 15–30% lexical replacement, a process that he equates with about 1000 years of time (see also Blust 1993). This estimate accords well with the archaeological time gap of perhaps 1500 years between the initial arrival of Neolithic cultures in Taiwan (c. 4000–3500 BCE), and their arrival much later (c. 2200 BCE) in the northern

Philippines. However, the subsequent development from PMP to Proto-Oceanic involved only a 12% lexical loss, which implies a relatively fast movement from the Philippines to the Bismarck Archipelago, the likely homeland of Proto-Oceanic. A 12% loss would hardly have impaired mutual intelligibility and it must have been a percentage of this order that Cook was unknowingly recording between Maori and Raiatean in 1769.

These observations imply that early MP populations located across the huge region from the northern Philippines (the likely homeland of Proto-Malayo-Polynesian) to the Bismarck Archipelago (the likely homeland of Proto-Oceanic) could have traveled that huge distance with only a 12% loss of shared vocabulary. This is supported by the archaeological record for quite rapid Neolithic dispersal (chapters 7 and 8) during the second millennium BCE. The migrations probably occurred in more than one direction at any one time, although we will perhaps never know the precise directional details for certain since mutual intelligibility would have allowed all sorts of movements to occur without leaving clear traces in the eventual subgrouping structure of MP.

The issue of varying rates of language change through time has also been quite important within Austronesian historical linguistics because it affects the validity of time estimates using purely linguistic data. Raiatean and Maori were spoken by isolated island populations who never met speakers of other non-Polynesian languages, so their rate of linguistic change was quite slow. Perhaps it would have taken a millennium or more for them to lose mutual intelligibility completely. However, MP languages in western Melanesia and coastal New Guinea had quite different histories, involving such rapid contact-induced change due to influence from Papuan sources that many now have only minimal quantities of inherited Austronesian cognate vocabulary.

Indeed, attempts to date Austronesian linguistic history using linguistic calculations alone have had a long presence in Island Southeast Asia and Oceania, involving especially the two analytical vocabulary-based techniques termed lexicostatistics and glottochronology. I do not discuss these techniques here since they have gone rather out of fashion in recent years, and readers can find an account in my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007:113–116), wherein I discuss Blust's (2000a) negative investigation into their usefulness, together with earlier lexicostatistical claims by Isidore Dyen (1965) for a Bismarck Archipelago origin for the Austronesian language family.

However, the whole chronological question of pulse and pause in the Austronesian migration process has been investigated recently by an application of phylogenetic computational methods derived from the biological sciences (Gray et al. 2009; Gray and Jordan 2000; Greenhill and Gray 2009). The Bayesian statistics applied to Austronesian cognate vocabulary by Gray and colleagues allow definition of a phylogeny that defines both pulses and pauses in expansion, and which can also offer a calibrated chronology by using ancient but dated inscriptional languages. Within MP, these include (Old) Javanese, Malay, Cham, and Balinese, all first written in stone or copper plate inscriptions with Saka Era dates (commencing 78 CE) during the late first to early second millennia CE, within the heyday of the Indic kingdoms.

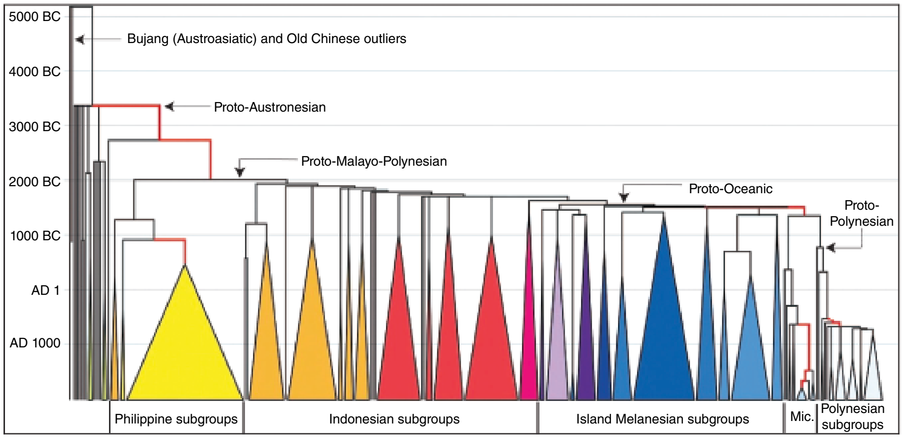

Figure 6.3 Map and maximum clade credibility tree of 400 Austronesian languages (Mic. = Nuclear Micronesian languages (i.e., without Chamorro and Palauan, which are WMP). Source: modified from Gray et al. (2009: Figure 1), and reproduced courtesy of Russell Gray and Simon Greenhill. Individual subgroups are identified in detail in Gray et al. (2009) and this reproduction is only intended to give a general overview.

The tree derived from this methodology is presented in Figure 6.3, and it reveals very clearly a slow evolution in Taiwan starting about 5300 years ago (early Austronesian), followed by a major starburst between 4300 and 3500 years ago (early MP), which quickly reached western Micronesia and Melanesia. Much later movements occurred into eastern Micronesia and Polynesia, precisely as illustrated by the archaeological record. Austronesian dispersal from Taiwan to New Zealand thus required 4000 years, but the rate of expansion was clearly not fixed and pre-determined. As in all of human prehistory, circumstances, and no doubt intentionality, mattered as well, as did pure chance.

The upshot of the above discussion is that vast areas of Island Southeast Asia and western Oceania were initially settled by Malayo-Polynesians speaking a single language, or at most a group of very closely related and mutually intelligible languages and dialects. The subgroups that linguists recognize today, whether in Taiwan or anywhere else in the Austronesian world, did not appear fully formed during these first few centuries, although they might have been faintly foreshadowed quite quickly as communities began to drift apart with distance. Indeed, the early centuries of the breakup of PMP will have left us very few clues from which to determine migration directionality, apart from the obvious clue of a Taiwan starting point and a geographical chain of intervisible islands leading directly into the Philippines. Beyond the Philippines, many options offer themselves, some shown in Figure 6.4.

The Material Culture and Economy of the Early Austronesians

We might now ask what it was that drove the Austronesians and Malayo-Polynesians to settle such a vast area, taking their language(s) with them. From my perspective, the most important answers revolve around food production and boat building/

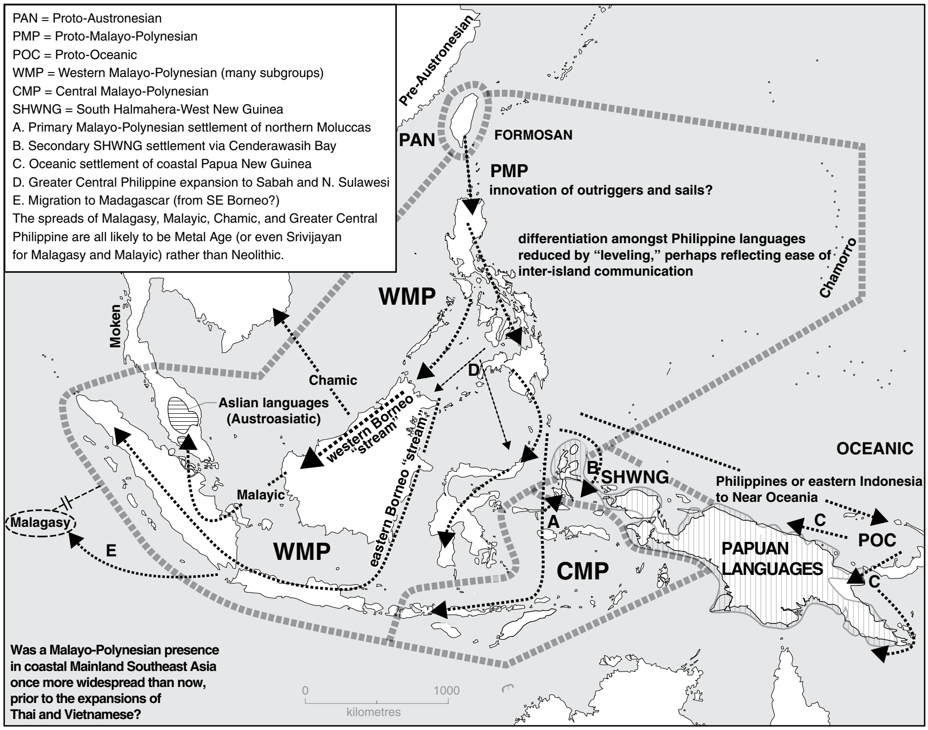

Figure 6.4 The likely migration directions of early speakers of Malayo-Polynesian languages, as reconstructed from comparative linguistic evidence.

navigational technology, and on these the archaeological record obviously offers a direct source of information (chapters 7 and 8). It is also accepted by linguists that cognates with stable meanings that occur at the extremes of the Austronesian world, for instance in at least one language in Taiwan, Island Southeast Asia, and Polynesia, are candidates for reconstruction to PAN (Blust 1976, and see Table 6.3). Candidates without a cognate in Taiwan are likely to be reconstructible to PMP if they occur in both Southeast Asia and Oceania, although loss through innovation in Taiwan might also be a possible explanation in some instances. Since PAN and PMP were separated by at least a millennium in time and a subtropical Taiwan versus a tropical Philippine latitude, the distinction between these two reconstructed proto-languages is of profound significance in plotting the details of Austronesian migration through Taiwan into the Philippines and Indonesia.

For instance, words for truly tropical plants such as sago and breadfruit can only be reconstructed for PMP, exactly as expected. They can only be grown with difficulty in most of Taiwan, which straddles the Tropic of Cancer. Words for colder climate species such as rice, millet, and sugarcane go back to PAN, and the first two clearly were grown in Taiwan since they survive there in the Neolithic record (Chapter 7, although actual remains of sugarcane have not yet been identified). In Table 6.3, the reconstructed items are separated into potentially Proto-Austronesian and potentially Proto-Malayo-Polynesian. I state “potentially,” since there is always a possibility that

Table 6.3 Reconstructions with potential archaeological correlations from PAN and PMP. Sources: Data from Blust 1976; Zorc 1994; Pawley 2002; Wolff 2010; Blust and Trussell 2014, and other sources as mentioned.

Class of Material Culture and Subsistence Economy	Level of Reconstruction	English Gloss for Reconstructed Item
Food Production	Proto-Austronesian	Domesticated pig, dog, rice in field, husked rice, cooked rice (Sagart 2003), rice straw, foxtail millet, sugarcane, banana, *Alocasia* sp. (an aroid), betel nut,[11] garden/cultivated field, canal/ditch, mortar, pestle, winnow, pandanus, drunk (adjective).
	Proto-Malayo-Polynesian	Cock/rooster, *Colocasia esculenta* (taro), *Dioscorea alata* (greater yam), coconut, breadfruit, ginger, citrus fruit, sago, cucumber, lime for betel quid.
Hunting and Fishing	Proto-Austronesian	Hunt, bow, shoot an arrow, fish-hook, fish trap, bamboo basket trap for fish, derris root fish poison, monkey, squirrel, pangolin (Blust 1982), head-hunting (Wolff 2010; Reid 2013).
	Proto-Malayo-Polynesian	Blowpipe (Zorc 1994), bamboo trail- or pitfall-spikes, bait, fish net, bird lime, snare, dolphinfish, tuna, bonito.
House and Contents	Proto-Austronesian	House/family dwelling, granary.
	Proto-Malayo-Polynesian	Ridgepole, rafter, thatch, storage rack above hearth, hearth, public building, ladder.
Tools, Utensils, Weapons	Proto-Austronesian	Needle, tattoo, pot, loom and weaving (Buckley 2012), hematite (Blust 2013b).
	Proto-Malayo-Polynesian	Putty/caulking substance, comb, conch shell trumpet, pillow/wooden headrest, digging stick, torch, axe/adze, ramie (a natural fiber, *Boehmeria nivea*).
The Canoe	Proto-Austronesian	Canoe/boat, sail, monsoon wind, rope/cord.
	Proto-Malayo-Polynesian	Paddle, outrigger, rollers for beaching a canoe, canoe bailer, rudder/steer, raft.

later borrowings can masquerade as deeper-level cognates if they fulfil sound-change requirements, and conversely it must be remembered that absence of a reconstruction at a particular level need not mean a real-life absence. It could just reflect replacement of lexical items, as perhaps with meanings such as paddle, adze, and ramie (a plant fiber), which do not technically reconstruct to Proto-Austronesian yet are known archaeologically in far older contexts in Neolithic southern China. It must also be remembered that there is only relatively limited information available from the 14 or so surviving Formosan languages. Most Formosan aboriginal populations now survive inland and on the east coast, and many have been heavily assimilated into the dominant Sinitic-speaking Taiwanese population.

I will be making further observations on this list in due course, but it should be noted that the domesticated animals do not include any herbivores (cattle, water buffalo, sheep, or goats). Another point, made by Pawley (1981, 2002) and by Blust (1976), is that sound correspondences suggest strongly that material culture traditions (potting, agriculture, fishing, etc.) were continuous through time. They were never lost by any widespread Austronesian populations and later regained through re-innovation or external borrowing, even though former food producers in interior Borneo and southern New Zealand did abandon food production and specialize in food collection owing to purely localized factors related to agricultural marginality.

The main point to be noted, however, is that PAN was clearly a vocabulary of food producers with some form of boat transport, a knowledge of pottery and weaving, and domesticated pigs and dogs. Proto-Malayo-Polynesian speakers specialized more in the production of tropical latitude tubers and fruits/nuts, acquired domesticated chickens, and now sailed between islands in canoes with outriggers and sails (see also Pawley and Pawley 1994; Zorc 1994). In archaeological terms, all of these peoples belonged to Neolithic and not Metal Age communities, albeit still fishing, gathering, and hunting whenever these activities were available and profitable.

The Austronesian Diaspora: A Perspective from Indonesia

An Invited Perspective by Daud Aris Tanudirjo

Indonesia has the largest Austronesian-speaking population of any country – no less than 250 million today. What is more, this archipelagic state occupies a strategic location on the Pacific Rim. Stretching from 6° north to 11° south in latitude and between 95° and 140° east in longitude, the Indonesian Archipelago is situated between the Indian Ocean in the west and the Pacific in the east, and between the Asian mainland and Australia-Oceania. It is thus precisely in the center of the Austronesian language distribution. These features ensure that the Indonesian archipelago will always play an important role in the search for the origins and dispersal patterns of the Austronesian-speaking populations.

A shared Austronesian culture has long been regarded as the root of modern Indonesian culture, as expressed in the Old Javanese and Sanskrit national motto *Bhinneka Tunggal Ika* (unity in diversity). However, awareness of a shared Austronesian heritage as the basis of the nation's identity has fluctuated, depending on political and historical perspectives. Interest was present during the Sukarno regime, after the Declaration of Independence in 1945, mainly due to the need for a cultural identity that could unite the whole of the nation. However, shared Austronesian identity was apparently not a useful concept during the New Order of the Suharto years (1965–1998). There was little discussion and research on Austronesian issues inside Indonesia at this time, even though linguistic and archaeological debates on this issue were escalating in the international forum. It was only after 2002 that Austronesian issues gained more attention from Indonesian scholars, especially as sociopolitical conditions in Indonesia showed signs of disintegration, against which a strengthening of national identity could be seen as a solution. Hence, proving the greatness of Indonesian culture in the past is regarded nowadays, by some, as a necessity. Such an obsession is manifested in research that aims to recover evidence for the autochthonous origins of a Greater Austronesian culture in Indonesia.

A Brief History of Austronesian Studies in Indonesia

The widespread existence of the language family that we presently know as Austronesian has been recognized since the end of the sixteenth century, when Cornelis de Houtman, the captain of the first Dutch fleet that landed in 1596 in Banten, West Java, noted a relationship between the Malagasy and Malay languages (Blust 1984–1985). In the seventeenth century, members of the Schouten and Le Maire expedition collected lexical items in East Futuna (western Polynesia), which came to the attention of the philologist Adriaan Reland. In 1708, Reland revealed close similarities between Malay and some languages of Oceania (Blust 1984–1985; Tryon 1995). In the early nineteenth century, William Marsden speculated that the origin of this as-yet-unnamed language family was in Asia (Anceaux 1965). In 1885, R.H. Codrington pointed out that some Melanesian languages were related to Malay and Polynesian (Terrell 1981). Based on a more systemic linguistic study, Hendrik Kern in 1889 called the language family "Malayo-Polynesian," a term evidently first used by linguist Franz Bopp in 1841 (Ross 1996). Further, Kern suggested that the homeland of the family was probably on the coast of the Asian continent, particularly in the southern part of Vietnam, although he also considered western Indonesia and southern China as other possible source regions.

Another prominent linguist, Father W. Schmidt, came to the same conclusion and located the origin of Kern's Malayo-Polynesian language family also in the southeastern portion of the Asian mainland. However, he coined the term "Austronesian" for the whole family in 1906, as it is still used in this book, and proposed an origin out of an "Austric" language which separated into the ancestral Austroasiatic and Austronesian language families. After the split, Austroasiatic remained on the mainland, while Austronesian moved into the island world (Anceaux 1965; von Heine-Geldern 1945). In Indonesia, the Kern–Schmidt hypothesis for the origins of the Austronesian language family in southern China or Vietnam was almost uncontested until a few decades ago.

The Kern–Schmidt hypothesis was also initially strongly supported by archaeologists working in the region. In the 1920s, P.V. van Stein Callenfels studied the distribution of certain types of stone adze that he deemed had been brought into Indonesia by Austronesian speakers. Based on the results, he agreed on a southern China or Vietnam homeland for this language family. In 1932, Robert von Heine-Geldern (1932) published his influential article, "Urheimat und früheste Wanderungen der Austronesier," in which he offered a quite comprehensive hypothesis to account for the dispersal of Austronesian speakers into Island Southeast Asia and Oceania. He placed the homeland of the Austronesian speakers in southern China, particularly in Yunnan. He also argued that there had been at least two waves of Austronesian migration, an earlier around 2000 BCE and a younger about 500 BCE. Though he placed the remote origins of Austronesian speakers in southern China, he contended that the immediate homeland was in the Malay Peninsula, where the ancestral Austronesian population developed what he called the *Quadrangular Adze Culture.* This consisted of cultural elements such as untanged and quadrangular-sectioned stone adzes, stone reaping knives, rice and millet cultivation, pig and cattle raising, brewing of rice beer, pottery making, bark cloth manufacture, head-hunting, construction of rectangular stilt houses, megalithic monuments, and a special style of art. He suggested that this culture dispersed widely from the Malay Peninsula westward to Madagascar and eastward through the Indonesian archipelago to the remote parts of the Pacific, assisted by the ability to construct and navigate seaworthy outrigger vessels.

In 1948, American archaeologist H.O. Beyer, who worked mostly in the Philippines, proposed that the homeland of the Austronesians was in South China or North Vietnam. He also favored Austronesian migration as several movements, but this time through the Philippines rather than the Malay Peninsula, and onwards into eastern Indonesia and western Polynesia. Later on, Roger Duff (1970) concluded similarly that the Austronesian speakers brought quadrangular-sectioned and tanged stone adzes from coastal South China, via Taiwan and the Philippines, into eastern Indonesia and Polynesia (including New Zealand).

This "Out of South China" model has nowadays become the most prominent theory in the reconstruction of the Neolithic cultural history of Indonesia. Alternative theories were sometimes introduced, the most significant coming from linguist Isidore Dyen (1965), who located the Austronesian homeland in western Melanesia based on a lexicostatistical analysis of basic vocabularies. This provoked some interest at the time (Murdock 1964; Koentjaraningrat 1997), but is now universally rejected by linguists. Until two decades ago, nearly all textbooks on Indonesian cultural history (e.g., Soekmono 1972; Soejono 1984), including elementary and high school texts, referred to the Out of South China theory. It has entered the common reservoir of knowledge of the Indonesian people, and "Austronesia" is now widely considered as a part of the Indonesian national identity.

Since the 1990s the "Out of South China " and "Out of Taiwan" models of early Austronesian migration have been introduced to Indonesian archaeologists mainly through the works of Peter Bellwood, through both his collaborative archaeological research in Maluku Utara (1991–1996), and his publications (e.g., Bellwood 1984–1985, 1995, 2000, 2007; Bellwood et al. 2011). My own PhD research in northeastern Indonesia (Tanudirjo 2001) was largely formulated as an examination of this hypothesis, and my new data allowed me to propose an alternative model of Austronesian dispersal based on theories of globalization (Tanudirjo 2001, 2004, 2005). I framed the Austronesian diaspora and subsequent prehistory within five successive phases: Homeland, Initial Dispersal, Later Dispersal, Regional Interaction, and Regionalization.

Austronesian Languages and National Identity

As a result of the above, debates on the origins and dispersals of early Austronesian speakers started to obtain wider and more serious attention, especially when the Indonesian Institute of Sciences, or Lembaga Ilmu Pengetahuan Indonesia (LIPI), decided to convene a special session on Austronesian prehistory during its 8th National Science Congress in 2003. This special session attracted scholars from various disciplines and exposed them to alternative theories to explain Austronesian origins, including those of Solheim (1984–1985) and Meacham (1984–1985) on autochthonous origins, Terrell's (1988) model of an "Entangled Bank" rather than migration as a metaphor for Austronesian expansion in Melanesia, and Oppenheimer's (1998) postglacial drowning or "Eden in the East" hypothesis for Sundaland (LIPI 2004). Some leading Indonesian scholars appeared to hold parallel opinions; for instance, paleoanthropologist Teuku Jacob (2004) and sociolinguist E.K.M. Masinambouw (2004) both argued that Austronesia was merely a linguistic entity created by language shift, unrelated directly to any extensive migratory movement of Austronesian speakers. The Sundaland hypothesis has recently attracted attention from a wider audience since, as expressed by Oppenheimer, it identifies the Indonesian archipelago as the center of development for many early civilizations. In this regard it can be compared with the hypothesis of Arysio Santos (2005) that Plato's lost continent of Atlantis was located in Indonesia. Santos' speculations have been very popular and have recently gained strong support from some geologists (Natawidjaja 2013).

Theories such as the above can trigger nationalistic views that boost Indonesia as the oldest center of a hypothesized world civilization (e.g., Samantho 2011; *Tempo* 2012). However, such interpretations tend to go too far and to become politicized. Research aimed at proving such interpretations enters the domain of "pseudo-archaeology" and indeed often sparks controversy (Tanudirjo 2012). Unfortunately, the Indonesian government sometimes gives implicit support to such research, as, for instance, to a multidisciplinary research project focused on the Gunung Padang terraced megalithic site in West Java (see Chapter 8 and Figure 9.6), claimed to be a buried stone pyramid "greater than Borobudur" built by indigenous tribes around 5200 BCE (Dipa 2014), and, what is more, with an inner chamber that contains tons of gold (*Tempo* 2012). In 2014, a large excavation was carried out by a research team that employed military personnel sponsored by the Indonesian Ministry of Education and Culture at a cost of more than 3 billion rupiahs (c. 215,000 US dollars), even though many scholars and prominent figures opposed the decision. The chamber has not yet been found.

From a modern Indonesian perspective, it is clear from all multidisciplinary sources of data that there was no simple population replacement during the expansion of the Austronesian-speaking people. It is more likely that complex interactions occurred between former inhabitants and immigrants, the latter perhaps arriving in more than one phase. Both migration and language shift, probably through bilingualism, thus lie within the roots of Austronesian expansion. Hence, the term "Austronesia" is most appropriate for the languages, rather than widespread entities in biology or culture.

Notes

1. Bellwood 2001a, 2001b, 2005, 2008, 2009, 2010, 2013, 2015; and see Ostler 2005.
2. http://www.ethnologue.com/browse/families.
3. Some idea of how quickly the population of Southeast Asia is growing will be gained by comparing these figures with those in first edition of *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 1985). Indonesia's population has increased by almost 60% since 1985, and Madagascar's has doubled.
4. True cognates will have undergone the regular phonological changes characteristic of each of the languages in which they are found. This is how they can be separated from borrowings, which usually carry give-away phonological features from donor languages.
5. (Comment from Peter Bellwood) The unique tectonic structure of the Philippines, with islands grouped around several inland seas, was described in Chapter 2 (see Figure 2.2) and might have had something to do with this leveling. The Philippines are geographically unique in Island Southeast Asia in this respect, and would always have had easy communication between coastal regions, except perhaps down the more rugged and exposed eastern fringe of the archipelago.
6. (Comment from Peter Bellwood) Kusuma et al. (2015) actually favor a sea nomad (Sama-Bajaw) origin for the settlement of Madagascar based on genetic evidence.
7. But since bandicoots are not native to the Fijian Islands the word applies there to a placental rat.
8. Readers of Chapter 4 will note, in Fig. 4.5, that ancient and modern Austronesian-speaking populations are linked most closely through their craniofacial measurements with ancient and modern East Asians, rather than with Austroasiatic-speaking Mainland Southeast Asians. This suggests some possible support for Sino-Austronesian links.
9. As linguist Andrew Pawley (2002:266) points out, "By definition, there was genetic continuity in the transmission of speech among the communities who carried Austronesian languages from Taiwan to Polynesia, but the speakers need not have maintained genetic continuity in the biological sense."
10. However, the usage of Papuan vernaculars until now by many of the native peoples ruled by the northern Moluccan trading sultanates of Ternate and Tidore raises questions about

just when this Sumbawa Papuan language, if this is what it really was, traveled so far west. Perhaps it was of historical-era origin.

11. The online Austronesian Comparative Dictionary (http://www.trussel2.com/ACD/acd-ak_b.htm) lists PAN reconstructions for both banana and betel nut.

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Chapter 7
Neolithic Farmers and Sailors in Southern China, Taiwan, and the Philippines

Since 2005, I have published two books of a general and worldwide nature, one on the origins and dispersals of food-producing societies, the other on the history of human migration.[1] These books contain many sections that reflect my current understanding of the history of the whole of mankind, both hunting-gathering and food producing. I have also published several articles focused on the Neolithic archaeology and corresponding linguistic and genetic prehistories of Island Southeast Asia.[2] My fundamental views concerning Island Southeast Asia have not changed significantly since the last full revision of my *Prehistory of the Indo-Malaysian Archipelago* in 1997 (Bellwood 1997, 2007). However, new data demand crucial adjustments, particularly concerning topics such as the development of rice agriculture and Neolithic population demography in China, the absolute chronology of archaeological assemblages throughout Neolithic Island Southeast Asia, and the archaeological relationships between Island Southeast Asia and external regions such as Vietnam, the Malay Peninsula, New Guinea, and Oceania.

From my current viewpoint, the biological, linguistic, and archaeological sources of evidence clearly attest a mid-Holocene Neolithic expansion of Malayo-Polynesian-speaking populations, with food production and boat construction skills, through the islands of Southeast Asia and onwards, commencing from Taiwan around 4000 years ago. The linguistic evidence was reviewed in the previous chapter and it is the view of both Robert Blust and me that the ancestral Malayo-Polynesian languages spread mainly with their speakers, rather than entirely through language shift. Given the need for a migration hypothesis, the only period of major archaeological change in Island Southeast Asia that can be correlated with the whole phenomenon of Austronesian (including Malayo-Polynesian) language dispersal was the commencement of the Neolithic. Naturally, this does not explain all the migration evidence that we have for the Austronesian language family, but it certainly explains a very substantial foundation, extending from Taiwan all the way out into Polynesia and eventually Madagascar along an ever-shortening time scale.

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

The economic evidence at present available suggests that a universal economy of hunting and gathering existed in Island Southeast Asia prior to the Neolithic, although the literature is not short of claims for indigenous and pre-Neolithic systems of fruit/tuber cultivation and arboriculture using vegetative methods of planting, a suggestion that goes far back into the history of agricultural origins research within the region.[3] Indeed, such forms of mid-Holocene (and independently developed) food production are now well attested for interior New Guinea (Lebot 1999; Denham 2011). It would be most unwise to rule them out for pre-Neolithic Island Southeast Asia. The strength of the Papuan biological and linguistic "barrier" to Austronesian settlement in New Guinea and adjacent islands implies that the Papuan-speaking peoples already had some form of economic advantage when Malayo-Polynesian-speaking peoples first arrived. Perhaps this was food production of a vegetative nature, as in the New Guinea Highlands. However, we need further archaeological evidence for the lowland and island regions of far eastern Indonesia and Near Oceania before we can state authoritatively that food production was in place there prior to the Neolithic.[4]

In this regard, the issue for Island Southeast Asia is not in fact whether pre-Neolithic people were 100% hunter-gatherer and Neolithic people 100% farmers. Far more significant is the issue of the demographic potentials of whatever economic systems were in place at the times in question (Bellwood 2009). What population densities were they capable of supporting, with what rate of population increase per generation? Neolithic material cultures of ultimate mainland Asian origin, and Austronesian languages, replaced the material cultures and languages that were there beforehand. This in itself is a situation worthy of careful recognition and research.

Indeed, within Island Southeast Asia proper, the sheer coherence of Neolithic expansion from Taiwan into Island Southeast Asia and Oceania by 1000 BCE, as well as the universal dominance today of Malayo-Polynesian languages west of the Moluccas and eastern Nusa Tenggara, suggest that late Paleolithic and pre-Malayo-Polynesian forays into low-level food production probably had little demographic or cultural impact.[5] However, the cordilleran mountain regions of New Guinea proper contained broad high-altitude equatorial valleys that were highly conducive to an indigenous development of food production and without parallel in the volcanic arc or Sunda shelf portions of Island Southeast Asia. This is an extremely important observation that needs to be stressed. In New Guinea, immigrant Malayo-Polynesian-speaking populations were only ever able to maintain their languages in small coastal pockets.

While it is rapidly becoming apparent that the Neolithic expansion in many regions of Island Southeast Asia brought to a close the long era of prehistoric hunting and gathering, it was certainly not a geographically unified or totalitarian process of biological and cultural replacement. Late Paleolithic populations continued to use Island Southeast Asian caves long after Neolithic cultures arrived, as suggested, for instance, by Mijares (2006) for northern Luzon. The hunting and gathering lifestyle has been progressively eroded but it has certainly never disappeared entirely. Flaked stone tools continued to be used by both hunting-gathering and agricultural groups until the recent past in some areas, especially in southern and eastern Indonesia.

Agriculturalists have also continued to hunt and gather into modern times. Hence, in recent millennia, different technologies and economies could and did occur in neighboring and contemporary sites, creating a cultural mosaic.[6]

The Origins of Rice Production in China

At present, the archaeological record does not indicate an independent origin of food production in Island Southeast Asia. Of the major crops grown there, rice and the millets were introduced from southern China and are identified linguistically as part of the Proto-Austronesian agricultural vocabulary, together with pigs and dogs. Non-cereal plants such as aroids (taro-like species), yams, bananas, and sago palm were also domesticated in various times and places within the region from southern China to New Guinea, whereas truly tropical crops such as breadfruit and coconuts were domesticated in Island Southeast Asia or western Oceania (Bellwood 2007:245–249). However, outside the New Guinea Highlands we have no direct evidence that indigenous plants stimulated a local origin of agriculture amongst local hunter-gatherer populations. It is far more likely that they were brought into existing Austronesian cultivation systems as migrants spread and discovered useful species already under some degree of management by indigenous hunter-gatherers.

There is now enough botanical, linguistic, and archaeological evidence to allow a clear reconstruction of the early stages of agricultural prehistory in China, hence of the economic background for Neolithic migration into Island Southeast Asia. The Yellow and Yangzi rivers are two of the largest in Asia, both flowing roughly 500 km apart in the lower 1000 km or so of their courses. Within and between their middle and lower basins we find the archaeological record that documents the early cultivation and domestication of three very important crops – rice (*Oryza sativa*) of the *japonica* subspecies in the wetter south, and foxtail and common millet (*Setaria italica* and *Panicum miliaceum*) in the drier north and west. Both millets and rice occur together in many Neolithic sites along the Yellow River and also in the Huai Valley between the Yellow and Yangzi, but the Yangzi itself initially had a focus on rice.

Foxtail and common millet were the main crops of the earliest Yellow River Neolithic and were presumably domesticated there. They helped (eventually with rice, from the south) to fuel the rise of Sinitic civilization, which entered its early historical Bronze Age (Shang Dynasty) around 1500 BCE. We are not here concerned with the rise of Sinitic civilization *per se*, but it should be noted that the Chinese languages are deeply related to other East Asian languages such as Tibetan and Burmese, the whole forming the Sino-Tibetan language family, which spread extremely widely over the northern mainland of Southeast Asia, together of course within China itself and Circum-Himalayan central Asia.

Our interest from an Island Southeast Asian perspective is focused more on the Yangzi (Figure 7.1). This river flows with its many tributaries through a vast region of temperate monsoonal climate, characterized by heavy summer rainfall alternating with a cold dry winter during which plant growth is severely impeded. Would-be rice farmers

Figure 7.1 The Neolithic of southern China and Taiwan – sites discussed and the landscape of early rice cultivation. The shaded area shows where pre-domestication cultivation of *Oryza sativa japonica* occurred prior to 6000 BCE. The dotted line, after Fuller et al. (2010), shows the northern and western limits of wild rice during the early Holocene. Numbered sites are 1, Caoxieshan; 2, Kuahuqiao; 3, Hemudu; 4, Tianluoshan; 5, Shangshan; 6, Tangjiagang; 7, Baligang; 8, Tanshishan; 9, Keqiutou; 10, Fuguodun; 11, Damaoshan; 12, Dabenkeng, Yuanshan, and Xuntangpu; 13, Hongmaogong; 14, Niumatou; 15, Huagangshan; 16, Dakeng. For additional sites in Taiwan and Luzon see Figures 7.3 and 7.4.

could only have raised one crop per year without irrigation under such climatic conditions, yet it was probably also those very conditions, at this particular latitude, that promoted the initial development of cultivation and eventually full rice agriculture.

Unfortunately, no archaeologist, botanist, or zoologist has ever explained *exactly* why humans, in so many separate parts of the world, should have progressed independently into food production at various times during the past 12,000 years, with such dramatic consequences for the demographic and cultural trajectory of our species.[7] Suggested socio-economic backgrounds for agriculture include a prior existence of sedentary behavior with elements of individual rather than group ownership of territory (Gallagher et al. 2015), risk avoidance in situations of sharp climatic instability, population growth beyond available resources requiring conscious production rather than collection of food, and the economic demands of competitive feasting behavior (Hayden 2011). Sedentism for defense amongst hunter-gatherers might also have been promoted by heightened levels of between-group aggression.

Of course, all of these could have played varying roles in different regions in the promotion of sedentism and cultivation (Bellwood 2005), and to them we must add the essential proviso that being in the right place at the right time really *mattered*. Some regions were far richer in domesticable and highly successful wild plant and animal species than others. This is essentially why the Middle East, central China, Mesoamerica, and the northern and central Andes have played such fundamental roles in Holocene world prehistory (Diamond 1997).

It is also very clear that humanity's post-Paleolithic advancement must have related in some way to the fundamental warming and wetting of the earth that occurred after the last glacial maximum (LGM), especially between about 18 and 13 kya. This warming, with its increased production of carbon dioxide and plant and animal life, was undoubtedly involved in the demographic expansion of humanity, ultimately of course into the billions of people who exist today. There is absolutely no trace of any such development before the last glacial maximum, and certainly none after previous interglacials, except perhaps for the first movement of modern humans out of Africa during or after the last interglacial, a topic touched upon in Chapter 4. But this movement did not involve food production, perhaps because of limitations in Middle Paleolithic technology, especially in the management of plant foods. In my view, it was the final post-LGM episode of warming that set the stage for our rise to cultural and demographic glory, although that warming was not the only actor on the stage.

If postglacial warming really was the sole "cause" of food production, then we might expect it to have developed everywhere in the warmer and agriculturally possible (temperate and tropical) latitudes of the globe. Manifestly, it did not. At European contact, many populations in Australia, the Americas, and the Old World remained hunter-gatherers (indeed all of them in Australia and Tasmania), even in regions as agriculturally rich today as California, Florida, eastern Australia, and even parts of tropical Malaysia and the Philippines. This suggests to me that the hunt for any universal cause for food production, such as worldwide postglacial warming, will always be frustrated. This obliges us to look for more proximate causes. From an East Asian perspective we need to ask why central China was so special, apart from the obvious fact that the wild ancestors of rice and foxtail millet must have grown there when food production started to develop.

The answer will probably run something like this. Twenty thousand years ago, during the dry and frigid last glacial maximum, sea levels were lowered by over 100 m and average temperatures were 5°C below the present. The lower courses of the Yellow and Yangzi rivers were incised into the exposed continental shelf of eastern China, flowing into estuaries located as much as 1000 km to the east of the modern coastline. Agricultural fertility meant little to humans at that time but the potential for development was already there, especially on the extensive loess soils formed of glacial dust carried outwards by the winds that were created by cold air sinking over glaciers. Also in that landscape existed the wild ancestors of pigs and dogs, and presumably broomcorn (common) and foxtail millet wherever they could tolerate the cold, although at that time wild rice would only have grown in the far south of China.

Wild plant production increased rapidly with the start of postglacial warming, as did the numbers of wild animals that fed on the plants and the humans who fed on both. The early Holocene sea level reached a maximum, after a relatively rapid 60 m rise, between 9500 BCE (the end of the Younger Dryas mini-glaciation: Smith et al. 2011) and 5000 BCE. The Yellow and Yangzi valleys were now drowned as deep estuaries in their lower courses. Wild rice spread northwards almost to the Yellow River in the warmer and wetter early Holocene monsoonal conditions, although the domesticated Yangzi subspecies (*Oryza sativa japonica*) originated from a perennial wetland ancestor (*Oryza rufipogon* – Figure 7.2) and hence required permanent wetlands. Such wetlands would have been relatively infrequent along the newly drowned eastern coastline of China prior to 5000 BCE, but some would have existed in certain protected inland locations.

According to the archaeological record, such protected wetland locations included:

a) small inland valleys south of Hangzhou Bay in northern Zhejiang Province, where the oldest evidence for rice cultivation actually occurs in sites of the Shangshan culture (Zheng et al. 2016);
b) the freshwater wetlands of the nascent Yangzi delta itself around Lake Taihu, protected from marine incursion by sand ridges (Zong et al. 2007);
c) the alluvial lakes in the middle Yangzi Valley, mainly in Hubei and Hunan provinces;
d) the Huai Valley and other near-coastal regions between the Yangzi and Yellow rivers.

However, after 5000 BCE, the arrival of a relatively stable sea level allowed new areas of agriculturally productive alluvial land to form through alluvial deposition in downstream valley bottoms, along coastlines, and in river deltas. It is henceforth after this time that we see the most dramatic evidence for population growth in the Yangzi and Huai basins.

It is likely that the perennial *Oryza rufipogon* was eventually converted into the annual cultivated and domesticated *Oryza sativa* through planting in locations where water was present for a few months only during the summer monsoon.[8] This purposeful movement on to summer rain-fed rather than all-year-round wet soils would have assisted the domestication process, since seasonal swamps would not have supported wild stands of perennial *Oryza rufipogon* and so the problem of incipiently domesticated *Oryza sativa* backcrossing constantly with perennial wild rice would have been minimized. Thus, any characteristics selected by human planting could have been retained in the population (Allaby et al. 2008).

However, the question remains – why should people have cultivated rice, or any other cereal, in the first instance? Why not just continue forever collecting plant foods from the wild, especially if the wild was becoming more productive under warmer postglacial climatic conditions?

To examine this question we must start with some definitions. "Cultivation" refers to a series of human activities – land clearance, planting, watering, weeding, keeping off predators, harvesting, threshing, storing, and replanting next season. Some hunters and gatherers exploit wild cereals and process them for bread ("damper") and gruel products, but they do not go through such an elaborate series of seasonally determined activities as those just listed, which taken together are markers of an agricultural

Figure 7.2 Top, right to left: wild perennial *Oryza rufipogon*; wild annual *Oryza nivara*; and domesticated annual *Oryza sativa*. Bottom: domesticated *Oryza sativa* being harvested with a metal finger knife, Iban, Sarawak. Sources: top, photo Colin Totterdell, CSIRO, Canberra; bottom, photo Hedda Morrison.

economy. However, simple cultivation can work very well with purely wild crops as well as domesticated ones, and it is here that the genetic definition of "domestication" needs an introduction.

Domesticated crops and animals have been selected by human management, usually via interference in the reproduction of planting or breeding stock to promote favorable characteristics. In cereals, these include the ability for grains to stay on the ear in a bunch when ripe (a habit termed non-shattering), bigger and more grains per ear, synchronous ripening of grains both on individual plants and within stands, loss of dry-season dormancy (meaning the seeds can be planted throughout the year), and variations in taste, color, and stickiness (especially for rice). Domesticated animals also developed favored characteristics related to docility and fertility. Whether or not ancient humans selected for these characteristics *consciously* is a question that cannot easily be answered, but I always like to think that our ancestors were just as smart as us. Surely every hunter-gatherer since some time back in the Paleolithic has understood that a seed put in the ground and watered can grow into something interesting, and that it can be rewarding to keep pet animals and perhaps allow them to breed?

However, genetic domestication was not in itself the origin of food production; cultivation takes the prize in this regard. We must not forget that it was cultivation, as a sequence of food-producing activities in one place, which promoted settlement sedentism and its corollary of human population growth, thus leading in snowball fashion to more cultivation and no doubt to the rise of the overcrowded world that we inhabit today.

But we still need to ask why humans began to cultivate if they could simply collect from the wild. Remember, the world climate was even warmer than now during the early Holocene, and certainly warmer than during the LGM, so wild rice grew up to a little north of the Yangzi at that time. Average grain production per wild rice plant is thought to have been higher at this marginal and stressful latitude than in southern China (Lu 2006), so possibly quite large human populations subsisted from it (Yan 1991:125). However, during this time of transition from the Pleistocene into the Holocene the climate was still quite unstable. Around 10,000 BCE, the short-lived Younger Dryas mini-glaciation would have reduced the length of the summer growing season for a millennium or so, especially as far north as the Yangzi or Huai, sufficiently to reduce wild rice yields. Did people decide to plant and protect some wild rice at this time in order to survive?

This question about the role of the Younger Dryas has been asked in the early agricultural context for many regions of the world. While it remains difficult to pinpoint it as a direct cause for conscious cultivation in China, the general idea that such a burst of climatic inhospitality might have stimulated cultivation activity within the general climatic trend of getting warmer, wetter, and more food-rich is worthy of consideration. This could be true for many different regions of early agricultural development, including the Middle East, China, Mesoamerica, and the Andes (Bellwood 2005; Lu 2006).

Nevertheless, the practice of cultivation *per se* still does not explain plant and animal *domestication*, since for the latter we need some behavioral factor that will induce selection of favored characteristics. Simple gathering or even cultivation of wild rice without selection will lead to no genetic change in the crop, no matter how widespread the cultivation might be. For instance, if the rice is harvested slightly unripe to avoid loss through shattering, this will preclude any seed selection for replanting. To encourage the genes for non-shattering within a wild cereal population one must select in some way amongst the harvested rice grains that are kept for planting in the next growing season. For instance, if one uses a sickle or finger knife

(Figure 7.2) to harvest rice grains, it is likely that those genetically predisposed not to shatter, or to ripen later on the ear, will be more likely to be harvested than those that shatter early. A similar level of selection will occur if the grains are harvested very late, when the shattering ones will have dispersed already and only those with a non-shattering genotype will be most likely to survive on the plant and be collected (Fuller 2007). Non-shattering genes are actually quite rare in wild populations since they hinder successful reproduction, so the harvesting knives of stone or shell (or bamboo?) found in some Chinese and Taiwan Neolithic sites are of interest as a selection mechanism in this regard.

Because of the gradualness of selection for domesticated characteristics, the archaeological record of rice domestication in China was quite drawn out, occurring mainly between 7000 and 4000 BCE. It was marked by a gradual rise in the proportions of non-shattering grains in archaeological assemblages, with the slowness caused perhaps by constant backcrossing with wild populations (Fuller 2007; Fuller et al. 2009). Yet there are some sites, especially in the Huai Valley between the Yellow and the Yangzi, and south of Hangzhou Bay, that have quite high proportions of domesticated grain (recognized from microscopic examination of spikelet breakage patterns) as early as 6000 BCE.[9] What we appear to see is a mosaic of local transitions to domestication in rice, some more successful than others, until about 4500 BCE when domesticated rice took a major hold throughout the middle and lower Yangzi and Huai valleys and the collection of wild foods such as acorns and chestnuts fell away dramatically. From this time onwards, central China embarked on one of the greatest demographic expansions in its history, with migratory repercussions that eventually (thousands of years later) reached as far away as Polynesia and Madagascar.

The Evolution of Neolithic Societies in China

In central China, *Oryza sativa japonica* was well on the way to becoming a domesticated wetland crop by the late sixth millennium BCE, grown in small embanked plots that retained water. What cultural and demographic characteristics accompanied its domestication? Here, we have an absolute bonanza of archaeological material, mostly recovered in the past decade (Plate 3). To put matters in perspective, between 7000 and 3000 BCE the population of the central plains of China increased by a factor of between 10 and perhaps even 50, according to which regional settlement pattern data are drawn upon.[10] This population increase depended upon the production of increasingly domesticated crops and animals, including not just rice but possibly also other tree, grass, and tuber crops such as sago palms (Yang et al. 2013), bananas, and possibly sugar cane and taro. By 2500 BCE, the human population during the Qujialing and Liangzhu phases in the middle and lower Yangzi basins had perhaps entered the millions, when central China surely had one of the densest populations in the contemporary world, as arguably it still does today. Indeed, Biraben (2003:2) has suggested that the central Chinese population attained 20 million between 2000 and 1 BCE, although this estimate was based on cross-cultural inference rather than archaeological data.

Five thousand years beforehand, what could arguably have been sedentary village life made an initial appearance during the Shangshan phase (c. 7000 BCE) in the Yangzi region, in sites located in small swampy valleys south of Hangzhou Bay (Liu et al. 2007; Long and Taylor 2015). Houses, apparently on piles, were constructed of timber, and people harvested a late summer rice crop that was definitely at an early stage of domestication in terms of a low presence of non-shattering spikelet bases (Zheng et al. 2016). Fragments of rice chaff, stalks, or leaves were mixed into Shangshan potting clay as temper.

Two millennia later (c. 5500 BCE), lots more rice and pottery, with remains of a log canoe and several paddles, were deposited in waterlogged layers in the lower Yangzi site of Kuahuqiao (Plate 3b). By this time there is archaeological evidence for offshore sailing to the islands of the Zhoushan Archipelago, newly formed off the mouth of Hangzhou Bay by the postglacial rise in sea level (ZPICRA 2004). This is the first direct evidence we have for sea crossing in southern China and it is very significant in light of what was to come.

By 5000–4500 BCE, very large villages of longhouses on stilts were being constructed at the famous excavated sites of Hemudu and Tianluoshan, both in alluvial lowland settings in northern Zhejiang Province, south of Hangzhou Bay.[11] Hemudu was an eye-opener for the world when first excavated in 1973, being a village of rectangular timber houses (one being 7 m wide by over 23 m long) constructed with skillful carpentry techniques and raised above ground on rows of timber piles (Plate 3a). Large quantities of rice husk were found as temper in the sherds and in one area of the excavation a solid mass of rice husks, grains, straw, and leaves formed a layer, perhaps once a threshing floor, with an average thickness of 40–50 cm. This rice, still not entirely non-shattering, was cultivated in the alluvial soils around both sites, possibly with a range of non-domesticated plant foods including foxnuts, water chestnuts, and huge quantities of acorns (perhaps from planted trees, and perhaps fed to pigs). The acorns were stored in large pits. Pigs accounted for most animal bones and it is assumed, based on a decrease in tooth size, that they were domesticated, together with dogs. The range of mammals hunted included water buffalo, deer, rhinoceros, elephant, and monkey. A massive earth oven suitable for cooking such animals, with large balls of fired clay to retain the heat (stone being absent in these alluvial lowlands), was excavated at Tianluoshan (Plate 3c).

The material culture of Hemudu and Tianluoshan is particularly impressive (Plate 3d–h). It includes finely carved wooden artifacts and house timbers that illustrate the use of mortises, tenons and dowels, detachable wooden spade blades, hoes made from animal scapulae, bone tools and whistles, jade penannular earrings, quartz microdrills like those from Bukit Tengkorak in Sabah (Chapter 8), and stone adzes with oval or quadrangular cross-sections. Knee-shaped adze hafts are also found, of a shape that occurred universally amongst the Malayo-Polynesian-speaking peoples of Oceania at European contact. Pottery items include portable stoves, spindle whorls, animal figurines, and a range of cord-marked vessels with round or flat bases and often carinated bodies and incised rims. This earthenware tradition shows that the totality of potting knowledge found in the early cultures of Taiwan and Island

Southeast Asia was already present in the Yangzi region at least a millennium before the beginning of the Neolithic in Taiwan. This need not mean that Hemudu and Tianluoshan were necessarily sources in themselves for migration to the south, but the excellence of preservation in their waterlogged assemblages makes them beacons for the achievements represented in Yangzi Valley Neolithic life prior to 4000 BCE.

Lately, it has become possible to identify a sequence through time in the development of cultivation systems in some of these lower Yangzi archaeological sites through analysis of the phytoliths of weed species, focusing on phytolith forms known to characterize wet versus dry environments (Weisskopf, Harvey et al. 2015; Weisskopf, Qin et al. 2015). Thus, the earliest Neolithic fields were created from natural perennial wetlands along river banks and next to swamps. Then followed a phase of seasonal rain-fed cultivation with small sunken or embanked fields, as rice farming spread away from the permanent wetlands on to the seasonally wet alluvial plains. Finally came the development of true canal-irrigated cultivation in embanked field systems during the late Neolithic, around 2500 BCE. This sequence is actually rather important, because as rice spread into Island Southeast Asia it appears to have undergone similar changes, from wetland fields, through rain-fed shifting cultivation, towards the irrigated wet rice systems that characterized the early Indic kingdoms in suitable environments in Southeast Asia (Bellwood 2007:249–253).

Neolithic Movement into Southern China

With the establishment of full agricultural dependence after 4500 BCE, a portable economy of transplantable and transferable domesticated plants and animals allowed a number of Neolithic population spreads to commence from the Yangzi region southwards.[12] Some followed the coastline southwards towards Fujian, others followed inland tributaries of the Yangzi southwards towards Guangxi, Guangdong, and northern Vietnam. The latter movement, according to Rispoli (2007), was well marked by a spread of distinctively incised and punctate- or dentate-stamped pottery. Both of these movements brought Neolithic societies with agriculture to beachhead positions facing Taiwan by about 4000–3500 BCE.

The reason for all of this emigration from central China need not have been population pressure in the absolute sense of exceeding the carrying capacity of the terrain, even if periodic climatic and sea level perturbations in the lower Yangzi region did from time to time impact adversely on specific sites and cultures (Zong et al. 2007). Neither is it necessary to visualize huge concerted migrations of Neolithic populations similar to those of refugees in the present and recent past. Rather, we must think in terms of small but continuous movements with the ability to maintain high birth rates in new and advantageous environments. If every family on average had three children or more, and if only 25% of these children across the whole population died before childbearing age, then it does not require a mathematical genius to understand that farming populations would extend continuously outwards, as in high-birth-rate colonial situations in the Americas and Australasia during the nineteenth century, and also amongst Chinese settlers in Taiwan after 1660 CE (Chen 1987). After all, a population of 100 people, increasing at a rate of only 1% every year, will turn into ~2 million in 1000 years unless increasing mortality rates or birth control decisions intervene.

Such growth leads to what has commonly been referred to as "demic diffusion" in the genetic literature (e.g., Cavalli-Sforza 2002), whereby an expanding population spreads amongst and through an indigenous one (assuming the targeted region was already populated) with resultant admixture, leading to a constant diminution of the source-region genetic profile of the immigrants as they spread. This would have been combined with a constant centrifugal increase in the representation of indigenous genetic profiles, which would doubtless have been quite diverse in the case of populations with indigenous Paleolithic roots. The concept of demic diffusion plays a major role in my two recent books about worldwide patterns of human migration (Bellwood 2005, 2013), and it undoubtedly played a major role in Neolithic China and Southeast Asia, just as it did if we examine the courses of colonial population expansion in the past few centuries in the Americas, Australia, and New Zealand.

Under what cultivation regimes did rice agriculture spread throughout southern China to reach Southeast Asia beyond Taiwan? Dorian Fuller and Ling Qin (2009) have suggested that it spread originally as a wet-field crop, in accordance with the lower Yangzi sequence described above. However, it was also spreading southwards from central China at a time when coastlines were maximally flooded by the Holocene sea level rise, such that perennial freshwater swamps would have been of limited extent. Swamplands were plentiful in the Yangzi basin and delta situations (Zong et al. 2007: Figure 1; Zheng et al. 2009), but such favorable circumstances are unlikely to have been available along the more exposed coastlines of China south of Hangzhou Bay.

As an example of this, the Neolithic site of Tanshishan in Fujian Province, now 75 km inland near Fuzhou City, was located between 3000 and 2300 BCE on an island at the head of a long and deeply incised estuary (Rolett et al. 2011). I have noted a similar situation for the coastline and rivers of Ilocos Norte in the northern Philippines (Bellwood et al. 2008); the Holocene sea level rise here drowned narrow incised valleys that were cut down to the last glacial maximum sea level through steep coastal terrain (the Philippines do not lie on a continental shelf), forming long and deep inlets flanked by steep slopes. Mike Carson in his invited perspective below investigates such situations further for southeastern Taiwan and the lower Cagayan Valley of Luzon.

All of this means that wet rice agriculture had problems in spreading initially beyond the Yangzi region during the mid-Holocene high sea level phase, owing to a scarcity of wetlands. Hence, it is likely that rice farming spread towards Taiwan partly through shifting cultivation in the steep and rugged landscapes of Fujian and Guangdong, with rain-fed cultivation in embanked fields occurring only in valley bottoms wherever sufficient flat land was available. Of course, hunting, fishing, and gathering continued as well, as stressed by Jiao (2016). However, while Jiao uses the term "low-level food production" for Neolithic communities in southern coastal China, we must take into account the lack of preservation of any plant remains at all in many sites (so we cannot really know what was their subsistence economy), and also a propensity of the "low-level" concept to focus on the poorer rather than the richer environments. The significance of this will become clear when we examine the waterlogged sites at Nanguanli in Taiwan, where unusual circumstances of preservation have revolutionized understanding of Neolithic economy in that region.

The finer details of the southern Chinese archaeological record need not delay us further, except that one question needs to be asked. Which rice-growing Neolithic populations at around 3500 BCE were the most likely to have moved from the mainland of southern China across to Taiwan? The syntheses of archaeological research in Fujian Province by Tianlong Jiao and his colleagues (Jiao 2007a, 2007b) indicate that sequential Neolithic cultures, potentially instrumental in the colonization of Taiwan, existed in several coastal localities and on many small offshore islands formed by the postglacial sea level rise. The sites of Liangdao, Fuguodun, Keqiutou, Tanshishan, Damaoshan, and Huangguashan, all located facing Taiwan on the coast of Fujian or on small offshore islands, document a series of consecutive cultural developments between 6500 and 1500 BCE.[13] Between these two dates there was a gradual shift from mainly cord-marked and impressed pottery towards plain wares, with some red slipping occurring throughout the sequence. We see a similar trend, albeit slightly later in date, in the Neolithic of Taiwan. The origins of red slipping within the East Asian context were probably in central China, given its occurrence on the rice husk tempered pottery from Shangshan in Zhejiang at about 7000 BCE. Stamped circles and punctate stamping were also present after 3500 BCE at Tanshishan and Damaoshan in Fujian, and these decorative techniques occur widely in some of the oldest pottery in Island Southeast Asia and western Oceania.

In addition, the earliest stone adzes in the Fujian coastal sites were untanged (e.g., at Keqiutou), but stepped ones (for hafting) became common after 2500 BCE, especially at Tanshishan and Huangguashan (Jiao and Rolett 2006). These stepped adzes with trapezoidal or triangular cross-sections are generically similar to many from Neolithic Taiwan and the Philippines, including the Batanes Islands (Duff 1970; Bellwood and Dizon 2013). Other important cultural and exchange markers such as jade bracelets, biconical spindle whorls, and rice were also present by 3000 BCE at Tanshishan and Huangguashan, as well as in Guangdong (Yang et al. in press). Today, Fujian is one of the poorer provinces of China in agricultural terms, with only a very narrow coastal plain and periodic drought, hence the significance of this coastline in the Chinese diaspora of the nineteenth and early twentieth centuries into Southeast Asia and Oceania. Perhaps it offered similar persuasions for emigration during the Neolithic.

In recent years, archaeologists in working Taiwan have also shown great interest in Neolithic assemblages that occur in Guangdong Province to the west of Fujian as possible sources for the Taiwan Neolithic. The relevant sites here occur around Shenzhen (Xiantouling and Dahuangsha), in Hong Kong, and around the Pearl delta (Tsang 2005). The Neolithic cultures of this region originated in middle Yangzi Neolithic cultures dating to about 5000 BCE, such as Tangjiagang, Gaomiao, and Daxi, rather than in the Yangzi delta itself. However, these Guangdong connections in untanged and tanged adzes, stone knives, grooved bark cloth beaters of stone, and incised and delicately stamped pottery (Yang 1999) could be precursors for some aspects of the Taiwan Neolithic, as discussed by Hsiao-chun Hung in her invited contribution below. Domesticated rice phytoliths dating to 3500 BCE are also reported from a sedimentary core from eastern Hainan (Wu et al. 2016), although the archaeological record for this strategically located island still remains obscure.

Of course, populations from several areas of coastal southern China could in reality have made crossings to Taiwan, initially perhaps bringing more than one different language. All surviving indigenous languages on the island are Austronesian, but if immigrant Neolithic populations were small in the first instance, it is possible that those with the most viable economies and fastest growth rates eventually imposed their languages on smaller groups. Seeking a single archaeological source for any Neolithic island population can be a difficult exercise, and in this regard a combined Guangdong–Fujian source region might be the wisest option.

The Out of Taiwan Hypothesis for Austronesian Dispersal into Island Southeast Asia

At this point, I want to emphasize a hypothesis already introduced linguistically in Chapter 6, one that will play a very important structural role in the remainder of this chapter and the next. The hypothesis suggests that the vast majority of the modern Austronesian-speaking populations of Island Southeast Asia, especially those with a recent Asian genetic heritage, share a common biological, linguistic, and cultural origin in a period of population migration from Neolithic southern China, through Taiwan, commencing around 5500 years ago. This is the "Out of Taiwan" hypothesis. At the present time, it has both supporters and detractors.[14]

Linguistically, the Out of Taiwan hypothesis has already been presented in detail in Chapter 6. The movement out of Taiwan into the Philippines and Indonesia carried Austronesian languages and their speakers at the level of Proto-Malayo-Polynesian (perhaps only one or a few closely related languages to begin with), such that all existing Austronesian languages today in Southeast Asia beyond Taiwan, and including Oceania, belong to the enormous Malayo-Polynesian subgroup. In archaeological and chronological terms, the actual movement from Taiwan via the Batanes Islands into Luzon occurred around 2200 BCE, give or take a few centuries. This hypothesis will, of course, be substantiated in the remainder of this chapter, and it is important to remember that the chronology comes mainly from the archaeological record, with assistance from linguistic calibrations using epigraphic source materials in languages such as Old Malay, Old Javanese, and Old Cham (attested from the mid to late first millennium CE; see Gray et al. 2009).

However, before going further I should stress three important provisos about issues connected with the Out of Taiwan hypothesis that are open to possible misunderstanding:

a) The hypothesis does not propose that the ancestors of all living people who speak Austronesian languages migrated from or through Taiwan. Many Australo-Papuan populations, including the Philippine Negrito and Island Melanesians, speak languages in this family and hence qualify as Austronesians. But they have genetic profiles that are primarily of much deeper indigenous (pre-Neolithic) Southeast Asian and Melanesian origin.

b) Neither does it require mass migration or the extinction of indigenous populations. Initial Neolithic settler groups were perhaps very small, but with high birth rates, and it would have been the numbers of settler females and their birth rates in the new territories that would have determined eventual demographic outcomes.

c) The suggested Neolithic population migration from southern China into Taiwan around 5000 years ago does not mean that all modern Southeast Asians have "Han" Chinese ancestry. South China was not Sinitic-speaking during the Neolithic. The Chinese cultural landscape that exists today originated as a result of dynastic migration and settlement from central China, commencing during the Zhou Dynasty and extending by 100 BCE into northern Vietnam. China south of the Yangzi, prior to the Shang and Zhou dynasties (c. 1600–221 BCE), and certainly prior to the Qin and Han (221 BCE to 220 CE), can be regarded in cultural, linguistic, and population terms as part of Southeast Asia.

The small island of Taiwan therefore played a fundamental role as a gateway for the movement of Neolithic populations, material cultures, and languages from southern China into Island Southeast Asia, as underlined by a new analysis of ancestry components in whole genomes across many Southeast Asian populations (Mörseberg et al. 2016). Even as I write, new data come to hand with surprising frequency supporting an Out of Taiwan origin for Malayo-Polynesian-speaking peoples. For instance, a major chloroplast DNA clade of the paper mulberry tree (*Broussonetia papyrifera*), source of an inner bark used across the Pacific Islands and much of Southeast Asia to make bark cloth, has recently been shown to be of Taiwan origin (Chang et al. 2015).

Neolithic Cultures in Southeast China, Taiwan, and Luzon

An Invited Perspective by Hsiao-chun Hung

In southern China, the oldest evidence for rice agriculture is currently much later than that for pottery production. Although early rice cultivation can be traced before 6000 BCE in the middle Yellow and middle-lower Yangzi valleys, rice farming in southern China, especially in Fujian, Guangdong, and Guangxi, is not yet attested before 3000 BCE (Zhang and Hung 2010; Yang et al. in press). Instead, archaeological evidence prior to this date in coastal southern China still indicates a continuing reliance on maritime resources (Zhang and Hung 2014), as represented by numerous shell midden and sand dune sites dated between 5000 and 3000 BCE. These include Keqiutou in Fujian and Xiantouling in Guangdong (Figure 7.1), both with sand tempered pottery decorated with stamped and incised motifs.

The Xincun sand dune site in Guangdong (3350–2470 BCE) has also yielded an excellent record of plant foods. Identified starch grains and phytoliths on the surfaces of grindstones and pounders indicate exploitation of sago starch (*Caryota* sp.), bananas, lotus roots, Chinese water chestnuts, acorns, fern rhizomes, and seeds of the perennial cereal Job's-tears. A small number of phytoliths are also of rice, although there is no information available as to whether any of these plants were cultivated or domesticated. However, because the starch grains were identified on the working ends of stone tools, definite food processing is implied (Yang et al. 2013).

These Holocene fisher-forager groups eventually underwent varying degrees of cultural transformation, beginning 3000 BCE, especially under the influence of Liangzhu and related agriculturalists spreading from the middle and lower Yangzi Valley into Lingnan (the region south of the Nanling Mountains) and southeast China. In Fujian, the oldest carbonised rice grains date to 2870–2340 BCE at Tanshishan (Yan 1989). Phytoliths and pollen in sediments at Zhuangbianshan, one of the largest settlements of the Tanshishan cultural phase, confirm the occurrence of rice during the same time period (Ma et al. 2013). At Shixia in northern Guangdong (2600–2300 BCE; Figure 7.1), large quantities of rice grains and stalks in the lower and middle layers are claimed to be of cultivated rice (Yang 1978). Other Guangdong Neolithic rice remains, both grains and phytoliths and all postdating 3000 BCE, have been identified in the pre-Shixia phase at Shixia itself (Yang 1998; Yang et al. in press), at Shaxia in Hong Kong (Lu et al. 2005), at Guye in Gaoming (Relics from the South 2007), and at Xinghuahe in Kaifong (Xiang and Yao 2006).

The list of domestic animals associated with early farmers in southern China is still small, but the available information suggests a north-to-south gradient in the assigned ages. In Qihedong Cave (Fujian), bones of domestic dogs are claimed to occur in two cultural layers dated around 13,000 to 7000 BCE and 7000 to 5000 BCE (Fan 2013:369–370). However, dates for early dog bones are closer to 5000 BCE in southern Guangxi (see Lu 2010). Domesticated dogs and pigs have been reported from Tanshishan dated to 2600–2000 BCE (Fujian Museum 1984, 2004; Luo 2012). Farther south, bones of domestic dogs and pigs occur at Cuntou in Guangdong, dated around 2100–1200 BCE (Zhang Chi, pers. comm.).

Assessment of the role of southern China in the Neolithic of Taiwan and the Philippines must also take into account the new craniofacial data from human burials presented in Chapter 4. In his continuing research with me in southern China, Hirofumi Matsumura has also identified a two-layer population sequence with Australo-Papuan hunter-gatherers followed by Asian Neolithic farmers. The former remained the dominant population until about 3000 BCE, represented by burials without grave goods in crouched or flexed positions. After 3000 BCE, skeletons were buried in extended positions and often with grave goods.

Taiwan

A similar two-layer sequence of human population is documented from two adjacent sites on Liangdao (Liang Island) in the Taiwan Strait, as well as on the island of Taiwan itself (for site locations see Figures 7.1, 7.3). Two burials were excavated on Liangdao, the older being an Australo-Papuan adult male buried in a flexed position about 6300 BCE, the younger an Asian adult female buried in an extended supine position about 5500 BCE (Chen and Chiu 2013). In Taiwan, the only known Paleolithic burial recovered so far comes from the Xiaoma cave

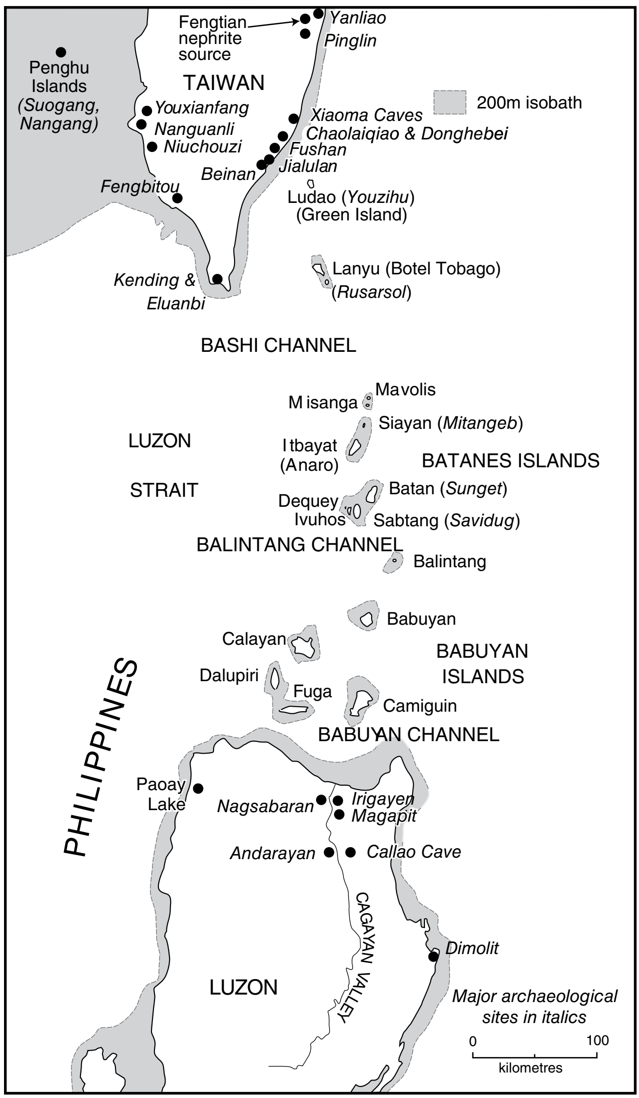

Figure 7.3 Archaeological sites in southern Taiwan, the Batanes Islands, and northern Luzon.

complex in the southeast of the island, this being an adult male buried in a crouched posture about 4000 BCE. My research with Matsumura suggests that this individual was of Australo-Papuan affinity, most closely related with Negrito populations in the Philippines. This is particularly interesting since it suggests that a Negrito population once lived in Taiwan, a situation apparently documented in Chinese texts and Formosan oral traditions. With the beginning of the Dabenkeng Neolithic, most burials in Taiwan switched to an extended supine posture, which continued into the Metal Age.

The Dabenkeng culture (TPK), dating from possibly 4000/3500 and lasting to 2200 BCE, correlates with the Early Neolithic in Taiwan (Hung and Carson 2014). An assemblage of pottery, polished stone adzes (see Plate 4), and village settlements with cemeteries replaced the late Palaeolithic Changbinian assemblages that had characterized the island since at least 25 kya. The Dabenkeng culture developed through early (4000/3500–2800 BCE) and late (2800–2200 BCE) phases. Early Dabenkeng sites are represented by shell middens or located in sand dunes, and so far no evidence of rice has been found in them. The shell middens are often located on slightly elevated ground originally overlooking swamps or shallow-water coastal environments, now filled with alluvium.

During its later phase (2800–2200 BCE), the Dabenkeng culture has evidence for both rice (*Oryza sativa*) and millet cultivation at the southwestern Taiwan sites of Nanguanli and Nanguanlidong in the Tainan Science Park (Tsang and Li 2016; Hsieh et al. 2011; Tsang et al. 2016, 2017). These two sites contain bones of fish, deer, pigs, and dogs, including four complete dog burials at Nanguanlidong. However, the nature of the Dabenkeng economy before the Nanguanli assemblages remains unclear, owing to lack of archaeobotanical data and an absence of direct dating of the actual plant remains. The question of whether rice and millet were cultivated right from the start of Neolithic settlement in Taiwan, or arrived later to be grafted on to a mainly gathering, hunting, and fishing economy, cannot be answered at present. Direct radiocarbon dates for rice from Taiwan suggest a presence only from 2500 BCE, on current evidence. One possible origin for the early Dabenkeng can be traced to the Pearl delta in Guangdong (Tsang 2005; Hung 2008), with other cultural influences from Fujian and Zhejiang entering northern Taiwan (Liu and Guo 2005). So far, the Dabenkeng cannot yet be traced to any single culturally unified source.

The subsequent Middle Neolithic in Taiwan, around 2500/2200–1500 BCE, reveals a significantly increased reliance on rice and millet farming. Sites of this period are characterized primarily by the use of fine cord-marked and red-slipped pottery, both generally regarded as a direct development from the coarse cord-marked Dabenkeng pottery (Li 1983; Tsang 1992; Liu 2002; and see Figure 7.6 below). However, some pottery of this stage still shows connections with coastal China, suggesting continued cultural interaction. Diagnostic Middle Neolithic artifacts include polished stone knives (presumably for rice harvesting), stone adzes, nephrite (jade) ornaments, jar burials, and larger settlements with an implied increase in population number and density.

The transition from Early to Middle Neolithic has been well documented at Xuntangpu in northern Taiwan (Figure 7.1, no. 12), which has a sequence dated between 2600 and 1700 BCE (Liu et al. 2008; Liu 2007). At least 92 sites of the Xuntangpu culture are known (Kuo 2008; Chu 2012). Stone harvesting knives are now common and Dalongdong has produced carbonized rice grains (Chu 2012). Elsewhere in Taiwan during this phase, carbonized rice grains or impressions in pottery occur at Chikan B in the Penghu Islands (Tsang 1992), Kending in southern Taiwan (Li 1985), and Youxianfang in Tainan (Tsang and Li 2016). A recent study of rice phytoliths by Deng Zhenhua in collaboration with the author has confirmed that domesticated rice remains occur in several Middle Neolithic sites in eastern Taiwan, including Chaolaiqiao, dating prior to 2000 BCE (Deng et al. in press).

Also during the Middle Neolithic, visible differences developed between Taiwan regional assemblages that exceed those in the earlier and more homogeneous TPK, leading to a recognition of five geographically separate facies or cultures. These are Xuntangpu in northern Taiwan, Niumatou in central-west Taiwan, Niuchouzi in southern Taiwan, Fushan in eastern Taiwan, and Hongmaogang between northern and central-west Taiwan (Liu 2007). More than 300 Middle Neolithic sites have been recorded across the whole island (Tsang 1990; Li 2003), over seven times the number recorded in the Early Neolithic. This is an impressive statistic linked to population growth and presumably an increasing productivity of rice and millet agriculture.

At the same time, offshore fishing and sea voyaging technologies developed considerably, highly significant to explain the success of the contemporary Malayo-Polynesian expansion into the Philippines. Thus, at Eluanbi and Eluanbi II in southern Taiwan (Li 2002), we find stone net sinkers, fish-hooks, bones of very large marine fish such as grouper, and especially large pelagic carnivores such as dolphinfish and marlin. The last two species imply open sea trolling from moving canoes, quite far from shore (Campos and Piper 2009). Stone raw materials were also exchanged widely throughout Taiwan at this time. Olivine basalt from Penghu was used to make adzes, and Fengtian nephrite from eastern Taiwan was used for ornaments and adzes that were carried back to Penghu, as well as to Ludao and Lanyu islands (Hung 2004, 2008).

Between Taiwan and Luzon

The Luzon Strait is about 350 km wide, between the southern tip of Taiwan and the northern coast of Luzon in the Philippines (Figure 7.3). The major islands here belong to the Batanes and Babuyan groups, the former with crucial archaeological evidence for understanding long-term interaction between Taiwan and the rest of Island Southeast Asia. The warm Kuroshio Current flows from south to north through this region, leading a few scholars to speculate that Neolithic human migration from Taiwan to the Philippines might have been difficult, if not impossible (Solheim 1984–1985:81). But new archaeological data make a north to south crossing a certainty, on more than one occasion.

Ludao and Lanyu (Botel Tobago)

Ludao and Lanyu are the closest islands to Taiwan, located on the northern side of the Bashi Channel (Figure 7.3). Ludao lies 33 km from the southeast coast of Taiwan, with clear visibility, and was formerly inhabited by indigenous people related to the modern Tao population (previously termed Yami) of Lanyu today (Kano 1946:398–424). The archaeological records of Ludao and Lanyu can be divided into three phases: Middle Neolithic with fine cord-marked pottery (2200–1500 BCE), Late Neolithic Beinan (1500–300 BCE), and Metal Age Lobusbussan (after 500 CE) (Liu et al. 1995:36–38; Liu et al. 2000:147). No TPK sites have yet been identified on these islands. So far, the only known Middle Neolithic site is Yugang on Ludao, where fine cord-marked sherds occurred in low frequency within a larger assemblage of red-slipped vessels with ring feet and tall rims. This pottery is close to that of the Middle Neolithic Fushan facies in eastern Taiwan.

The Late Neolithic Beinan phase in Ludao/Lanyu affiliates with the full Beinan culture of eastern Taiwan, and one of the key sites is Youzihu on Ludao, dated 1620–1455 BCE. This site contains many shell beads and artifacts of mainland Taiwan origin – Fengtian nephrite ornaments and worked fragments, slate points, and adzes of a metavolcanic "water melon" rock. At this time, very intense cultural interaction occurred between Ludao and the Taiwan mainland, as well as with Batanes and Luzon to the south.

The Metal Age Lobusbussan phase is represented only on Ludao and Lanyu and differed considerably from the contemporaneous Iron Age cultures of Taiwan, suggesting increasing cultural differentiation at this time. There is at present a curious gap of about 800 years between the end of the Beinan and the beginning of the Lobusbussan phase, and this raises the question of whether or not the ethnohistoric Tao (or Yami) population of Lanyu (and formerly Ludao) descended from Batanes immigrants, as indicated very strongly by the linguistic evidence. Perhaps these islands were uninhabited or only sparsely utilized around 500 CE, and thus available for resettlement.

The Batanes Islands

Ten islands comprise the Batanes, of which only Itbayat, Batan, and Sabtang support populations today. They lie about 190 km south of Taiwan and 160 km north of Luzon (Figure 7.3). The indigenous inhabitants are the Ivatan (Batan and Sabtang) and the Itbayaten (Itbayat), whose closely related languages belong to the Bashiic subgroup of Malayo-Polynesian (Li 2001:277; Ross 2005).

Linguistic reconstructions suggest that Malayo-Polynesian-speaking populations have had a considerable time-depth in Batanes, although much of the actual differentiation between Ivatan, Itbayaten, and Yami (Tao) has been quite recent (see Blust's comments on Bashiic languages in Chapter 6).

The Neolithic in Batanes (see Figures 7.8, 7.9 below) lasted from 2200 until 500 BCE or later, when copper and iron made tentative appearances. As with Ludao and Lanyu, there is currently no archaeological evidence for any human settlement of these islands before the Neolithic (Bellwood and Dizon 2005, 2013). The oldest Batanes pottery from a typological perspective, compared with Taiwan assemblages, comes from Reranum Cave on Itbayat Island (Figure 7.8b). It is predominantly red-slipped and undecorated, with small quantities showing fine cord-marking, the latter a significant discovery as it is the only one so far in the northern Philippines and strongly linked with the Middle Neolithic fine cord-marked traditions of Taiwan. Another early pottery assemblage comes from Torongan Cave, lacking the fine cord-marking but otherwise the same red-slipped plain ware. In particular, the rim and vessel forms in these Batanes sites resemble those at Fushan, Chaolaiqiao, and other Middle Neolithic sites in eastern Taiwan.

By 1200 BCE, rich artifact assemblages are known from Sunget on Batan and the basal layer in the Savidug Dune Site on Sabtang. The Sunget assemblage includes red-slipped and circle-stamped pottery with ring-feet and handles, biconical terracotta spindle whorls, adzes made of volcanic stone and Taiwan jade, a Taiwan slate point, and Taiwan-style double-notched pebble net sinkers (Koomoto 1983:55–61; Bellwood and Dizon 2013). This assemblage shows clear cultural similarities with the contemporaneous Late Neolithic in Taiwan, especially with the Huagangshan and Beinan cultural groups on the eastern coast. For example, handles attached to the sides of globular vessels with ring feet were common in Sunget, Beinan, and Huagangshan, but absent in the previous Middle Neolithic fine cord-marked phase, as well as in the subsequent Sanhe (Iron Age) phase in eastern Taiwan.

Burial jars in Batanes sites, such as Savidug Dune Site, were identical to many in eastern Taiwan. Jar burial had a long presence in Taiwan, beginning by 2000 BCE with red-slipped burial jars in the Middle Neolithic, particularly in Niuchouzi sites in southwestern Taiwan (Figure 7.6b). It became very common around 1000 BCE during the Taiwan Late Neolithic, especially in sand dune sites on the eastern coast such as Huagangshan, Dakeng, and Yanliao (Ye 2001). As well as jar burials, Savidug Dune Site at around 500 to 1 BCE also yielded pieces of worked Taiwan jade and a shell "spoon" made of *Turbo marmoratus*, the latter similar to shell spoons in the Tabon Caves on Palawan (Fox 1970), in many contemporary southeast Taiwan sites such as Jialulan (Egli 1972) and Zhihangjidi (Sung et al. 1992), and in Eluanbi and Eluanbi II at the southern tip of Taiwan (Li 1983).[15] Similar objects continued to be used until historic times by the Formosan Amis in eastern Taiwan (National Museum of Natural Science 1990).

Indeed, the export of raw materials from Taiwan to Batanes evidently occurred on many occasions, commencing by at least 1200 BCE, as recorded by the Anaro jade workshop on Itbayat which commenced occupation around this time, contemporary with the late Beinan phase in southeastern Taiwan. Considerable quantities of worked Taiwan nephrite and slate have been found at Anaro, both rocks being absent in the volcanic and raised coral landscapes of the Batanes and Babuyan Islands. Slate is common in the central mountains of Taiwan.

The earliest Neolithic cultures that occur from coastal southern China into the northern Philippines can thus be traced back to homelands located north or west, confirmed by the gradient in relevant radiocarbon dates moving outwards from source regions in coastal southern China and Taiwan. The early pottery of the Pearl delta at 5000–3500 BCE was characteristically red-painted and coarse cord-marked with incised decoration. Later, in Taiwan, similar vessel forms with coarse cord-marking and incision dominated the TPK Early Neolithic at 4000–2500 BCE, and were later replaced by Middle Neolithic fine cord-marked and red-slipped pottery at 2500–2200 BCE. Eventually, plain red-slipped and red-painted pottery dominated the later phase of the Taiwan Middle Neolithic at 2000–1500 BCE. In Ludao, Lanyu, and Itbayat some of the earliest pottery was still fine cord-marked and contemporary with the Middle Neolithic in Taiwan.

Finally, the commencement of the "Neolithic" in each region was marked by the occurrence of a cultural complex of new traits, including large and presumably sedentary settlements, advanced technology in pottery manufacture, evidence for animal and plant domestication, and other aspects of material culture such as spinning, weaving, and bark cloth production. Even the widespread bark cloth industry in the Asia-Pacific region can be traced back to southern China (e.g., Ling 1963; Tang 1997), with stone beaters dated as early as 4000–3000 BCE from the Pearl delta (Tang 2003). To the east, bark cloth beaters occur in the TPK sites of Changguang, Dabenkeng, and Nanguanli in Taiwan (Tsang and Li 2016), and in northern Luzon in the Philippines at 1500–1000 BCE (Thiel 1986–1987). The recent demonstration by Chang et al. (2015) that paper mulberry (*Broussonetia papyrifera*) originated in southern China and Taiwan, before being reproduced asexually in the Pacific Islands by human agency, has been referred to above.

Northern Luzon

Taiwan and northern Luzon have a similar archaeological history in that both received intrusive Neolithic traditions that eventually replaced indigenous Paleolithic assemblages of pebble and flake tools (these being absent in Batanes). In Luzon, the Neolithic is best represented in the Cagayan rift valley, holding the longest river in the Philippines. Since 1971, more than 30 Neolithic and Iron Age shell middens have been found along the lower Cagayan, forming the densest pattern of prehistoric settlement in the Philippines. Some of these sites have yielded red-slipped plain ware pottery inspired from Middle Neolithic Taiwan at about 2200 BCE, with very similar rim and vessel forms. Other Cagayan artifacts, such as baked-clay pendants, spindle whorls, Taiwan jade objects, and bark cloth beaters point congruently to origins in Taiwan (Hung 2005, 2008; Hung et al. 2007; Thiel 1986–1987). So far, the earliest domestic pigs in the Philippines, dated to before 2000 BCE, have been discovered from Nagsabaran (Piper et al. 2009).

The agricultural repertoire of the early Neolithic phase (2000–1000 BCE) in northern Luzon remains unclear, but the Neolithic site of Andarayan near Solana has produced red-slipped pottery with direct AMS radiocarbon dating of a rice husk inclusion to 2050–1400 BCE. A corroborating charcoal date from the site is 1950–1050 BCE (Snow et al. 1986:3). Our recent excavations at Magapit have recovered carbonized rice grains and banana phytoliths radiocarbon dated to 1000 BCE, and more than 200 carbonized rice grains have been floated from the Neolithic layer at Nagsabaran (ongoing research in collaboration with Deng Zhenhua), above a dense charcoal layer with nodules of low-fired clay C14-dated to 2200 BCE. This charcoal implies vegetation clearance by the first settlers of the site.

We infer that two types of settlement existed in the lower Cagayan landscape after 2200 BCE, as reconstructed by Mike Carson in his following contribution. Nagsabaran represented a village of pile dwellings directly in the valley, close to the river level and adjacent to marshland. Magapit, on the other hand, was established on a low limestone hilltop overlooking the river.

The very large alluvial plains that exist within the valley today were not created above river level until after 1500 BCE, so the initial Neolithic land-use pattern there could not have involved any great extent of wet rice farming. Indeed, Paz (2005) has suggested that rice might have been less popular in Philippine prehistory than tuber cultigens such as yam and taro, and Latinis (2000) has stressed the importance of an arboreal-based subsistence strategy in Island Southeast Asia and Oceania. To explain these changes in subsistence economy from East Asia into Island Southeast Asia and the western Pacific, Dewar (2003:369–388) has suggested that a high variability of rainfall in the northern Philippines (including Batanes) limited the reliability of crops such as rice that require ample water. As discussed later in this chapter, this environmental situation appears to have led to some major changes in the nature of the domesticated plant economy as Neolithic populations spread from Taiwan through the Philippines into Indonesia and Oceania.

Coastal Palaeo-landscapes of the Neolithic

An Invited Perspective by Mike T. Carson

The Neolithic settlements in, and migrations through, southern China, Taiwan, and the Philippines took place in landscape settings that were under constant change as a result of geomorphic processes. Paleo-landscape research offers a way to learn about the ancient environmental contexts of Neolithic sites, many in tropical Island Southeast Asia now obscured by thick layers of sediment or hidden within altered landform configurations (Carson 2011, 2014). Present-day coastal landscapes often bear little resemblance to those of early Neolithic contexts, and to track the changes in such landscapes it is necessary to plot the depths and dates of ancient ground surfaces and sedimentary units relative to available records of sea level change and tectonic movement, the latter being most active in this region through processes of continental plate subduction.

The terrain models presented here were generated with freely available online geospatial data managed by the governments of Taiwan and the Philippines, refined with elevation contours interpolated from the 2013 Shuttle Radar Topography Mission (SRTM) Version 3. Land-cover units were assigned as geological formations and soil types based on geospatial data plus field observations in 2013–2015. Contour lines were coded according to different time intervals, each with an adjusted value for elevation according to the rate of tectonic uplift plus the dating and thickness of sedimentary layers in each land-cover unit. The models were adjusted for sea level variation according to their chronology.

The two paleo-landscape reconstructions presented are for key periods in the Holocene records of Taiwan and the northern Philippines, each undergoing a transition from maximum postglacial sea level to subsequent marine regression and alluvial sedimentation. China's southeastern coastline at 4000–3000 BCE, the approximate time of first Neolithic migration to Taiwan, consisted of hillslopes flanked by narrow beach pockets and deep and narrow high sea level estuaries, often with a number of small offshore islets. Lowland sediments had not yet begun to accumulate and the most suitable lands available for rice farming would have been situated in inland locations where sedimentary build-up had already filled valley floors prior to 4000 BCE. In coastal zones, sedimentary profiles show that significant build-up from alluvial (riverine) and colluvial (hill slope) sources began after 3000 BCE, most likely accelerated by inland forest-clearing and agricultural activities. However, these newly forming lowland sediments still remained at or beneath sea level during the +1.5–2.5 m high stand from 3000 through 1000 BCE (Zong 2004; Zong et al. 2009).

A good example of a settlement of this date is Tanshishan (3000–2300 BCE), in the Fuzhou basin, opposite Taiwan. Here, the population lived on low hills and promontories along an estuary that reached nearly 80 km inland from today's shoreline (Rolett et al. 2011). Available wet rice land then would have been quite limited, as also in Taiwan, where the first Neolithic settlers probably occupied incipient but stable beach ridges. By 2800 BCE in Taiwan, alluvial sediments began to accumulate along the western coastline, likely due to increased slope erosion prompted by forest-clearing. Residential sites began to develop on these new landforms, as revealed archaeologically at Nanguanli and Nanguanlidong in the Tainan Science Park, both now buried under 7 m of alluvial sediment and more than 20 km inland (Tsang 2005), a distance increased in part by a lowering of sea level after 1000 BCE (Chen et al. 2004).

The landscape of uplifted eastern Taiwan consisted of hilly terrain directly flanked by aquatic habitats at 3000 BCE, and differed significantly from the gently shelving west coast attached to the shallow Asian continental shelf (Figure 7.4). Today's coastal plains and river terraces did not emerge and stabilize until after 1500 BCE, allowing very large Late Neolithic settlements such as Beinan (Plate 5) to develop thereafter, adjacent to good agricultural lands. The previous Middle Neolithic communities here lived at sites such as Fushan and Chaolaiqiao on what are now roughly level hilltops created from uplifted former coastal terraces (Hung 2008). Today, these sites lie about 40–50 m above sea level, but when occupied they were less than 20 m above, prior to rapid tectonic uplift at a rate of about 7–9 mm per annum in the southeast and 4–6 mm in the northeast. These are some of the most rapid rates of uplift in the geological record (Liew et al. 1993) and would have caused significant erosion and loss of soil, with very high rates of river incision, perhaps a factor in encouraging people to search for new land to the south.

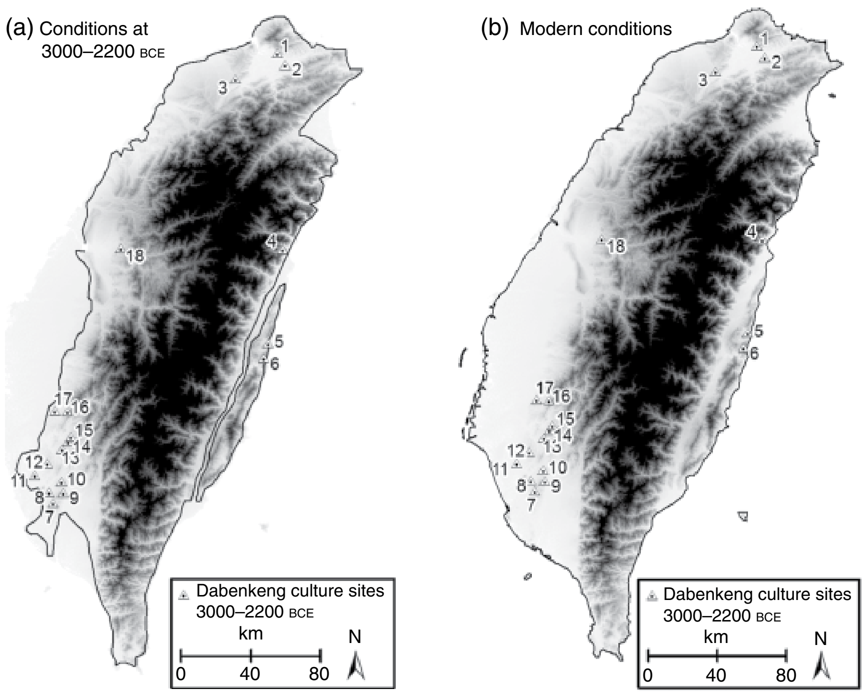

Figure 7.4 The Taiwan coastline during the Dabenkeng phase (3000–2200) BCE compared with today. Note the separate Dabenkeng phase eastern coastal island created by the subduction process. Sites: 1. Fuji; 2. Wanlijatou; 3. Dabenkeng; 4. Yuemei 2; 5. Gangkou; 6. Changguang; 7. Fengbitou; 8. Kongzhai; 9. Liuhe; 10. Fudeyemiao; 11. Gangkoulun; 12. Xinyuan; 13. Bajia; 14. Qijia; 15. Dachangqiao; 16. Nanguanlidong; 17. Nanguanli; 18. Anhelu. Source: figure by Mike Carson.

By 2200–1500 BCE, when sea level was still about 2 m higher than today, several Neolithic sites were occupied in the lower Cagayan Valley of Luzon, the longest and widest valley in the Philippines. Prior to 500 BCE the immediate riverside here consisted of marshy terrain close to a very large inlet of the sea (Figure 7.5), not yet covered by the alluvial sediments that support irrigated rice fields today. In these former marshlands, slightly elevated areas were chosen for stilt houses close to the water level, as at Nagsabaran (Hung 2008). Nearby limestone bluffs on the valley edge offered stable rocky surfaces well elevated above the river, and one was utilized for the settlement at Magapit. The marine coastline of the lower Cagayan Valley did not offer accessible coastal plains for settlement until after the sea level lowering that began around 1000 BCE.

In each of the above examples, newly arrived Neolithic coastal communities occupied sites with access to mixed aquatic zones and lowland hill slopes, without much of the flat terrain most suitable for wetland rice farming that exists so extensively today. Wetland rice probably appeared on any large scale long after the initial migrations, and the food-producing economies of the first Neolithic communities most probably focused on dryland rice cultivation,

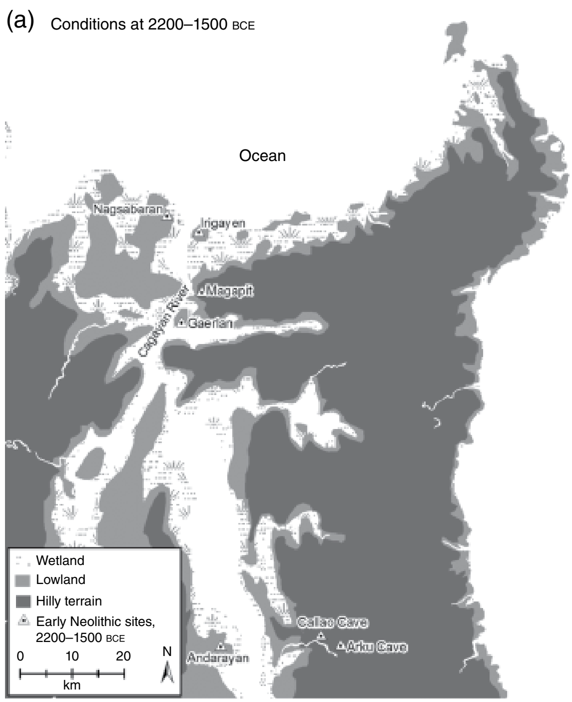

Figure 7.5 The Cagayan Valley coastline at the start of the Neolithic compared with today. Note the huge expansion of coastal and riverine lowland since 2000 BCE.
Source: figure by Mike Carson.

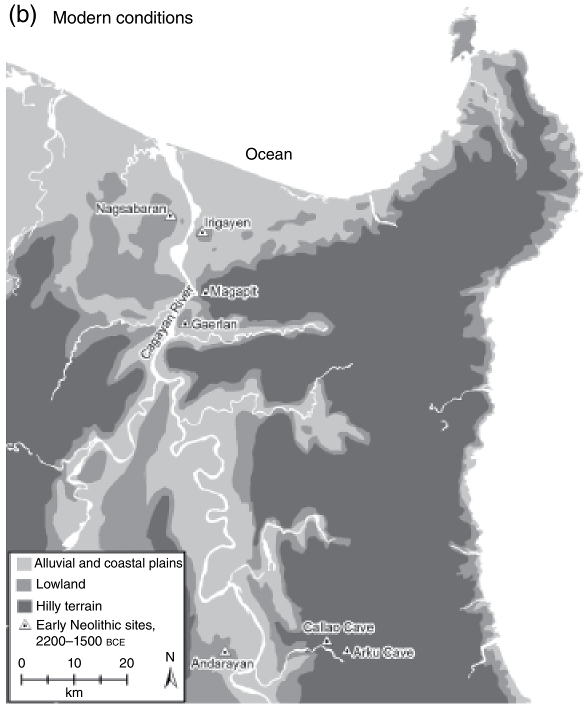

Figure 7.5 (Continued)

supported by fruits, tubers, and animal resources. The significance of these observations is that one cannot easily reconstruct, anywhere in the world, ancient food-gathering or food-producing strategies purely from the characteristics of landscapes as they exist today.

Further Observations on Neolithic Cultures in Taiwan

As related by Hsiao-chun Hung above, the Neolithic in Taiwan commenced around 3500 BCE with the establishment in coastal locations of the Ta-p'en-k'eng culture (henceforth TPK, and now spelt in pinyin as Dabenkeng), first introduced to the archaeological world in detail by K.C. Chang (1969) through his excavations at the coastal sites of Dabenkeng and Fengbitou, both located on high points just inland from the western coastal plain (Hung and Carson 2014). Initially, the TPK was poorly understood due to erosion and poor preservation of organic materials, as well as a virtual absence of reliable chronometric dates. But the recent excavations of twin waterlogged sites at Nanguanli and Nanguanli East (Nanguanlidong) on the outskirts of Tainan City have caused a revolution in knowledge similar to that sparked by the discovery of sites such as Kuahuqiao, Tianluoshan, and Hemudu in lower Yangzi China.

Rescue excavations in Nanguanli first took place in 2000 into waterlogged deposits 7 m below ground level, and actually a little below current sea level, during underground construction for a science-based industrial park.[16] The location is 20 km from the sea now, but the coastline was very close at that time to these two sites, which date between 2800 and 2200 BCE. Preserved timber posts suggest a presence of pile dwellings along the shoreline. Eighty-two human burials, mostly extended and supine in parallel rows, one in part of a wooden canoe,[17] with a few flexed burials as well, reveal evidence for tooth ablation, betel chewing stains, and the wearing of shell necklaces and ear ornaments. So far, none have been analyzed morphometrically, but facial reconstructions reveal an Asian morphology. Interestingly, forensic examination of the skeletons suggests relatively good health conditions similar to those of skeletons from the Iron Age site of Shisanhang, some 2000 years younger (Pietrusewsky et al. 2016), suggesting that no decline in general health occurred during the intervening millennia. However, one Nanguanli individual carried five projectile points in his body, attesting social conflict and perhaps resource competition (Tsang and Li 2016:132).

These Nanguanli burials contained complete pots with round or pedestaled bases and cord-marked, incised, stamped, red-painted, and red-slipped decoration (Plate 4). The associated occupation layers also yielded truncated-conical and biconical baked clay spindle whorls, stone bark cloth beaters, perforated slate and bone projectile points, untanged and shouldered stone adzes (some of basalt from the Penghu Islands in Taiwan Strait, and some of Fengtian nephrite found near the modern city of Hualian), pebble net sinkers notched on two sides, and tanged shell reaping knives made from nacreous and flat *Placuna placenta* oyster shells (Tsang 2005; Tsang and Li 2016; Li 2013). Found also were four complete dog burials (Plate 4h), pig bones (presumably domesticated, but this is still debated), and literally thousands of carbonized grains of *japonica* rice, common millet and foxtail millet (Hsieh et al. 2011:180; Tsang et al. 2017:9). Dogs actually exceeded pigs in bone numbers (Li 2013) so perhaps some were eaten, as in the southern Vietnam Neolithic (Piper et al. 2014), as well as being buried as companions. Similar human–dog relationships exist today in modern China and Vietnam.[18] Marine fish and shellfish also played a major role in the food economy.

Taiwan archaeologists have long debated whether the TPK was a farmer or a forager culture,[19] but the finds from Nanguanli leave me in no doubt that food production was a significant part of the economy, at least by 2500 BCE, as discussed by Hsiao-chun Hung above. However, the Nanguanli sites are considered by Taiwan archaeologists to be typologically late in the TPK sequence, so we cannot be sure exactly to what degree the very first TPK arrivals in Taiwan relied on food production. Total reliance on hunting and gathering is extremely unlikely from my perspective due to the highly expansive nature of this culture. But, whatever the answer, the TPK is of enormous importance as a potential correlation for the oldest linguistic stage of Austronesian society that can be identified in Taiwan. Not only does this culture have clear mainland Chinese origins, but it also has what I believe are clear successors in the following phases of the Taiwan Neolithic, as well as in the earliest Neolithic cultures of the Philippines and Indonesia.

Following the establishment of the Dabenkeng culture there is very good evidence for considerable population growth in Taiwan, as discussed by Hung above, with a

20-fold increase in site numbers by 2000 BCE according to Liu Yi-ch'ang (2007) for one region near Taipei. There was also a 20 to 30 times increase in total site area for this Taipei region, with individual sites reaching a maximum extent of 60 hectares. Similar data are available for eastern Taiwan, indicating that the third millennium BCE was a period of considerable growth throughout the island (Hung 2005). It is striking that the movement of Neolithic populations from Taiwan into the northern Philippines, at around 2200 BCE, also coincided with this period of high population density.

However, this movement also coincided with some potential evidence for climatic change towards cooler and drier conditions, with population decline and landscape degradation, especially in the Yangzi basin itself (Liu and Chen 2012:246). In the Penghu Islands that lie between Taiwan and Fujian, the numbers of archaeological sites underwent a sharp decline around 4000 years ago (Tsang 1992). This decline also correlated with the uplift of the eastern coast of Taiwan at the remarkable rate of 10 m per millennium, one of the fastest rates on record in Southeast Asia, as discussed above by Mike Carson. One wonders if environmental setbacks such as heavy erosion and riverine down-cutting, combined with a peak in the size of the eastern Taiwan human population, played an important role in setting off Neolithic migration into the Philippines. Causality at this time-depth is hard to demonstrate, but the combination of migration-inducing factors at the time and place in question seems beyond coincidence.

By 2200 BCE, a key change in pottery decoration was taking place, apparently all over Taiwan, leading to a decline in the proportions of cord-marking and other forms of surface decoration and a rise in the popularity of red-slipped but otherwise plain surfaces (Figure 7.6). Regional complexes such as Xuntangpu in the Taipei basin, Fushan and Chaolaiqiao on the eastern coast, and Niuchouzi in the Tainan region of the southwest coast show this trend clearly (Hung 2005, 2008; Hung and Carson 2014). By 2200 BCE, the pottery in use at southeastern sites such as Chaolaiqiao and Xiaoma Cave was almost all plain ware. It was at this time that the basal Neolithic tradition of such red-slipped plain ware pottery was carried with rice agriculture from Taiwan through Batanes into Luzon, leading eventually to further migration into central and southeastern Indonesia. Red-slipped plain ware is therefore an important clue to the identity of the first Neolithic cultures in the Philippines and Indonesia.

A number of interesting new developments also occurred in this Middle Neolithic phase, including a use of large burial jars at Youxianfang near Tainan (Niuchouzi phase – see Figure 7.6b), this being the oldest evidence for this tradition in Island Southeast Asia by perhaps a millennium. There was an increasing use of stone reaping knives and also of Fengtian nephrite, especially for making finely drilled and shaped bracelets. One-piece angling fish-hooks of *Turbo* shell, and the separate stone shanks and bone points used for trolling lures, crucial equipment for canoe-borne deep-sea fishing of surface-swimming carnivorous fish such as tuna, marlin, and dolphinfish, are all attested in Neolithic marine midden deposits of this phase on the southern tip of Taiwan (Li 1997). Bone one-piece bait hooks are also reported from the Middle Neolithic site of Suogang in the Penghu Islands (Tsang 1992).

By the mid-second millennium BCE, red-slipped or non-slipped plain ware was fairly universal in Taiwan, together with sporadic occurrences of dentate- and circle-stamping,

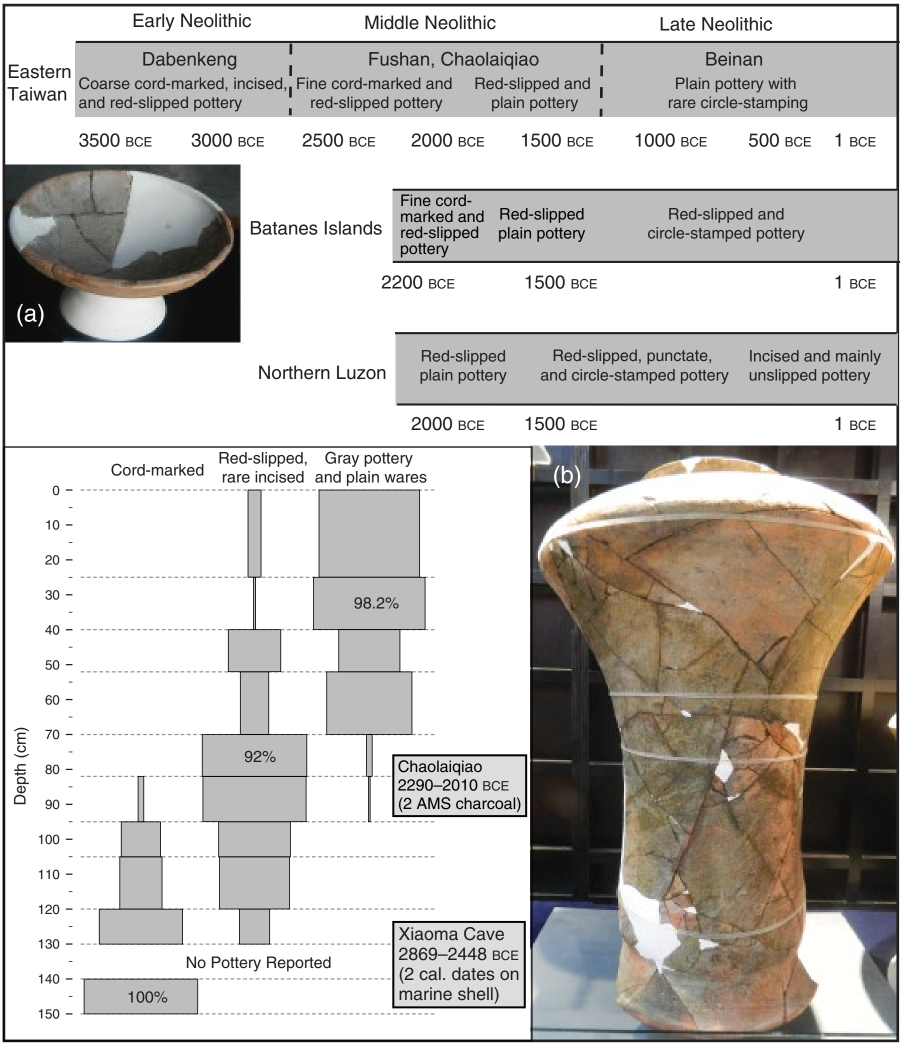

Figure 7.6 Top: the pottery sequences c. 3500 to 1 BCE in Taiwan, Batanes, and northern Luzon. Bottom: the switch from corded to red-slipped pottery c. 2000 BCE in Xiaoma Cave and Chaolaiqiao, southeastern Taiwan. The red-slipped pots (a) and (b) are from Youxianfang, a Middle Neolithic site of the Niuchouzi culture, Tainan. Vessel b (orifice diameter 16.5 cm) was used as a burial jar, although this need not have been its original function. Vessel a, a very typical red-slipped form for the Neolithic in Island Southeast Asia (see Figure 8.4), is 24 cm diameter. Sources: data from Hung 2008. Photos by the author, courtesy of National Museum of Prehistory, Taitung.

as at Yuanshan in Taipei. When I was first writing my *Prehistory of the Indo-Malaysian Archipelago* (1985) I regarded Yuanshan as significant for Neolithic movement to the south of Taiwan, given that little other positive information was available at that time. Yuanshan is probably rather too far north and west to have played any direct role in this movement, but its material culture still offers a good window on the situation in Taiwan around 1500 BCE, when movement into the Philippines was well under way. Yuanshan pottery is characterized by globular vessels with ring feet and strap handles, decorated with some incision or stamping and red slip. Cord-marking is absent, as in the early pottery assemblages of the Cagayan Valley and eastern Neolithic stream in Island Southeast Asia (Chapter 8). Other Yuanshan items include untanged, shouldered and stepped quadrangular adzes, slate projectile points, chipped stone hoes, stone bark cloth beaters, and spindle whorls of clay.

In recent years, eastern coast Taiwan archaeology has been illuminated by some quite remarkable discoveries at the 40 to 80 hectare village site of Beinan (Lien 1989, 1991, 1993), a contemporary of Yuanshan. The main excavations here took place as a result of railway station construction and have yielded remains of 50 house foundations and over 1500 burials, dating mainly between 1500 and 800 BCE, stratified over an older TPK component. The houses were constructed of timber and laid out in rows on rectangular stone pavements and platforms, some of the latter accessed from remarkable carved slate "ladders" (Plate 5). Adjacent to the house rows were rows of dry stone-walled storehouses. The floors of the dwelling houses and the open spaces between them contained slab-lined burial cists, many with multiple burials, that revealed a high rate of infant and fetal death (Lien 1991:344), typical of societies undergoing a transition into high-density populations dependent on food production (Bellwood and Oxenham 2008).

The pottery from the Beinan graves is mainly a fine orange ware, sometimes red-slipped, with no other forms of decoration. The most common form appears to be a jar with two vertical strap handles (like Yuanshan pottery) and a ring foot. Spindle whorls, pig and dog figurines, and stone bark cloth beaters also occur in the site. The grave goods include some remarkable items of Fengtian nephrite: tubular beads, bracelets, penannular earrings with circumferential projections (so-called *lingling-o*, a very widespread form in Southeast Asia, especially in the following Metal Age), anthropomorphic earrings, and perforated projectile points. As with the Nanguanli burials from a millennium or more beforehand, most adults had four of their upper teeth extracted – the canine and first incisor on each side (Tsang and Li 2016:135) – and stained teeth attest to betel chewing.

Looking at Taiwanese prehistory from an Island Southeast Asian perspective, it is obviously the cultural phase prior to 2000 BCE that is of most interest, since it is clear that Austronesian settlers had already moved into the northern Philippines by this time. The Beinan culture is thus a little late, but its remarkable 1500–1000 BCE village reveals much about the lifestyle of the time and its plain pottery style finds some affinity with the oldest pottery assemblages to the south. Given the importance of stone structures in regions settled later by Austronesians, especially in southern Indonesia and the islands of Oceania, Beinan stands as a 3000-year-old archaeological beacon.

The Neolithic of the Philippines

The Philippine archipelago (see site locations in Figure 7.7) is of fundamental importance for understanding the genesis of Malayo-Polynesian dispersal through Indonesia and Oceania. As noted in Chapter 2, it forms a close-set group of islands around a

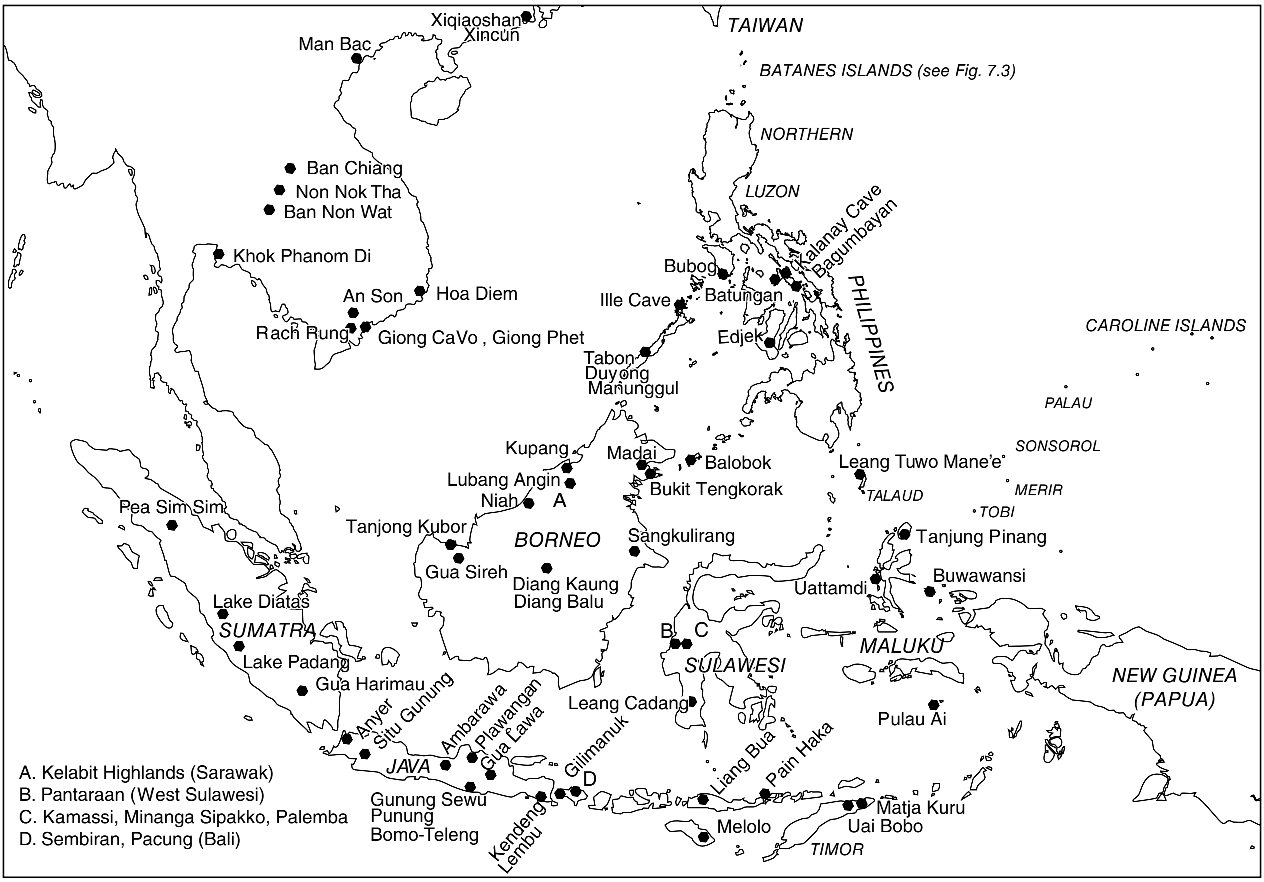

Figure 7.7 Neolithic to Metal Age sites in the Philippines and Indonesia.

number of small inland seas and offered an ideal nursery situation for the development of sails, outriggers, and other aspects of boat technology. The Philippines also represent the first truly tropical region to be reached by ancestral Austronesians during their early movements from southern China through Taiwan. Most of the coherent Neolithic sequences in the Philippines come from the far north, particularly the Batanes Islands and Cagayan Valley, but sufficient is known to make it clear that Neolithic settlers from Taiwan arrived around 2200 BCE and that populations carrying red-slipped pottery with an intriguing style of surface decoration set off between 1500 and 1300 BCE from the Philippines to reach Sulawesi, western Micronesia and, most importantly perhaps, the Lapita "heartland" of the Bismarck Archipelago in western Melanesia, the source of initial settlement and population in Polynesia far to the east (Valentin et al. 2016). Interestingly, there were once claims that eastern Polynesian and especially New Zealand Maori cultures were linked to a Philippine motherland by specific parallels in nephrite ornaments and stepped stone adzes (Beyer 1948:50; Duff 1970).[20] Such claims still provide interesting questions for Oceanic prehistorians to consider, and I suspect that Beyer and Duff might have been partly correct.

The Batanes Islands

As Hsiao-chun Hung has noted, the initial Neolithic settlement of the Philippines is well recorded in the archaeology of the Batanes Islands, which lie between Taiwan and Luzon (Bellwood and Dizon 2005, 2008, 2013). The Babuyan and Batanes Islands are visible in overlapping stages from the northern coastline of Luzon (and vice versa) on a clear day, as well as between each other, but the 150 km distance from Lanyu to the 1000 m Mt Iraya volcano on Batan Island would have been too great for visibility.[21] The Batanes also lie in the path of the northward-flowing warm Kuroshio Current, although our results yielded so much Taiwan nephrite and slate through a period lasting from about 1200 BCE to perhaps 500 CE that frequent movement from Taiwan to Batanes, probably in both directions, can now hardly be doubted. There is also some evidence that this current has fluctuated considerably in strength through millennia-long cycles in the past (Pearson 2013:23).

The Batanes research has covered 4000 years of prehistory, with evidence gleaned from many archaeological sites located on four different islands – Batan, Savidug, Itbayat, and Siayan – excavated between 2002 and 2007 by teams from the Australian National University and the National Museum of the Philippines. The chronological sequence of development in artifacts and their stylistic attributes, especially in pottery and spindle whorls, Taiwan slate and nephrite, and other lithic and shell artifacts form a keystone in the broader understanding of northern Philippine prehistory, and relations with adjacent regions (Figures 7.8, 7.9).

The sequence began about 4000 years ago in Torongan and Reranum caves on Itbayat Island. Both sites have red-slipped plain ware with tall rims, sometimes internally hollow, like rims from contemporary southeastern Taiwan sites such as Chaolaiqiao (2200 BCE), Fushan, and Xiaoma Cave. Reranum also has a few sherds of cord-marked pottery, the only site in Batanes to do so, and we presume that this

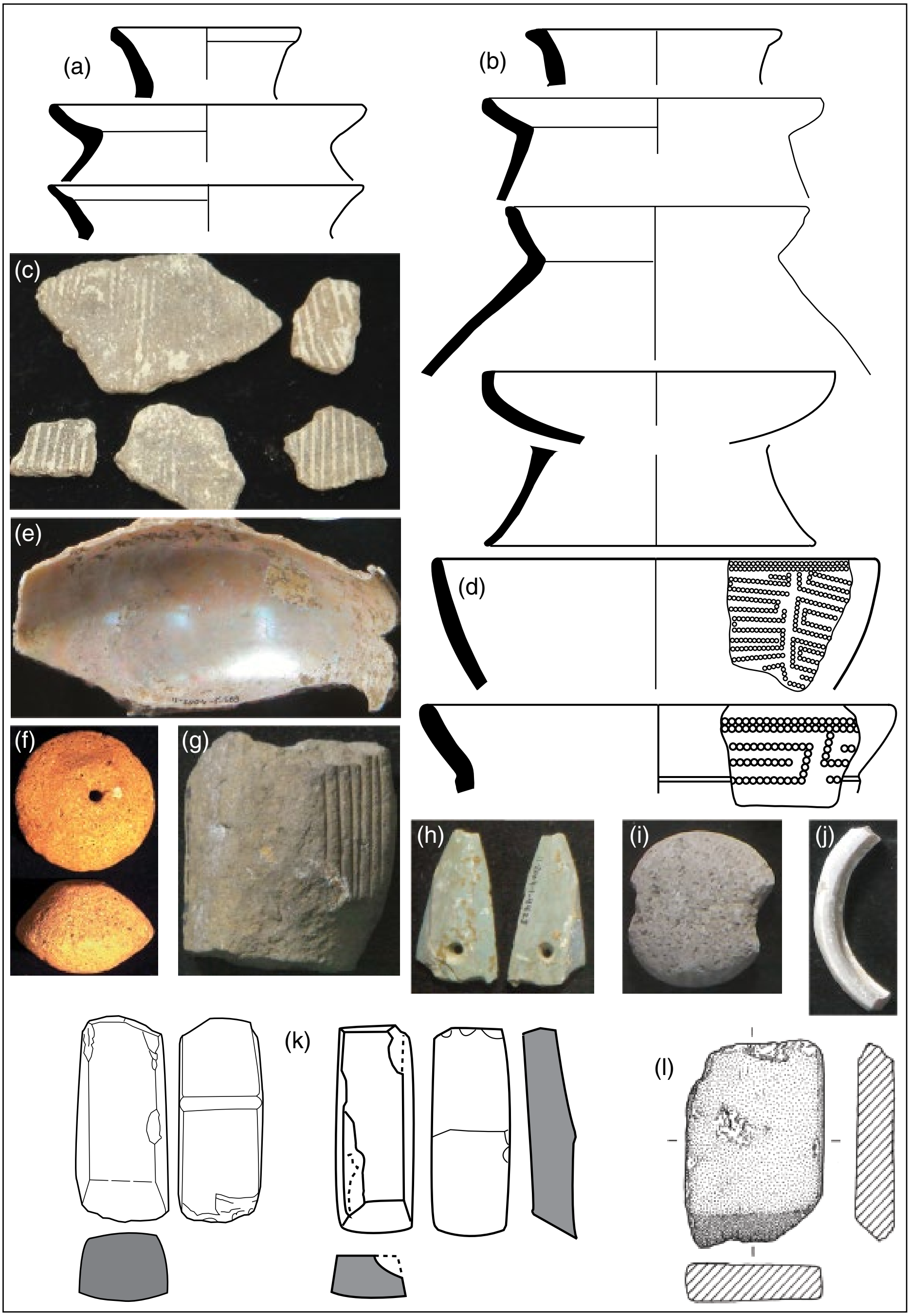

Figure 7.8 Batanes Neolithic artifacts with Taiwan affinities, 2000–500 BCE. (a) red-slipped plain ware rims from Chaolaiqiao, Taiwan, 2200 BCE. (b) similar red-slipped rims and a bowl/pedestal combination from Reranum, c. 2000–1500 BCE. (c) cord-marked sherds from Reranum. (d) circle-stamped decoration from Anaro, c. 1000 BCE. (e) shell "spoon" from Savidug Dune Site, Sabtang, c. 1000–500 BCE. (f) baked clay biconical spindle whorl 5 cm diameter, Anaro. (g) stone bark cloth beater fragment, Anaro (compare with Plate 4(f) from Nanguanli). (i) double-notched stone sinker, Savidug. (j) shell bracelet fragment, Savidug. (k) grooved and stepped stone adzes, Anaro. (l) Fengtian nephrite adze with quadrangular cross-section, Anaro. Source: photos and drawings by the author; courtesy of National Museum of the Philippines.

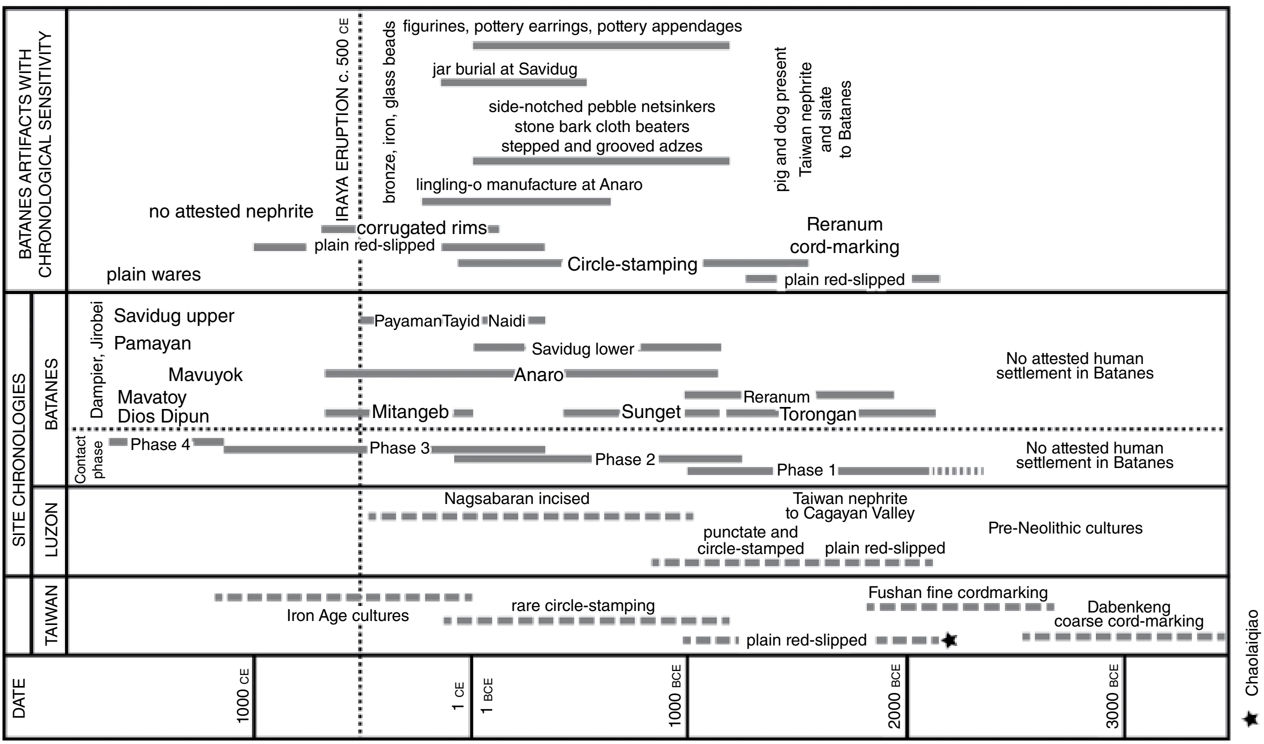

Figure 7.9 The four proposed phases for Batanes prehistory, together with radiocarbon chronologies for the excavated Batanes sites, and contemporary cultural manifestations in Taiwan and Luzon. For details see Bellwood and Dizon (2013).

assemblage dates to a period around 2000 BCE, when cord-marking was becoming increasingly rare in Middle Neolithic Taiwan. These two caves unfortunately yielded no animal bones or plant remains, but both appear to document the initial human settlement of these islands. Absolutely no archaeological evidence was found to indicate that the Batanes were discovered or settled prior to the Neolithic, although it is impossible to rule out entirely a previous ephemeral settlement by hunter-gatherers, who would have survived poorly in these small and terrestrially resource-poor oceanic islands.[22]

Our report on the Batanes research (Bellwood and Dizon 2013) recognizes four phases in Batanes prehistory (Figure 7.8), lasting until Japanese and British contact in the late seventeenth century. Phase 1, 2200 to 1500 BCE, with its red-slipped plain pottery from Torongan and Reranum, is still rather fugitive and known only from these two caves. Phase 2 (outer limits 1300 to 1 BCE) is perhaps the most prominent in all of Batanes prehistory, being represented by large assemblages from the major open sites of Sunget (Batan Island), Savidug Dune Site (Sabtang Island), and Anaro (Itbayat Island). The range of artifacts with Taiwan parallels in Batanes Phase 2 is quite remarkable. These sites have yielded the first clear evidence for import into Batanes of artifacts (especially adzes) made of nephrite from the Fengtian source near Hualian in eastern Taiwan, and also of Taiwan slate (especially perforated points). With these Taiwan artifacts are found sherds of red-slipped and circle-stamped pottery, baked clay spindle whorls, side-notched pebble net sinkers like TPK sinkers in Taiwan, flaked stone hoes, grooved or stepped[23] and polished stone adzes similar to many in Middle Neolithic Taiwan, and shell bracelets and other ornaments. Bones of domestic pigs and dogs were also present during this phase, again indicating contacts with Taiwan, which continued on after 500 BCE into the Metal Age (Batanes Phase 3), as we will see with nephrite ornaments in Chapter 9. The chronological gradient in Neolithic cultures from Taiwan, through the Philippines, to eastern Indonesia removes any significant likelihood of Neolithic origins in the Wallacean region (including the Philippines) to the south.

However, the strong emphasis in Batanes pottery decoration on using motifs created *purely* from rows of stamped circles rather than punctate or dentate lines was always rather unique, with direct parallels existing only in Taiwan and Lanyu. This might relate to a relative self-containment of the Batanes stylistic scene. Indeed, these islands are in a zone prone to drought stress and lack of surface water (Dewar 2003), meaning that rice cultivation has never been important and is still not today, although occasional summer monsoon fields of dry rice are planted. It is likely that the first Neolithic populations to arrive moved on quickly to enter the more fertile landscapes of Luzon, and especially the broad and well-watered Cagayan Valley.

The Cagayan Valley of Luzon

Moving south from Batanes into the broad Cagayan rift valley in northern Luzon we find a sequence very similar to that in Batanes, commencing with red-slipped and mostly plain ware like that of Batanes Phase 1 (Figures 7.6, 7.8). This appears in the lower levels of the Magapit shell mound (as yet undated – research by Hsiao-chun Hung and Mike Carson continues), beneath the Nagsabaran shell mound at around 2200 BCE, and in the open sites of Pamittan and Andarayan in the central Cagayan Valley. It also occurs in Mabangog Cave in the central valley and in Rabel, Arku, Laurente, and Musang caves in the Peñablanca limestone massif near Tuguegarao, all sites with dates within the earlier second millennium BCE (Hung et al. 2011; Ogawa 2002). Armand Mijares (2007) suggests that the pottery in the caves was imported from Neolithic villages into Late Paleolithic hunting and gathering communities, who continued to occupy caves until well into the Neolithic.

In Arku Cave, a burial assemblage with red-slipped plain ware was associated with a range of artifact types with very strong Taiwan and Batanes affinities. These included shell disc beads and bracelets, penannular earrings of baked clay or stone (including two of Taiwan nephrite, like examples from Beinan), a stone bark cloth beater, baked clay truncated-conical and biconical spindle whorls, barbed bone points, two tattooing chisels of bone or deer antler, and trapezoidal-sectioned stone adzes like many found in Batanes (Thiel 1986–1987). The Arku burials, poorly preserved, were apparently primary or secondary and sometimes dusted with red ochre or placed in jars. The assemblage is very poorly dated to within the last two millennia BCE, but is significant in that it shows a number of rather striking parallels with similar materials dating from 1500 to 1 BCE in southeastern Taiwan and Batanes. Furthermore, fragments of two Taiwan Middle Neolithic nephrite bracelets have also been found in the basal alluvial layer at Nagsabaran.

The large Cagayan shell mounds of estuarine bivalves (*Batissa childreni*), such as Magapit and Nagsabaran, actually number more than 30 and are sometimes up to 5 m high. After 1500 BCE they contain the best examples of decorated pottery contemporary with Batanes Phase 2, but here with the addition of motifs formed by the infilling of incised bands with parallel lines of punctate (round and pointed) or dentate (rectangular) small holes (Plate 6). This decorated pottery in Luzon is currently hard to date precisely, but a series of C14 dates from Magapit, Irigayen, and Nagsabaran place it somewhere between 1500 and 1000 BCE.[24] Continuing research at Magapit and Nagsabaran will hopefully resolve the situation in favor of better precision.

Accurate dating is actually very significant, because this style of decorated and red-slipped pottery was obviously at the root of the first human settlement in the Mariana Islands (c. 1500 BCE), as well as beyond the previously inhabited Solomons into the Lapita zone of Island Melanesia (1300 BCE) and western Polynesia (900 BCE). So identifying the sources of these migrations, culturally and biologically ancestral to both Chamorro and Polynesians, is no minor issue. Without much doubt, this style of pottery reached an apogee in Luzon early in the second millennium BCE and thence spread onwards into Sulawesi, Borneo, the Mariana Islands, and the Bismarck Archipelago (Plate 7). However, Luzon not need have been its absolute point of origin. Similar punctate- and dentate-stamped decoration occurs in simple form in some Neolithic contexts in Taiwan (e.g., Nanguanli, Beinan, and Yuanshan), and, as demonstrated by Fiorella Rispoli (2007), in middle Yangzi basin Neolithic complexes such as Daxi

(c. 4500 BCE). It also occurs in simple form on some of the pottery recently excavated from Liangdao Island, dating to 5500 BCE and discussed by Hsiao-chun above.

In fact, the ultimate origins of this decorative style are rather obscure. The real significance of its dominance by 1500 BCE in the Cagayan Valley is not that it can be traced to some particular source in China or Taiwan, but that it illuminates one of the most significant early migrations of the Malayo-Polynesians, that which led ultimately to the Polynesians and Micronesians of Oceania.

The Philippines beyond Cagayan

In general, beyond Batanes and the Cagayan Valley, rather little information of a broadly interpretable and comparative nature has been recovered on the Philippine Neolithic in recent years. This probably reflects the deep burial of Neolithic open sites along fairly steep and formerly drowned mid-Holocene coastlines (Bellwood et al. 2008), as discussed above by Mike Carson. It is unlikely that such sites will be discovered in the near future since they are invisible to the normal surface collection and shallow augering survey methods used by archaeologists. Hopefully, this situation will one day change. But the Philippines, and also Indonesia, do not have state-sponsored programs of rescue archaeology to keep a watch during deep construction activities.

In this regard, the reason why so many Neolithic open sites have survived in the Cagayan Valley is that they are topped by high and visible shell mounds. The lower Cagayan River is particularly rich in estuarine shellfish resources, especially compared to the smaller freshwater rivers and streams found elsewhere in the Philippines, and so can be expected to have attracted large populations. Although there have been recent excavations in Philippine caves such as Ille (Palawan) and Callao (Cagayan), the results have mostly emphasized Paleolithic contexts. Open sites with rich Neolithic deposits are few, but enough is clear to suggest that a Neolithic horizon characterized by plain or red-slipped pottery spread beyond Cagayan in the mid-second millennium BCE, eventually to reach Sulawesi, eastern Borneo, and southeastern Indonesia.

Within the Philippines beyond Cagayan this early plain ware horizon is marked at sites such as Bagumbayan on Masbate, Edjek on Negros, and Balobok Cave in Sulu (see Bellwood 2007:223 for references on these sites). Potentially the most interesting site, however, exists on the eastern coast of Luzon, where an open site called Dimolit on Palanan Bay in Isabela Province was excavated long ago by Warren Peterson (1974). The lower occupation level here was probably occupied between 2000 and 1500 BCE (the C14 dates were in some disarray), and as a "first" in Island Southeast Asian Neolithic archaeology the posthole settings for two 3 by 3 m houses were found, each with double walls, the outer post row being set in a slot (see Bellwood 2007: Figure 7.6). The Dimolit pottery was red-slipped plain ware, as in Batanes Phase 1 and the early Neolithic of the Cagayan Valley, comprising globular or carinated vessels and dishes, some on ring feet with small clustered perforations. Unfortunately, recent social unrest in this area has inhibited archaeologists from returning to the site for further excavation.

Decorated pottery similar to that from the Cagayan middens was also reported long ago by Solheim (1968) from a disturbed and undated burial cave in Batungan Mountain on the island of Masbate in the central Philippines. This assemblage included red-slipped sherds from carinated vessels with incised, dentate-stamped, and stamped-circle motifs very similar to those in the Cagayan sites. Another more enigmatic find, of a flexed and face-down burial of a male in Duyong Cave on Palawan, was associated with an untanged quadrangular-sectioned Neolithic stone adze, four *Tridacna* ground shell adzes (the largest shown in Figure 5.6), two *Conus* ear discs, a *Conus* breast pendant (Fox 1970:63; and see Bellwood 2007: Figure 7.10), and six *Anadara* shells that may have been used as lime containers for betel chewing. The skeleton had betel-stained teeth (Fox 1970). This burial was unusual in having no associated pottery and it has no direct date, although it postdated a Late Paleolithic shell midden dated to around 4300 BCE. Given the occurrence of *Tridacna* shell adzes in pre-Neolithic contexts elsewhere in the Philippines, northern Moluccas, and the Admiralty Islands (Chapter 5), one wonders if this burial belonged to an indigenous shell adze-using hunter-gatherer, with the added provision of a quadrangular-sectioned stone adze acquired from a nearby Neolithic community.

The extensive excavations in the Tabon Caves undertaken in the 1960s by Robert Fox (1970) also produced huge amounts of pottery, but this material was never analyzed thoroughly and it is impossible now to identify a coherent Neolithic signature. These caves did contain some cord-marked pottery (Fox 1970:83), but it is unclear if it is of Neolithic or Metal Age date. As we will see in Chapter 8, cord-marked pottery was apparently present during the initial Neolithic at Niah and Gua Sireh in western Borneo, but it is not definitely attested until the Metal Age in eastern Borneo and Sulawesi (Bellwood 1988; Anggraeni 2016).

Southern China, Taiwan, and the Philippines – a Neolithic Assessment

In this chapter we have examined the genesis of agriculture from an indigenous background of hunting and gathering in China, followed by the spread of an agricultural population through southern China into Taiwan by about 3500 BCE and onwards into the Philippines by about 2200 BCE. In terms of the totality of Austronesian dispersal over such a vast area of the earth's surface, from Madagascar to Easter Island, this was the engine room that commenced the expansion. In the regions just discussed, there can now be little doubt that the Neolithic began with the appearance of migrant populations with Asian craniometric affinities, who brought in a knowledge of agriculture and animal domestication, as well as a new series of technological items ranging from red-slipped pottery, through polished stone adzes, to the spindle whorls used in the process of weaving clothing. They also brought in an advanced knowledge of canoe construction and ocean navigation. All this we know from the records of biological anthropology (including genomics), comparative linguistics, and archaeology.

It is also clear from both the skeletal and archaeological records that these were not the first colonists of the region. Hunter-gatherers with Australo-Papuan craniofacial affinities had preceded them for tens of thousands of years, extending back into the rather misty arrival period of modern *Homo sapiens* more than 50,000 years ago. By the time Neolithic populations arrived, around or soon after 2000 BCE, these older populations would already have been deeply differentiated in biological and linguistic terms. In terms of biology, some (perhaps the Niah Deep Skull – see Chapter 4, footnote 5) appear to have resembled modern Negrito populations, while others resembled more the recent and modern peoples of Australia and New Guinea.

In terms of Paleolithic language we know little, but it cannot be assumed that all languages spoken across the region before Austronesian arrival were closely related to the Papuan languages of New Guinea. Extinction of indigenous languages must have operated on a massive scale once the Austronesian/Malayo-Polynesian languages began to spread through the region, although this process might have spread over quite a long period of time and indeed is still operating today as Bahasa Indonesia gradually replaces small-scale Papuan and Malayo-Polynesian languages alike in remote regions.

The survival of Negrito populations in so many parts of the Philippines is of great interest here, since it suggests that they existed in larger numbers during the early Holocene than was the case, for instance, in the equatorial forested interior of Borneo, where no traces of them exist nowadays. Their survival in the Philippines does suggest that the Austronesian expansion was not a total wipe-out of preceding populations, but more an infiltration with various degrees of admixture or side-by-side coexistence. The pre-Austronesian hunter-gatherer populations, through admixture, have left a clear signature in the peoples and cultures of Island Southeast Asia today, including the Philippines, even if they have here entirely adopted Malayo-Polynesian languages. However, their contributions survive most strongly in the southern and eastern parts of Indonesia and around New Guinea. We turn to these regions in the next chapter.

Notes

1. Bellwood 2005, 2013; see also Bellwood 2009; Bellwood 2015.
2. E.g., Bellwood 2011a, 2011b; Bellwood et al. 2011; Bellwood in press a, in press b.
3. E.g., Sauer 1952; Barker and Janowski 2011; Barker 2013; Denham 2013.
4. I am currently involved in research on phytoliths and starch grains using soil samples collected during my many years of excavation in both caves and open sites across Island Southeast Asia, with colleagues Tim Denham (ANU), Alison Weisskopf (University College London), and Alison Crowther (University of Queensland). Results are pending.
5. Linguist Antoinette Schapper (2015) argues for a presence of seafaring agriculturalists in Wallacea before Malayo-Polynesians arrived, but the archaeological evidence that she quotes is extremely weak. However, that many formerly Papuan-speaking populations in eastern and southern Wallacea might have adopted Malayo-Polynesian languages is not in dispute, and neither is the linguistic evidence for a widespread usage in these islands of a Papuan term *muku* for 'banana'.
6. Hutterer 1976; Sather 1995; Denham 2011.

7. The idea of a single source for the whole of global food production, in every continent, no longer has any support.
8. Fuller and Qin 2009; Crawford 2011; Weisskopf, Harvey et al. 2015.
9. Zhang and Hung 2013; Deng et al. 2015 for Jiahu; Zheng et al. 2016 for the Shangshan culture.
10. The increases in population numbers that accompanied these developments of food production in central China are calculable, on a relative basis, from settlement numbers and their areas plotted through time. Li et al. (2009) plot data on more than 11,000 archaeological sites in central China and suggest a 10-fold population increase between 5000 and 2000 BCE for the lower Yangzi region. Zhang and Hung (2008) record for the Dongting Lake region of Hunan Province (middle Yangzi) an increase from 22 small sites in the Pengtoushan Phase (6000 BCE) to 200 sites, including some very large ones, in the Qujialing-Shijiahe Phase (3000 BCE); this suggests an increase considerably more than tenfold. Based on settlement areas, Qiao (2007) has estimated a 50-fold increase in population between the Peiligang Phase (6000 BCE) and the Erlitou Phase (2000 BCE) in the 219 km^2 Yiluo region of Henan Province, with total population estimates of 217 people for the Peiligang and over 10,000 for the Erlitou. Admittedly, the last calculation is for the Yellow River rather than the Yangzi, but such figures suggest that East Asia has been a fount of cultural and population growth that could always have impacted on the human prehistory of other regions of Asia and the Pacific.
11. Chekiang 1978; Hemudu 2003; Li and Sun 2009; Nakamura 2013.
12. Fuller et al. 2010; Zhang and Hung 2008, 2010, 2015; Cohen 2014; Silva et al. 2015.
13. Ko et al. 2014; Zhang and Hung 2008, 2010, 2015.
14. Detractors often wrongly call the Out of Taiwan hypothesis the "Express Train," after an article by Jared Diamond (1988) specifically on the Lapita culture of the western Pacific. However, the overall migration of Austronesian-speaking populations from Taiwan to New Zealand required more than 3000 years, between 2000 BCE and 1250 CE. It was hardly an express train throughout its full extent, despite the obvious speed of the Lapita expansion, and Diamond never intended to promote such an interpretation.
15. Philip Piper (pers. comm.) has suggested that these shell "spoons" might in fact represent ships of the dead, with figurative handles identical to the aft portion of the ship on the Manunggul burial jar from Palawan (Fox 1970: frontispiece).
16. This circumstance is worthy of comment, since it was widely assumed that the TPK was non-agricultural owing to a basic lack of any archaeobotanical evidence, prior to the discovery of the two Nanguanli sites in waterlogged soil 7 m beneath the surface of the western Taiwan coastal plain.
17. Stone-lined graves are also known from TPK contexts in eastern Taiwan (Hung and Carson 2014:1126).
18. There is also a complete dog burial from Neolithic Nagsabaran in northern Luzon.
19. Chang 1981; Hung and Carson 2014; Jiao 2015.
20. See also Bellwood and Hiscock (2013:287) for some remarkable parallels between Philippine Iron Age and New Zealand Maori nephrite ear pendants.
21. Pers. comm. from Geoffrey Irwin, an authority on ancient Oceanic voyaging.
22. A squatting skeleton from Diosdipun Cave on Batan Island, found with no archaeological associations, is currently being dated and tested for ancient DNA (Bellwood and Dizon 2013:43–44). It might be pre-Neolithic.

23. Stepped stone adzes occur as early as 4500 BCE at Hemudu in the Yangzi basin. See Plate 3h.
24. Aoyagi et al. 1993; Ronquillo and Ogawa 2000, 2002; Ogawa 2002; Hung et al. 2011; Carson et al. 2013.

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Chapter 8
The Neolithic of East Malaysia and Indonesia

South of the Philippines, archaeological traces of Neolithic expansion during the middle and late second millennium BCE have been found in a number of Indonesian and East Malaysian sites, although the relatively poor conditions for open site preservation along the equator, especially in Wallacean islands with their steep and eroded or alluvially buried coastlines, mean that there has been a concentration on limestone and raised coral caves in very remote locations. Many of the excavated cave sites, such as the Niah Caves in Sarawak, are in regions of low population density and poor agricultural potential, such that many might have continued in use into recent times by hunter-gatherers rather than farmers. In fact, the Niah Caves were traditionally within the territory of Punan hunter-gatherers and bird's-nest collectors, and many of the Neolithic and Early Metal Age burials found in them might have been of food-producing individuals carried in by relatives from afar. Lowland open sites on the scales of those in Taiwan or the Cagayan Valley are perhaps so deeply buried that only commercial earth-moving equipment will ever bring them to light, except in very lucky cases of preservation such as the Kalumpang sites in interior Sulawesi.

Pottery traditions in Indonesia and East Malaysia suggest that at least two cultural streams might have been involved in the movement southwards from the Philippines. In this regard, the archaeological evidence fits with the linguistic evidence presented in Chapter 6 by Robert Blust, which suggests a separation into western and eastern streams in the vicinity of northern Borneo. The eastern one carried mainly plain red-slipped pottery and a diminishing reliance on rice into eastern Borneo (Sabah and eastern Kalimantan), Sulawesi, eastern Java, and the northern Moluccas. The situation in Nusa Tenggara and Timor still remains a little uncertain owing to the absence of large and informative Neolithic assemblages. The western stream, via Palawan and Sarawak, is more poorly understood but carried cord-marked and paddle-impressed pottery to western Borneo, Sumatra, and western Java, with no major presence of red-slipped plain ware. Linguistically, this western migration stream continued onwards from Borneo during the Early Metal Age to give rise to the Malayic-speaking populations of Peninsular Malaysia and those of Chamic-speaking central Vietnam,

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

who established themselves on the Asian mainland amongst Austroasiatic-speaking Neolithic populations who had already been in residence there since at least 2000 BCE. The archaeological record for these movements to Mainland Southeast Asia is currently not well understood, but they appear to have been associated with a use of bronze and iron and as such will be dealt with in Chapter 9.

Interestingly, material items of definite Taiwan origin, such as Fengtian nephrite tools and ornaments, and some of the Taiwan artifact types found with them (spindle whorls, perforated slate points, notched pebble net sinkers, stepped adzes), did not spread during the Neolithic into Island Southeast Asia beyond the Batanes Islands and Luzon. This geographical fall-off southwards in Taiwan markers suggests that early Neolithic settlers beyond Taiwan did not maintain frequent ties with their homeland (contrary to many previous assumptions about "lifelines"), and probably locked their energies into a continuous search for new resources by moving to new islands or landscapes whenever they could.

This "foundership" trend, with consequent cultural losses as well as innovations, was of course very apparent in Oceania (Bellwood 1996), where rice and millet cultivation never penetrated and where potting and loom weaving eventually (in Polynesia) disappeared altogether. Innovations that occurred beyond Taiwan, at least according to the linguistic evidence, included outriggers and double canoes, and the archaeological and ethnographic records tell us of the multiple social formations, from egalitarian tribes to proto-states, that evolved to populate contact-era Polynesia. There was also a switch in the tropics of eastern Indonesia and Melanesia away from rice towards indigenous tree and tuber crops such as bananas, coconuts, breadfruit, taro, and yams. The abandonment of cereal cultivation on the route towards Oceania perhaps reflected the ever-wet equatorial climate, together with the apparent lack of interest in growing cereals amongst Papuan-speaking food producers accustomed to New Guinea systems of arboriculture and the vegetative reproduction of tubers (Barton and Denham 2016). Even today, rice cultivation does not flourish near or along the Equator in Indonesia.[1]

Indeed, one of the most striking aspects of Neolithic archaeology in Island Southeast Asia is that there are no large mounded and nucleated settlements of the kinds commonly found associated with riverine rice cultivators in northeast Thailand and Vietnam (Bellwood 2015). My suspicion here is that this reflects the non-permanent nature of land exploitation in the early Neolithic Philippines and Indonesia, a situation promoted by a reliance on shifting agriculture and a move away from rice. Large Neolithic settlements on the Southeast Asian mainland were often located close to large rivers and estuaries, where rice cultivation in drained and embanked fields (*sawah* in Bahasa Indonesia) on fairly extensive alluvial soils would have been much easier than in the steeper and partially drowned coastal and riverine landscapes of much of Island Southeast Asia, especially Wallacea. This supports the idea that true wet rice cultivation in embanked fields in Island Southeast Asia was not widespread until the Early Metal Age, or even later.

In moving now to the archaeological record in East Malaysia and Indonesia, I must stress in connection with the following assemblage descriptions that it is impossible to deal with the Neolithic and Early Metal Age periods anywhere in Island Southeast Asia in *absolute* separation from each other. These were not separate periods in real-life social or population terms. For archaeologists working in Island Southeast Asia they offer an archaeological shorthand for purposes of ordering data in time, with the separation between the two periods placed around 500 BCE. At present, the oldest dates for bronze axes and bracelets (or indeed any kind of metal object) anywhere in Island Southeast Asia come from directly dated skeletons in Gua Harimau, southern Sumatra, and fall between 650 and 350 BCE (Simanjuntak 2016). One presumes that these artifacts were imported at this early date from Mainland Southeast Asian sources in West Malaysia, Thailand, or Vietnam.

In China and parts of the mainland of Southeast Asia, the arrival of bronze between 1500 and 1000 BCE was related to increases in elite presence and power, especially during the Shang Dynasty of central China (late second millennium BCE). Population densities and site sizes increased even more in these regions after 500 BCE, during the age of iron, the mightiest metal of all for those intent on forest clearance, agricultural production, and the creation of empires through warfare. The Romans and Han Dynasty Chinese knew this well. But we have no good evidence, so far, for such significant social changes connected with the arrivals of bronze or iron in Island Southeast Asia, at least not outside the context of interaction with the axis of power and ideology that linked this region with India from about 200 BCE onwards. Perhaps some significant developments of Polynesian-like genealogical hierarchy occurred indigenously during the pre-Indic Early Metal Age, if there actually was one with *in situ* metallurgy in Island as opposed to Mainland Southeast Asia (a problem we discuss further in Chapter 9), but until some evidence is produced for this we must keep an open mind.

In Island Southeast Asia, both the Neolithic and Early Metal Ages, therefore, fused seamlessly into one continuous sequence of cultural development. In my opinion, the basic foundations of the modern Island Southeast Asian anthropological landscape, in terms of indigenous people, indigenous languages, and indigenous (non-Indic, non-Islamic, and non-Christian) religions and cultures, were laid down during the Neolithic and thus were well in place by 500 BCE. The Early Metal Age after 500 BCE was an interesting period of further Austronesian migration to Vietnam, the Malay Peninsula, and Madagascar, and doubtless of further population admixture as well as trade and interaction. Equally interesting have been the historical, colonial, and independence periods since. But none witnessed such great shifts in the basic human population geography of Island Southeast Asia as the Neolithic.

The Western Neolithic Stream – Sarawak and Onwards

I will now introduce the *western Neolithic stream* in Island Southeast Asia by continuing the Niah sequence where I left off in Chapter 5. The original excavator of the Niah Caves, Tom Harrisson (e.g., 1970: Table 6), guessed a date around 2500 BCE for the appearance of the "quadrangular adze" Neolithic at Niah, but the Neolithic and Early Metal Age burial ground that yielded the Neolithic evidence from the site was excavated and recorded in such a way that no fully coherent sequence was recognizable

(B. Harrisson 1967). The recent British-Malaysian research at Niah (Barker 2013) has been focused on the Pleistocene and early Holocene layers towards the front of the cave, so this situation remains. However, some of the Niah sherd types can be dated by association with C14-dated burials in the various excavated caves at Niah (Lloyd-Smith 2013; Cole in press) and by means of typological parallels in other dated sites elsewhere in Sarawak and Brunei.

An original (and rather short) pottery report (Solheim et al. 1959) recognized the following ceramic groups in the Niah Caves, most presumably associated originally with burials:

1. Cord-marked and basket-impressed pottery (cf. Plate 8c–e from Gua Sireh) with globular, carinated, or open bowl body forms, a few on pedestals with perforations. My own examination of the Niah sherds stored in the Sarawak Museum in Kuching in 2005 leads me to believe that some of these non-geometric paddle-impressed pottery sherds might be Neolithic in origin, even though these decorative styles continued to be used into Early Metal Age contexts, as at Lubang Angin. However, some pottery of this type was apparently in use during the second millennium BCE, or perhaps earlier, at Gua Sireh in western Sarawak (both Lubang Angin and Gua Sireh are discussed below).
2. "Three-color ware," with incised and impressed meander and scroll patterns, painted in red and/or black (Plate 8a, b). Pots of this type, together with double-spouted water containers without bridges (Plate 8a), are dated from burial evidence to the later first millennium BCE in the cave of Lubang Angin and hence are Early Metal Age in their central date range, as presumably at Niah.
3. Double-spouted vessels of a different type with bridges between the spouts, dated to between 700 and 1500 CE at the site of Kupang in Brunei (Figure 9.8a; Bellwood and Omar 1980). At Kupang, they occur with a style of geometric carved-paddle-impressed pottery termed "Tanjong Kubor ware," after a type site in western Sarawak (Solheim 1965). This Tanjong Kubor ware also occurs at Niah and throughout the sequence at Gua Sireh. It is undoubtedly Early Metal Age and younger in date and will be described in Chapter 9. Its production using intricately carved wooden paddles has continued, side by side with imported Chinese ceramics, until now amongst the ethnographic Iban and within the ethnographic Malay potting tradition of Peninsular Malaysia.[2]

The above list implies that only the cord-marked and basket-impressed pottery in Niah is likely to be of Neolithic date, the rest Early Metal Age. The red-slipped plain ware that dominated the eastern stream of Neolithic dispersal in Indonesia is not in evidence in the Niah Caves, Lubang Angin, or Gua Sireh, except as occasional sherds. However, there is much uncertainty here, and to understand why we must examine the Neolithic burial record itself from Niah.

Around 145 burials of Neolithic to Early Metal Age date were excavated in the West Mouth by Tom and Barbara Harrisson. They have recently been re-examined by

Lindsey Lloyd-Smith (2013). They date mostly between 1500 and 200 BCE (but only 800 to 200 BCE in other caves at Niah, according to Cole in press), although C14 dates in the Niah Caves do continue in small numbers into the past 2000 years (Table 5.1). This suggests that some usage of the caves continued well into ethnographic times, as implied also by the presence of Chinese trade ware sherds and the Tanjong Kubor carved-paddle-impressed ware. The Niah Neolithic and Early Metal Age burials followed the earlier Paleolithic burial series after a virtual hiatus of over 4000 years in the use of the cave.

It appears that the oldest West Mouth Neolithic burials were flexed, then came a major series of extended supine burials, some in lidded wooden coffins[3] and some wrapped in textile shrouds and/or bamboo caskets. These supine burials commenced around 1300 BCE in Lloyd-Smith's chronology. Jar burials were present from about 1000 BCE onwards and a few cremations appeared shortly after. Jar burials, in fact, continued until quite recently in Niah since some were placed in imported Chinese jars of probable Song (960–1279 CE), Yuan, or Ming Dynasty (1368–1644 CE) date. Some of these were cut open at the top to take a primary burial and then fitted back together again, like some of the older earthenware jars in the Savidug Dune Site on Sabtang Island in Batanes and from Pacung in North Bali, here from Early Metal Age contexts. Several Niah burials lacked skulls. Grave contents included ochre powder to color the soil and bones red, rattan baskets and textiles of palm fiber (Cameron in press), pandanus mats, ramie cordage, pillows of wood, bamboo or leaves, a quadrangular adze, sherds of three-color ware, two bone rings, and a wooden disc-shaped earplug. Some younger burials had glass beads, remnants of textiles, and metal artifacts.

The Niah Caves pottery sequence has recently been reconstructed from the minor burial cave assemblages, apart from the West Mouth, by Franca Cole (in press). She places in her "Early" phase (800 to 200 BCE) the bridgeless double-spouted pots and the globular and carinated vessels with tall rims. This agrees generally with the sequence I have offered above, and Cole's Intermediate phase continues through the Early Metal Age with the three-color ware and the bridged double spouts, eventually to enter a Terminal phase with Chinese trade wares dated after 1300 CE.

The burials at Niah are rather interesting because the caves themselves show no actual evidence of Neolithic occupation, only burial. The West Mouth also appears to have been out of use for any kind of human activity between 200 BCE and 900/1000 CE. Yet pottery vessels in 14 of the Niah burials contained rice grain impressions (Doherty et al. 2000), suggesting that the people buried had at least some knowledge of rice cultivation. Strontium and lead stable isotope studies on tooth enamel from the skeletons reveal that many of their owners did not live near Niah (Valentine et al. 2008), hence their bodies must have been carried into the cave for burial, possibly in the form of desiccated or smoked corpses (some burials showed signs of burning) removed from mortuary houses and carried to Gunung Subis wrapped in the caskets or mats in which they were eventually buried.

The pottery was thus presumably non-native to the immediate vicinity of Niah, which is not surprising since it is unlikely that rice was grown close to Niah during

Neolithic times, given the densely forested and swampy nature of the surrounding terrain. Carbon isotope studies of the skeletons also reveal that their owners lived in fairly open landscapes, perhaps with forest clearance for agriculture (Krigbaum 2003, 2005), although exactly where these landscapes were is not clear from the stable isotope evidence alone, which relates to fine differences in ground water chemistry. Valentine et al. (2008:1471) summarize the information from the Niah burial ground as follows: "the West Mouth appears to have been a hub of Neolithic mortuary activity possibly meriting long distance transport of human remains and visitation by various Neolithic groups."

The Niah Caves therefore are still rather a conundrum. They presumably served as sacred caverns for Neolithic and Early Metal Age peoples, like many other Southeast Asian caves at this time, mainly of relevance for communicating with the dead and those supernatural entities who were in charge of the afterlife. The 1989 excavations in the cave of Lubang Angin in Gunung Mulu National Park (about 160 km southeast of Niah and 90 km inland: Ipoi 1993; Ipoi and Bellwood 1991) revealed a similar situation, yielding extended burials wrapped in bark cloth laid in shallow pits in the floor of the cave. The grave goods here seem to have been placed on the surface, which led to much mixing up of their remains, and like the Niah Caves the site had no sign of Neolithic or Early Metal Age dwelling usage. The Lubang Angin pottery is identical to much of that from Niah (Plate 8a, b) and includes cord-marked and carved-paddle-impressed vessels, double-spouted vessels without stirrups, and large carinated vessels of three-color ware decorated with red and black pigment (the third color being the surface color of the pot). The radiocarbon dates for Lubang Angin fall between about 600 BCE and 500 CE, and since glass beads and an iron knife were also found in the site it is clear that this assemblage overlapped with the Early Metal Age.

The Niah and Lubang Angin three-color ware is similar to other late Neolithic and Early Metal Age phase pottery from Sabah and especially the Philippines, where similar motifs in Manunggul Cave A on Palawan have been tentatively dated to the first millennium BCE (Fox 1970: frontispiece). Similar sherds also occur at Ille Cave in northern Palawan.[4] The Manunggul pottery, like the Niah three-color ware, has fairly exuberant incised curvilinear designs with punctate infillings. The three-color decoration also resembles that on pottery from the upper layer at Bukit Tengkorak in eastern Sabah, dating after 300 BCE (below). The interesting possibility arises that this three-color pottery in the interior region of Gunung Mulu might record inland expansion by Austronesian populations from coastal locations. Recent PhD research at ANU by Vida Kusmartono shows that Neolithic assemblages reached the upper Kapuas basin in the center of Borneo by 1000 BCE, although a precise origin for them is still unknown. Rice cultivation also reached the Kelabit Highlands in interior Sarawak by at least 200 CE (Jones et al. 2013), in association with *Eugeissona* sago palm exploitation, although in this instance the data come from a cored natural paleochannel rather than an archaeological context.

So far, the evidence described from Niah and Lubang Angin has been rather unhelpful about any truly Neolithic phase in Sarawak. Some of the cord-marked and basket-impressed pottery has an early "feel" and there are at least some burials in Niah

West Mouth dated to around 1300 BCE in Lloyd-Smith's chronology, although without a clear-cut pottery sequence attached to them. So, what was the nature of the Neolithic here, which obviously lacked the red-slipped plain ware that dominated in the eastern migration stream to the east of Borneo?

To help answer this question we must examine one of the most ambiguous Neolithic sites ever excavated in Island Southeast Asia. The cave of Gua Sireh lies about 55 km southeast of Kuching, in the limestone massif of Gunung Nambi in the far west of Sarawak. It is flanked by flat alluvial terrain, used today and perhaps since the Neolithic for growing rice. The site was first excavated by Harrisson and Solheim in 1959, then by Zuraina Majid in 1977 and most recently by Ipoi Datan in 1989.[5] The main part of the site is only 60 cm deep in its central area, over limestone bedrock, and peppered by postholes for Early Metal Age sleeping or burial platforms. So it is not surprising that signs of disturbance are rife in the sequence.

When excavated in 1989, Gua Sireh yielded a rather ephemeral preceramic occupation with a few stone flakes and riverine shells, with an oldest C14 date of about 20 kya. Pottery occurred in the top 25 cm, but with no apparent temporal sequence. Early Metal Age glass and carnelian beads were found through this 25 cm depth. The Gua Sireh pottery was mainly paddle-impressed, like much of the pottery at Niah and Lubang Angin, including cord-marked, basket-impressed (the most common), and geometric-impressed sherds of the Tanjong Kubor (TK) type. TK ware has been dated to 700–1500 CE at Kupang, as stated, and at Gua Sireh to about 650 CE from a direct C14 date on a rice grain in a sherd of Tanjong Kubor style pottery with diamond-shaped impressions (similar to Figure 9.8e and g). The rim forms from Gua Sireh are mostly short and notched types typical of Early Metal Age contexts elsewhere in Island Southeast Asia. Altogether, there is little about the site to suggest that it had any Neolithic occupation at all. Incision and red slip are extremely rare.

However, one charcoal C14 date from near the base of the pottery layers centered on 1500 BCE, suggesting a possible Neolithic presence in the cave. Another, of 2500 BCE, could perhaps have been of preceramic origin. But the greatest surprise of all came when a C14 date for a rice grain embedded in a sherd of the ribbed or basket-marked (not cord-marked) pottery was returned as 2300 BCE (Bellwood et al. 1992). This was a highly important discovery, supported by the later discovery of many rice husk fragments in the soil within the cave (Sen 1995). Was the date correct? One presumes so, unless the laboratory somehow managed to extract truly ancient organic materials from the clay matric of the sherd and to mix them inadvertently with the charcoal of the rice grain. Since this date was run in the early 1990s, under what are now very old protocols, we can never be certain.

When these discoveries were still fresh and I was preparing the 1997 edition of my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 1997:237–238), I optimistically suggested that the early date and the rice implied contact before 2000 BCE with the Neolithic of Mainland Southeast Asia, perhaps central/southern Thailand or the Malay Peninsula. I also suggested that they might indicate the founder presence of an Austroasiatic-speaking Neolithic population before the arrival of Malayo-Polynesians, given the observations by Alexander Adelaar that there are similarities in preploded consonants (e.g., *-pm* and *-tn*) between Dayak (Sarawak) and Aslian (central Peninsular Malaysia) languages. However, Adelaar was reluctant to demand a direct Austroasiatic (Aslian) migration to Borneo and left open the possibility that there was once an ancestral language complex common to both the Malay Peninsula and western Borneo that provided a common substratum (Adelaar 1995:91). One's mind springs at once to the late Hoabinhian period, lasting to as recently as 3500 years ago in remote regions, when foragers could have roamed the exposed Sunda shelf from the Malay Peninsula to Sumatra and western Borneo.

Twenty years later there is far more information available about the Neolithic of Mainland Southeast Asia (Higham 2014) and especially of Vietnam, partly as a result of research in that country in which I have been directly involved (Red River delta, central Vietnam, and the region north of the Mekong delta; Bellwood 2015). I see no close parallels in these regions for the Gua Sireh assemblage, and it is also quite apparent to me that the Gua Sireh pottery has nothing in common with the Neolithic pottery of the Thai-Malaysian Peninsula, which I described in Chapter 9 of my *Prehistory of the Indo-Malaysian Archipelago*.[6] My 1990s ruminations did help to set off a chase for Aslian (Austroasiatic) populations and a Mainland Asian Neolithic archaeological settlement of Borneo (Anderson 2005; Blench 2010, 2012), but none of this was associated with any actual discussion of Vietnam or Thai-Malaysian Peninsula Neolithic archaeology.

If Austroasiatic populations once settled western Borneo, either before or after the arrival of Malayo-Polynesians – and this is certainly not impossible – then they have left remarkably little trace.[7] The Gua Sireh pottery certainly cannot be traced back into the late Paleolithic or Para-Neolithic of northern Vietnam (as suggested by Bulbeck 2008). Coastal Vietnam had styles of incised and impressed (but not basket-marked) Neolithic pottery with shouldered stone adzes that are not paralleled in Gua Sireh. If there truly was a Neolithic presence in western Sarawak with rice at 2300 BCE, then I would associate it with an early aspect of the western stream of Malayo-Polynesian dispersal, like Niah and Lubang Angin a little later in time. And that, unfortunately, is almost as far as we can go at present with the western Neolithic stream in Borneo.

Java and Sumatra

Undated cord-marked and incised pottery is very widespread in western Java (Sutayasa 1973, 1979), but so far no detailed comparison has been made with the paddle-impressed pottery from Gua Sireh and Niah. Only the linguistic evidence at present suggests settlement by a Malayo-Polynesian population ancestral to the present Sundanese and Javanese, expanding southwards from eastern Borneo and possibly arriving between 1500 and 1300 BCE (Chapter 6). However, this movement would appear to have belonged to the eastern rather than the western Neolithic stream, to be described below, given that red-slipped pottery occurs in association with an excavated working floor for quadrangular adzes at Kendeng Lembu near the eastern tip of Java (van Heekeren 1972; Noerwidi 2009). Unfortunately, this site remains undated.

In fact, little has changed in the Neolithic arena in Java since *Prehistory of the Indo-Malaysian Archipelago* was last revised in 1997. One major problem for both Java and Sumatra may be that Neolithic sites along their South China Sea northern coastlines are likely to be buried under many meters of alluvium and beneath the water table (like Nanguanli in Taiwan). Hence, they are unavailable for archaeological research without heavy machinery.

Nevertheless, an enormous number of superbly manufactured quadrangular-sectioned adzes exist in museums in Java (Duff 1970, types 2A and 7A), often made from semiprecious stones such as serpentine, agate, or chalcedony. These suggest that widespread Neolithic populations once occupied the island, although many of these adzes could actually be of Early Metal Age date. There are extensive working floors for such adzes and stone bracelets in several locations in western and central Java, especially in the Gunung Sewu siliceous limestone region near Punung, southeast of Yogyakarta. A detailed analysis of surface material collected from one such Gunung Sewu site, located between the villages of Bomo and Teleng (Figure 8.1a–b), has been carried out by Daud Tanudirjo (1991). Another very extensive working area for siliceous limestone stone adzes exists near the village of Ngrijangan.

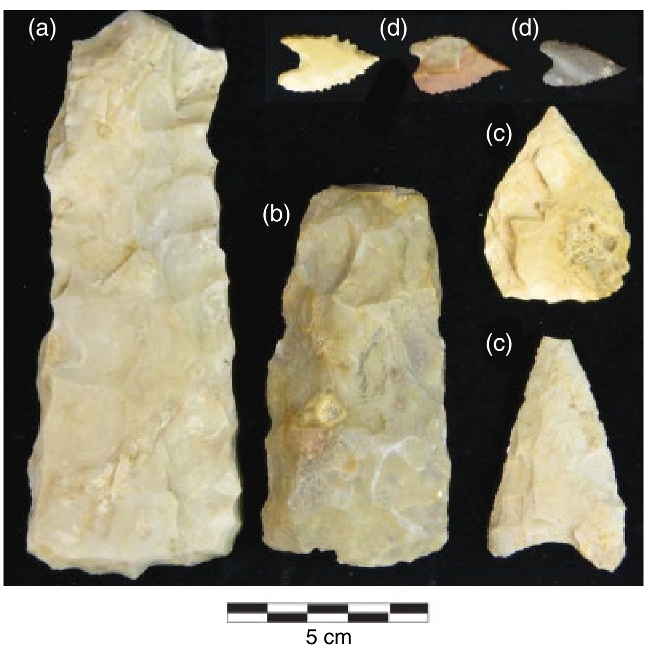


Figure 8.1 Neolithic flaked stone tools from Java and South Sulawesi. (a, b) quadrangular adze rough-outs on siliceous limestone, Punung, south Java (A from Bomo-Teleng workshop; B from Punung region). (c) points (flat and hollow-based) of siliceous limestone from the Punung region. (d) serrated and hollow-based Maros points from Leang Burung 1, South Sulawesi. Source: collections of the School of Archaeology and Anthropology, ANU (see Mulvaney and Soejono 1970, 1971) (see also color plate 15).

Despite the current lack of excavated Neolithic archaeology in Java, our understanding of Neolithic to Early Metal Age archaeology in Sumatra has undergone a recent revolution with the excavation of Gua Harimau in the Padang Bindu limestone region of southern Sumatra. This major cave site has already been discussed in the contribution by Matsumura and colleagues in Chapter 4, since its burials reveal a change from an older Australo-Papuan cranial morphology to an immigrant Asian Neolithic morphology at around 1000–600 BCE. The Pre-Neolithic burials were all folded in the normal late Paleolithic manner (see Figure 4.3), whereas the 76 excavated late Neolithic and Early Metal Age burials, some directly dated to between 750 BCE and 200 CE, were mostly extended and supine in the normal Neolithic manner.

The Gua Harimau pottery is mostly cord-marked and carved-paddle-impressed. Red-slipped plain ware is rare (only four sherds so far) and it thus appears that the eastern Neolithic stream never penetrated this far west in southern Indonesia. However, there are also some rare incised and punctate sherds in the site (Simanjuntak 2016), which, added to at least three more from nearby Gua Pondok Selabe (Widianto 2011:131), do provide a certain lifeline for those who wish to claim an Austroasiatic migration into western Island Southeast Asia prior to the arrival of the Austronesian-speaking peoples. I was inclined to reject this suggestion above for Gua Sireh and Sarawak, but given the closeness of Sumatra to the Thai-Malaysian Peninsula it might come as no surprise to know that incised and impressed ("rouletted") Neolithic pottery similar to that from Gua Harimau and Pondok Selabe does occur in sites dating to around 2000–1500 BCE in southern Vietnam (e.g., An Son; Sarjeant 2014: Figure 7.32), central Thailand (e.g., Khok Phanom Di), and the inland Malay Peninsula (e.g., Gua Cha; Bellwood 2007: Chapter 9). There is none in Gua Sireh. Further investigation could be warranted, but the Gua Harimau specimens appear to be much younger than those in the Vietnam and Thailand assemblages. Furthermore, I have not yet seen any of the Sumatran material at first hand.

Many of the Gua Harimau supine burials contain bronze and iron artifacts, to be described in Chapter 9, and it is not yet clear if any of the supine burials in the cave are actually Neolithic at all. One of the folded Australo-Papuan burials is directly dated to only 600 BCE, suggesting that the arrival of the Asian newcomers could have been at the end of the Neolithic or even early in the Early Metal Age in this rather remote area. Obsidian occurs from the preceramic basal layers in the site, dating from about 15 kya and presumably from a Sumatran source. However, it is most frequent in the upper pottery-bearing layers.

The Eastern Neolithic Stream: Eastern Borneo, Sulawesi, and the Moluccas

The eastern Neolithic stream is rather more coherent than the western one. Enough stratified sites have been excavated to indicate that the oldest Neolithic pottery was predominantly red-slipped plain ware, with an increasing presence over time of incised and impressed (open circle, dentate, and punctate) motifs, frequently in horizontal

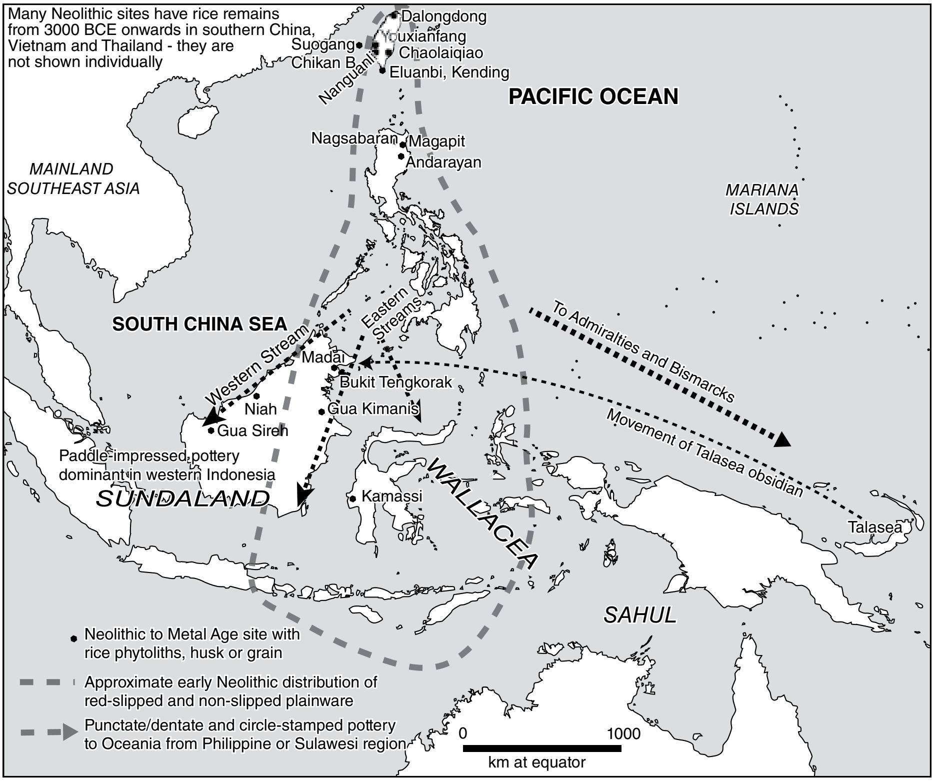
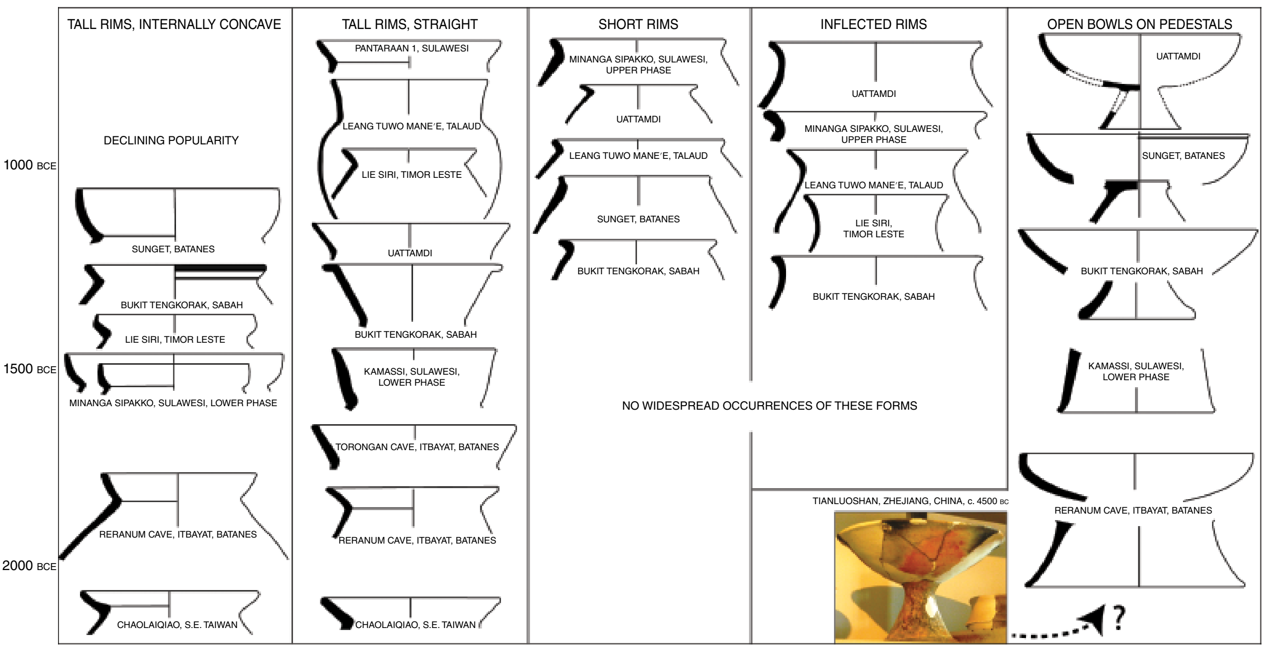


Figure 8.2 The distributions of red-slipped plain ware and Neolithic to Early Metal Age sites with remains of rice (Bellwood 2011b) in Island Southeast Asia, together with the movement of Talasea obsidian from New Britain to Borneo.

incised zones over red slip and infilled with lime or white clay (Chapter 7). This kind of decoration was present in northern Luzon by at least 1500 BCE and was deeply implicated in the settlements of the Mariana Islands (Carson et al. 2013) and the Lapita cultural region of Island Melanesia and western Polynesia (Plate 7).

Our current picture suggests that the red-slipped plain ware pottery tradition spread from southeastern Taiwan through Batanes and Luzon around 2200 BCE, and then into northern and eastern Borneo, Sulawesi, eastern Java, and the Moluccas, reaching the latter by soon after 1500 BCE (see map, Figure 8.2). The relevant rim forms, from southern China, through Taiwan and the Philippines, and into central and eastern Indonesia, are shown in Figure 8.3. Changes occurred as the spread took place, perhaps initially in Luzon, where the incised and impressed patterns began to dominate pot surfaces around 1500 BCE, after several centuries of domination by plain ware. This type of incised and impressed decoration occurred as early as 4500 BCE in middle Yangzi China, so it was not entirely an Island Southeast Asian invention, but its rise to dominance in Neolithic Island Southeast Asia was certainly widespread and hardly coincidental.



VESSELS ARE NOT ACCURATELY REPRODUCED TO THE SAME SCALE
DETAILS OF RED SLIP NOT SHOWN, BUT MOST VESSELS ARE RED-SLIPPED OR HAVE TRACES OF RED SLIP

Figure 8.3 Red-slipped plain ware rim forms through time and space in Island Southeast Asia. Note the possible ancestral form of the open bowl on a pedestal at Tianluoshan (c. 4500 BCE), bottom right.

In eastern Indonesia, the initial horizon of red-slipped plain ware without other decoration is well-documented in a number of rather small and marginal cave assemblages. The Leang Tuwo Mane'e shelter in the Talaud Islands contained red-slipped plain ware from thin-walled vessels with globular bodies and everted rims, dating possibly from 1500 to 1300 BCE (Bellwood 2007: Figure 7.11).[8] Across the Sulawesi Sea in the cave of Agop Atas (Madai) in Sabah, the early Holocene pebble and flake industry was succeeded, after a long gap in occupation, by a red-slipped plain ware pottery assemblage similar to that from Talaud (Bellwood 2007: Figure 7.11), with a continuing chert flake industry (Bellwood 1988). This type of red-slipped plain ware pottery was also excavated by Karina Arifin (2006) in Gua Kimanis in the Berau region of east Kalimantan, here with quite a lot of paddle-impressed pottery that could indicate a connection with the western Neolithic stream in Sarawak. The Kimanis pottery contained some examples with embedded rice husks in their fabrics.

In the northern Moluccas, red-slipped plain ware of the same type occurs in the rock shelter of Uattamdi, on Kayoa Island to the west of Halmahera. The Uattamdi red-slipped pottery occurs only in the lower half of the deposit, C14-dated to 1300–800 BCE. Above it lies an upper layer with Early Metal Age jar burials and incised pottery (Bellwood et al. 1998; Bellwood forthcoming). Some of the Uattamdi vessels had red painted stripes, like some from Leang Tuwo Mane'e. The assemblage also included shell beads and bracelets (Figure 8.4a), shell spoons/scrapers, and a lenticular-sectioned stone adze and stone chisel (Bellwood 2007: Plate 34) plus an abundance of stone adze chips. In addition, Uattamdi had well-stratified bones of Pacific clade pig (see contribution below by Philip Piper) and dog, both introduced and domesticated species in this region.

Red-slipped pottery similar to that from Uattamdi, in this case with some incised decoration, is also dated from about 900 BCE onward in the open site of Buwawansi, on Gebe Island to the east of Halmahera. Red-slipped plain ware dated to about 1000 BCE also occurs with chert and obsidian tools and pig bones on Pulau Ai in the Banda Islands of the central Moluccas (Lape 2000).[9]

Further east in Flores, the open burial site of Pain Haka has so far yielded 48 separate burials containing 55 individuals, buried either supine and extended in unidentified organic wrappings (bark cloth?) or placed in jars that were cut open across their shoulders to receive a presumably folded body. These burials date from 1000 to 200 BCE according to C14 dates on charcoal and human bone. The site has no metal or glass, but a preliminary report (Galipaud et al. in press) refers to basalt and *Cassis* shell adzes, the latter presumably similar to a large group found in Golo and Wetef caves in the Moluccas and dating to within the past 3000 years. There are also *Conus* and *Trochus* shell bracelets, together with red-slipped plain ware in the lower levels, followed by increasing incision and appliqué after 500 BCE.

Pain Haka has also produced at least one high-necked flask that is absolutely identical to an undated example associated with an extended burial at Gunung Piring in Lombok (Gunadi et al. 1978; Bellwood 2007: Plate 60e). Gunung Piring is identified as an Early Metal Age site, but might well have been subjected to disturbance. Some of the Pain Haka burials had their skulls removed, a practice paralleled at Nagsabaran in

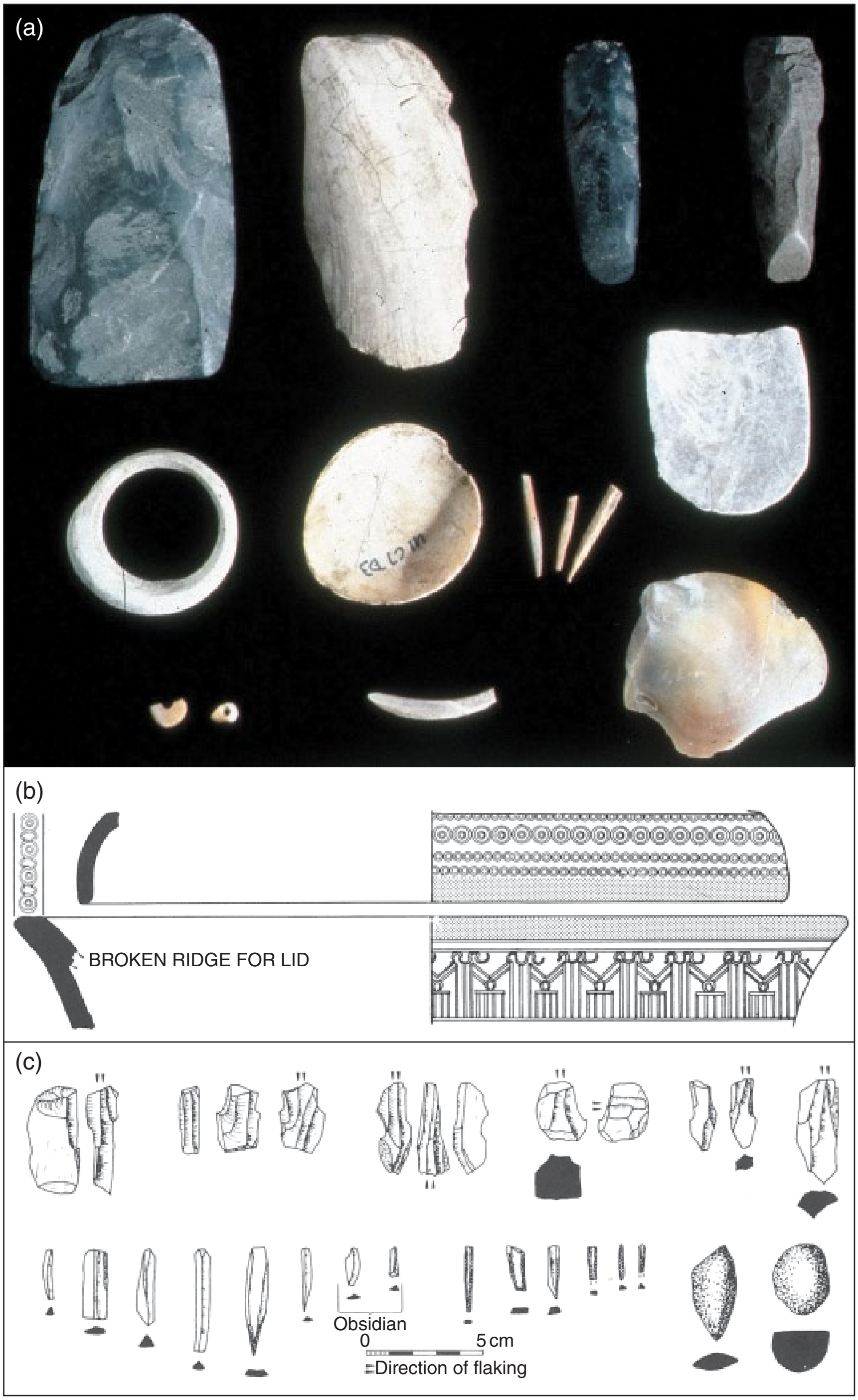


Figure 8.4 (a) stone adze and chisel (first and third from left, upper row), shell artifacts, and three bone points from Uattamdi, Kayoa Island, northern Moluccas, 1300–500 BCE. The chisel at top right is from Pitcairn Island, eastern Polynesia – an interesting parallel within the same

the Cagayan Valley, at Niah, at Gua Harimau in Sumatra, and far to the east in the Lapita site of Teouma (c. 1000–800 BCE) in Vanuatu (Bedford et al. 2010). All of this seems hardly coincidental.

Further to the east again, detailed recent research in Timor has not yet produced very much evidence for a clear Neolithic presence in the island (e.g., O'Connor 2015: Table 15.1 on C14 dates from Jerimalai shelter). It is also virtually absent in the Aru Islands. But the cave of Matja Kuru in Timor-Leste has yielded a very important dog burial dated to about 1000 BCE (Gonzalez et al. 2013). Older cave excavations in Portuguese Timor during the 1960s by Ian Glover (1977, 1986) produced plain but apparently unslipped pottery dated at that time by extrapolation from scattered C14 dates in rock shelter sequences to between 2500 and 2000 BCE. However, it is unlikely that Timor was reached by Malayo-Polynesian settlers before 1500 BCE, this island being virtually the end of the migratory road for them in southeastern Indonesia. As discussed in Chapter 5, the Timorese caves have also produced both Paleolithic and Neolithic shell disc beads and one-piece angling hooks of *Trochus* shell, as well as shell bracelets.

The early tradition of red-slipped plain ware within the eastern Neolithic stream thus seems to have marked a widespread expansion out of the Philippines, perhaps commencing before 1500 BCE and being traceable as far as eastern Java and perhaps Timor. So far, there are no signs of this red-slipped plain ware tradition spreading further into Oceania, where the initial Marianas and Lapita migrations from 1500/1300 BCE onwards carried the more elaborately decorated red-slipped and incised/impressed style of pottery shown in Plate 6 and Plate 7. However, this later incised and impressed pottery has not yet appeared in southeastern Indonesia beyond Sulawesi, or in New Guinea or even in Java. Neither has it been found so far in the Palau Islands of western Micronesia, despite intensive searching.

These two successive spreads, first of red-slipped plain ware and second of red-slipped incised and impressed ware, can be put into better context from two very important archaeological locations in Sabah and Sulawesi.

Sabah: Bukit Tengkorak

In 1987, excavations in a rock shelter formed amongst tumbled boulders on the rim of an extinct volcano called Bukit Tengkorak, near the town of Semporna in south-eastern Sabah, yielded a lower layer above the bedrock dated from C14 on charcoal to 1300–1000 BCE. It contained (figures 8.3 and 8.4b, c) red-slipped pottery with plain or incised pedestals, a single superbly decorated incised vessel with a matching lid, and lots of shell items including adzes, beads, bracelets, and a possible fish-hook shank,

Austronesian lithic tradition, even though perhaps 2500 years younger in time. (b) incised, circle-stamped, and red-slipped (stippled zone) vessel with lid from Bukit Tengkorak, c. 1200 BCE. (c) agate blade cores, blades and drills, lava files (bottom right), and two small flakes of Talasea obsidian, Bukit Tengkorak, 1200–800 BCE. Sources: (b) and (c) are from Bellwood and Koon (1989): these are archival drawings so the quality is no longer perfect.

together with shell manufacturing debris. Stone tools included untanged stone adzes with trapezoidal cross-sections, similar to the most common cross-section represented in the contemporary adze assemblage (c. 1200–800 BCE) from the Anaro site on Itbayat Island in the Batanes.

The lithic assemblage also included lava files, adze chips, a remarkable agate microblade and awl industry made on prismatic cores (Figure 8.4c) and, perhaps most remarkable of all, small chips of obsidian from three sources. One of these remains unknown but also occurs in the Talaud Island sites, the second (one piece only) was in the Admiralty Islands north of New Guinea, and the third and major one was the Kutao / Bao source at Talasea in northern New Britain in Island Melanesia (Figure 8.2).[10] The Talasea and Admiralty obsidian sources were used by Lapita people in the western Pacific, and the Bukit Tengkorak discovery of the Talasea material increased its distribution at around 1000 BCE to a rather amazing 6500 km, from Borneo to Fiji, thus making it perhaps the most widely distributed material in the Neolithic world.

The upper layer in the Bukit Tengkorak rock shelter, dated to the first millennium BCE, produced decorated pottery with much incision and punctate decoration, rim notching, cord-marking, and paddle impression. Red-slipped plain ware was much less evident. This phase thus represents expansion of the incised and impressed pottery tradition described above, perhaps with an ultimate source in the Philippines. Similar decorated pottery has more recently been found in caves in the Sangkulirang Karst in East Kalimantan, the same location as the rock art described in Chapter 5 (Chazine and Ferrié 2008). Fragments of pottery stoves, an important artifact class known as far back as 4500 BCE at Hemudu in Zhejiang, are quite common in this phase at Bukit Tengkorak, as are decorated lids and pedestals. Talasea obsidian was no longer imported, according to the rock shelter sequence at Bukit Tengkorak, but the other shell and stone industries continued.

Both phases at Bukit Tengkorak are rich in fish bones and these, plus the obsidian, pottery stoves (still used ethnographically by Sama-Bajaw sea nomads in the Sabah–Sulu region) and evidence for shell ornament manufacture, indicate that the inhabitants were adept seafarers and perhaps traders. Indeed, the Bukit Tengkorak agate prismatic microblade industry is quite unique in Island Southeast Asia and, if not a local innovation (which seems rather unlikely since no other site in Island Southeast Asia has ever yielded a close parallel), could reflect contact with regions of similar microblade production in Neolithic southern China. Candidates here might include the site complex of Xiqiaoshan in Guangdong (Huang et al. 1982) and also, perhaps surprisingly, the Neolithic site of Tianluoshan in northern Zhejiang (5000–4500 BCE; Li and Sun 2009:128). Microblade production is also attested from the beginning of the Holocene in the site of Lijiagou, in the Huai drainage system in Henan Province (Wang et al. 2015), although occurrences such as this, as at Tianluoshan, are much too old to allow for any direct contact with Bukit Tengkorak. The occurrence of similar microblade drills in the contemporary eponymous site of Lapita in New Caledonia (Sand 2010: Figure 122) suggests that this lithic technology also spread into western Oceania with the Lapita migration, possibly from the Philippines or northeastern Indonesia.

Does the Bukit Tengkorak assemblage represent a maritime-oriented tradition that one might expect to have characterized the earliest Malayo-Polynesian migrations into Oceania? The site has yielded no direct evidence for agriculture beyond a few rice phytoliths, but then neither have most others of this phase in Island Southeast Asia. The problem may have more to do with sampling and survival than a true absence. In 1994–1995, Bukit Tengkorak was excavated again by Stephen Chia (2003) from Universiti Sains Malaysia; he recovered similar material and dates to the 1987 excavations, but focused on the open areas of the site where stratigraphy might have been more mixed through cultivation activities in the past. The 1987 excavation took place within a protected rock shelter, so the sequence here, from a predominantly red-slipped plain ware to a predominantly incised and impressed pottery, seems to be much clearer.

It should be noted, however, that with a start date of 1300 BCE, Bukit Tengkorak probably does not record the initial spread of the red-slipped plain ware tradition into Borneo or Sulawesi. Older sites with this tradition exist in Sulawesi, as we will now see.

Sulawesi

Equally as significant as Bukit Tengkorak are the two Neolithic open sites of Kamassi and Minanga Sipakko (the "Kalumpang sites"), both located about 95 km inland up the Karama River, close to the modern town of Kalumpang in West Sulawesi (Anggraeni et al. 2014). Kamassi was first excavated by van Stein Callenfels in 1933 and by van Heekeren in 1949 (van Heekeren 1950, 1972:184–190) and was originally a hilltop site, although many archaeological materials have fallen down the side of the hill. The earliest Dutch work at Kamassi aroused interest since the assemblage included quadrangular and lenticular-sectioned stone adzes, some with unusual waisted or knobbed profiles, ground slate projectile points similar to Taiwanese Neolithic types (but without perforations), a stone bark cloth beater and some possible stone reaping knives (Bellwood 2007: Plate 33). The other site of Minanga Sipakko is stratified within a river terrace on the northern bank of the fast-flowing Karama, a little downstream from Kamassi, and is likely to have the better-preserved stratigraphy of the two.

The newest work at both sites offers a clear sequence. Two series of C14 dates, one for each site, indicate that Neolithic occupation was established around 1500 BCE with red-slipped plain ware of clear southern Taiwan and Philippine ancestry, characterized by tall everted rims, often with concave interiors, like many of the second millennium BCE rims from Batanes, Cagayan Valley, and southeastern Taiwan Middle and Late Neolithic sites such as Chaolaiqiao and Donghebei (Plate 9f). The red-slipped plain ware gradually shifted into unslipped plain ware during the 600 years or so that these two sites appear to have been occupied. Decorated pottery was most common in small quantities in the middle layers of each site, perhaps close to 1200 BCE, and one piece with circle-stamped and punctate decoration from Kamassi is remarkably similar to some of the decorated pottery from Magapit in the Cagayan Valley (Plate 9a).[11] In this region, carved-paddle-impressed pottery like that described from western Borneo does not appear until the Early Metal Age, at the site of Palemba, upstream from Kalumpang (Anggraeni 2016).

Of all the Neolithic assemblages excavated in Indonesia, these two Kalumpang sites, at least in their stone repertoires and red-slipped pottery, offer the closest resemblances with the Neolithic of the Philippines and Taiwan. Like the Cagayan sites, cord-marking and other kinds of paddle impression are absent. Both sites contain obsidian from an unknown (but probably Sulawesi) source, but this was not present in their lower layers, unlike the situation at Bukit Tengkorak where Talasea obsidian was present at the base. Hence, the two Kalumpang sites were apparently not in contact with the Talasea or Admiralty obsidian sources in Melanesia. Typologically, the Bukit Tengkorak red-slipped plain ware, as noted above, appears to be a little younger than the oldest Kalumpang pottery in that it has shorter rims, albeit not as short as the rims at the site of Pantaraan in the lower Karama Valley (Anggraeni et al. 2014), which dates from 800 BCE and thus overlaps with the tail-end of the Kalumpang sequence (both of the Kalumpang sites were seemingly abandoned around 900 BCE).

The assemblages of Bukit Tengkorak and the Kalumpang sites thus differ in interesting ways, especially in their obsidian sources and in the presence of the agate drill industry only in the former site, although the Kalumpang sites were presumably too far inland to have been involved in the working of marine shell using such drills. Indeed, the location of the Kalumpang sites around 100 km inland, up a fast flowing river in fairly steep terrain, renders it likely that the initial Neolithic presence in coastal regions of Sulawesi will turn out to be considerably older than 1500 BCE. The relationships between Bukit Tengkorak and Kalumpang may have reflected closely shared ancestry rather than direct contact. Kamassi also has a few rice phytoliths (Plate 9g), but an actual presence of rice cultivation remains uncertain.

The remarkable complex of large stone jars (*kalamba*) and human statues (Plate 10) found in Central Sulawesi, especially in the Bada and Besoa valleys in Lore Lindu National Park, has in the past been considered to be of Early Metal Age date and I have also treated it as such (Bellwood 1978:228; 2007:306).[12] I now feel the need for some Neolithic enthusiasm about these wonderful creations. Building on Kaudern's foundation survey published in 1938, further surveys in the Bada district (Sukendar 1980; Siswanto and Fahriani 1998) have brought to light more stone jars and statues and demonstrated some sort of association with iron and carved-paddle-impressed pottery, presumably of Early Metal Age affinity in the case of the latter. However, I would like to point out here some rather fundamental observations about both the anthropomorphic carvings and the jars. They could be a lot older than the Early Metal Age, albeit still considered sacred through the succeeding millennia, right up to the visit of Kaudern in 1917–1920.

The human statues in the Bada Valley (e.g., "Palindo" and "Langke Bulawa," shown as Plate 10a and b respectively) are legless busts portrayed above the groin with genitalia (obviously male in a, female in b) and fingertips meeting towards the navel. The generic similarities with Easter Island statues are obvious (e.g., Bellwood 1978: Figure 12.31), even though the latter do not have genitalia. This need not imply direct contact, or even exact contemporaneity, but I suggest we are looking at a shared tradition within Malayo-Polynesian societies of depicting human ancestors, possibly originally in wood, as busts with stylized arm and finger positions.

The second observation is more important from a chronological point of view. Near Bulili in the Bada Valley is an incised petroglyph shown in Figure 8.5a, a photo for which I must thank Derek and Margaret Reid since I have never been to the site myself. Kaudern (1938:106) states that this was once part of a large lid for a *kalamba*, with a central knob. Archaeologists who research the Lapita cultural complex in Melanesia and western Polynesia will recognize immediately that the design shown is almost identical to that on a potsherd excavated by Roger Green in the site of Nenumbo, Santa Cruz Islands (southeastern Solomons), dating from about 800 BCE (Sheppard et al. 2015; Figure 8.5b here). The human face with a pointed chin and the four-lobed petal-like design to its left occur with remarkable clarity in both compositions, despite the obvious addition of zones of fine dentate-stamping to the baked clay version. A similar face also occurs on the pottery "stopper" brought into my office about 15 years by a collector who told me it came from the Kalumpang region. Luckily,

Figure 8.5 (a) carved stone lid fragment at Bulili, Bada Valley (scale in 10 cm units). (b) the Nenumbo Lapita sherd, Santa Cruz Islands, c. 1200 BCE. Sources: (a), photo courtesy of Margaret Reid; (b), photo courtesy of Roger Green.

he allowed me to take a photograph, and I show this object in Plate 10c. I recall it as being 10–15 cm tall and it has a "belt" with a zone of dentate-stamping above (cf. Plate 9a–c for similar stamping from the Karama Valley and Luzon). The nipples are carved like those on the stone statue in Plate 10b. A small stone statue at Tamadua near Poso is shown in Plate 10d and this has a similar stance to the pottery stopper, although somewhat weathered, again with a kind of belt. Whether both figures once had arms is unclear.

The *kalamba* stone jars could also be Neolithic in origin, given the above observations about the Bulili lid fragment. The Besoa Valley stone jar in Plate 10g also has a ring of eight faces with nose, eye, and eyebrow shapes identical to those on the stone statues (a) and (b) in Plate 10. The apparent Early Metal Age associations of these *kalamba* may relate to burials placed in their vicinities for many centuries after they were fashioned, but this remains surmise.[13]

What can we conclude from all this? Without a lot more detailed research, the possibility of a Neolithic age for the central Sulawesi carvings must remain uncertain. After all, faces with pointed chins also occur on the bronze Pejeng drum from Bali (Figure 9.4), and this is presumably younger than 2000 years. But the links I have illustrated – with Easter Island, Lapita (800 BCE), and the Karama Valley Neolithic (1500–1000 BCE) – must surely suggest that this megalithic complex *could* be of mainly Neolithic antiquity. If demonstrated, this would be exciting indeed.

Finally, in southwestern Sulawesi, pottery also appears in small quantities in the upper layers of some Toalian rock shelter sites, perhaps here used by continuing hunter-gatherer populations. Glover (1976) reported pottery in association with Maros points in the shelter of Ulu Leang, and Bulbeck (1992:13) suggested a commencement date around 1500 BCE for pottery in South Sulawesi, on the basis of radiocarbon dates on human bone from Leang Burung 1. The sherds here are of plain, unslipped globular cooking pots with everted rims, although it is possible that any original red slip has either faded or was not recorded.

The round-based, hollow-based, and sometimes serrated Maros points (Figure 8.1d) form a particularly interesting aspect of South Sulawesi prehistory and were mentioned in Chapter 5, where an overlap with the Late Paleolithic Toalian backed flake/blade and microlith industry was noted. However, Maros points are commonly found with Neolithic and perhaps even younger pottery. They would appear to be related to the similar round-based and hollow-based points from the lower layer of the rather disturbed Gua Lawa rock shelter in East Java (Chapter 5), and from open-site surface collections in the Gunung Sewu region near Punung in central Java (Figure 8.1c). The Punung points are mostly surface finds and are often stated to occur with the quadrangular adze rough-outs referred to above, although none apparently were found in the Bomo-Teleng adze-working floor in central Java analyzed by Tanudirjo (1991; van Heekeren 1972:198–199). Currently, the precise chronology for these remarkable little points is unknown. None have been found in the Late Paleolithic Keplek layers in the many excavated and well-stratified caves in the Gunung Sewu region (Chapter 5), so they cannot therefore be classified unequivocally as late Paleolithic. Van Heekeren classified the Javan examples as Neolithic.

My own suggestion would be that these types of points served as hunting equipment, perhaps amongst indigenous hunter-gatherer groups who continued to occupy parts of Java and Sulawesi, living especially in caves, until long after the arrival of Neolithic populations. This kind of lithic technology is not something that can be easily sourced to Neolithic China, Taiwan, or the Philippines. Neolithic cultures in these regions focused heavily on polished adze and point technology, and retouched blade and flake tools struck from cores are rare to absent in many sites, except for the blades and drills from Bukit Tengkorak. The Toalian itself, which was clearly late Paleolithic in its earlier manifestations, provides a very likely source, as might the contemporary Keplek industry in central Java.

Fleshing Out the Neolithic Prehistory of Island Southeast Asia

As the archaeological sequence of events described in this chapter unfolded, the high cordillera of New Guinea, an equatorial folded mountain landscape without significant geomorphological parallel in Island Southeast Asia (including Borneo), witnessed an independent valley-based development of fruit and tuber horticulture. New Guinea Highland populations were technically Neolithic in that they used polished stone axes and produced food (*Colocasia* taro, Eumusa bananas, and probably sugar cane, with yams at lower altitudes) in highland valley swamps drained by networks of ditches. Such infrastructure has been identified from around 2000 BCE onwards at the site of Kuk in the Papua New Guinea Highlands, and was evidently preceded there by less intensive forms of cultivation including the creation of earthen mounds to assist plant growth (Golson 1977; Denham 2011).

However, New Guinea Highlanders lacked pottery until occasional contact was established with island-based Neolithic cultures (presumably Malayo-Polynesians) around 1000 BCE, at first perhaps via the Markham Valley in Papua New Guinea (Gaffney et al. 2015). They also lacked cereals, as well as domesticated animals until Neolithic populations introduced pigs and dogs, again probably around 1000 BCE and perhaps separately into the western and eastern ends of the island.

The major genetic and cultural influences of the indigenous Papuan peoples of New Guinea, beyond New Guinea itself, were in the islands of Melanesia, especially the Solomons, Vanuatu, New Caledonia, and Fiji.[14] Except for the Solomons, which were settled in the Pleistocene, the populations of these islands today reflect post-Lapita genomic admixture between original Asian/Polynesian (i.e., Lapita) settlers and later Australo-Papuan immigrants (Skoglund et al. 2016). In addition, a few Papuan languages are also spoken today in the very far east of Indonesia, in parts of Timor, Alor, Pantar, and Halmahera. The possibility that Papuan languages were once spoken further west than Timor remains open (Chapter 6), and Schapper (2015) argues convincingly for a series of Papuan linguistic features, inherited through substantial degrees of language shift, into the Malayo-Polynesian languages of Nusa Tenggara, Maluku, and West Papua.

However, there is currently no firm linguistic or archaeological evidence to suggest that mainland New Guinea served as a west to east migration route for Neolithic populations speaking Malayo-Polynesian languages and moving from Island Southeast Asia into Oceania (Figure 6.4). The ancestors of the first Malayo-Polynesians in the Pacific Islands beyond the Solomons were the Lapita population in Island Melanesia and Polynesia, and probably also the first settlers of western Micronesia. Their migration route from the Philippines was through the various islands that lie to the north of New Guinea, including the Mariana, Palau, and Admiralty island groups. The atolls of the Carolines would have been beneath high tide level at the time in question (Dickinson 2003).

Neolithic Food Production

Unfortunately, beyond Taiwan and the northern Philippines there has been very little paleobotanical research based on flotation of charred plant macro-remains or analysis of phytoliths and starch granules. This renders the region more difficult to understand in term of prehistoric subsistence economy than either China or Mainland Southeast Asia. While remains of domesticated animals are described by Philip Piper below, we really have no data about archeobotany from most sites and weathering can be so strong in both cave and open sites that even charcoal often does not survive. Neolithic populations in Island Southeast Asia did not helpfully mix crop waste materials into the fabrics of their pots as temper, although occasional fragments of rice grain and husk can survive accidentally in pottery. In fact, charred grains, husks, and phytoliths of rice in Neolithic to Early Metal Age contexts are already reported from a large number of sites in the northern and central parts of Island Southeast Asia (Figure 8.2).

To determine the significance of crop plants in Neolithic diets in Island Southeast Asia we can refer to the linguistic evidence for agricultural terms in proto-language vocabularies (Table 6.3). All Austronesian-speaking populations at ethnographic contact were crop producers, with the exceptions of some Philippine Negritos and a few groups in difficult agricultural terrain such as the deeply interior Punan of some northern parts of Borneo. Any suggestion that the Neolithic expansion into Island Southeast Asia was entirely hunter-gatherer would require that all later populations either developed food production independently on many occasions, or that food production spread piecemeal by cultural diffusion from some outside source. In my view, neither option is very convincing and both meet opposition from the linguistic vocabulary reconstructions pertinent for food production, as well as the occurrences of rice remains in many Neolithic and Early Metal Age sites (Bellwood 2011a; Bellwood, Chambers et al. 2011).

Indeed, there are some very useful proxy sources relevant for a consideration of Neolithic land clearance and food production. Stable isotope (carbon, nitrogen) studies of ancient diets as recorded in human bone have so far yielded few results in Island Southeast Asia, although data of this type have been discussed in Chapter 7 with respect to the Niah burials. Another source of information is the palynological study of ancient pollens recovered from cores drilled into soft sediments, especially in swamps. Dating is sometimes a problem here since analysts must extrapolate between

C14 dates that are often widely spaced within the cores, and the necessary assumptions made about regularity of deposition might not always be correct. Even so, a number of pollen diagrams from highland swamps in northern and central Sumatra and western Java have provided some interesting but rather equivocal evidence for forest clearance that may be related to settlement of these regions by cultivators, although most are not associated with any archaeology.

For instance, a pollen core from Pea Sim Sim Swamp near Lake Toba in northern Sumatra (1450 m above sea level) indicates that major forest clearance, evidenced by an increase in large grass pollen, began during the first millennium BCE. Lake Diatas near Padang (1535 m above sea level) in central Sumatra has yielded a similar sequence. The nearby Lake Padang core (950 m above sea level) indicates swamp vegetation clearance and burning by about 2000 BCE, and there is evidence here for an increasing protection of the useful *Arenga* palm species by 2000 years ago. At Situ Gunung in western Java (1015 m above sea level) there is an increase of pandanus and fern spores, perhaps indicating some forest clearance, at about 2800 BCE.[15] However, other Borneo, Sumatra, and Java pollen cores, admittedly from quite high altitudes, offer evidence for major forest clearance only after 1000 BCE.[16] Furthermore, there is often debate as to whether the vegetation changes observed were due to human impact or climatic change.[17]

As most of these records are from highland areas, it may be reasonable to expect that forest burning for cultivation in coastal lowlands in Sumatra and Java began slightly earlier than 1000 BCE. Indeed, Carcaillet et al. (2002) record a substantial increase in the presence of charcoal in soil profiles in Indonesia and Papua New Guinea from 2000 BCE onwards. Of course, hunter-gatherers are also quite capable of burning forest in drought periods, even close to the equator, a circumstance made clear by the presence of C14-dated charcoal particles in pollen cores going back beyond the Holocene in New Guinea (Haberle 1993) and from ancient soils in Brunei (Cranbrook and Edwards 1994:339). But the general agreement in date between the changes recorded in most of these cores and the expansion of the Neolithic looks rather strong, too strong to be due to pure coincidence.

Potential Phases of Neolithic Crop Production in Island Southeast Asia

In the second edition of my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007), which expanded on ideas about the Indo-Malaysian Neolithic initially formulated in Bellwood (1980), I included a discussion of the origins of the most significant crop plants in Island Southeast Asia and then described systems of cultivation such as shifting agriculture and irrigated *sawah* rice. In Chapter 7 here I have again elaborated on the issue of rice cultivation, especially in China. In addition, crops such as bananas, taro, yams, breadfruit, sugar cane, and coconuts were domesticated, or at least brought under human management, in several separate locations distributed throughout Island Southeast Asia and western Melanesia, including New Guinea.[18] The archaeological record and language distributions (Malayo-Polynesian versus Papuan) make it clear that the appearances of food production in Island Southeast Asia and New Guinea

Figure 8.6 A dry rice field (*ladang*) cut in rainforest, upper Kapuas basin, central Borneo. Source: photo by the author, 2014.

were independent phenomena, with links to China and Taiwan in the case of the former but in apparent isolation in the case of the New Guinea Highlands.

In *Prehistory of the Indo-Malaysian Archipelago* I also proposed three sequential and overlapping phases within Austronesian agricultural prehistory, paralleling those since postulated for the Yangzi region of China (Weisskopf et al. 2015). When Neolithic settlers first arrived in Island Southeast Asia with rice cultivation (phase 1), they would preferentially have grown the crop in localized swamp or alluvial back swamp conditions in which an initial labor investment could have created simple wet fields that were easy to maintain, and which would consistently have produced higher yields than dryland systems. Following this, in the hypothetical second phase, populations would necessarily have switched towards rain-fed cultivation on the edges of alluvial plains or shifting dryland cultivation on slopes (Figure 8.6) as they increased in population density and quickly utilized the limited areas of coastal and riverine swamp available during the mid-Holocene high sea level conditions. All major crops, including water-loving rice and taro, can be grown by dryland techniques if there is sufficient rainfall, and the dry (or upland) rice types probably developed secondarily at this time by selection for thick and deep roots and a tendency for early maturity to escape the effects of drought (Chang 1989). As noted already, the switches away from rice and towards increasing shifting cultivation probably explain the absence of large, permanent, and deeply stratified Neolithic settlements in many parts of Island Southeast Asia. The cycle of shifting agriculture and necessary fallow periods kept people on the move.

During the Neolithic expansion toward the equatorial zone, there was a partial replacement of rice by the ecologically better-adapted tubers such as yams and aroids, and fruit or starch-bearing trees (Latinis 2000). The system of shifting cultivation probably also underwent changes. Plot preparation for cereals in monsoonal regions far from the equator would have demanded a fairly complete clearance since cereals need full sunlight for ripening, with successful burning of vegetation. In the wetter equatorial zone, clearance would not have been so easy, especially for people with only stone tools. Vegetation grows prolifically throughout the year and the rainforest trees are more massive and could perhaps only be ring-barked rather than felled. More importantly, heavy rain can make burning impossible. In parts of Mindanao, yields can double when a good dry period allows a thorough burning of cut vegetation (Yengoyan, in Geertz 1963:22). So there would be obvious pressures along the equator toward the development of cultivation systems requiring less forest clearance and more emphasis on trees and tubers that do not require such broad expanses of uninterrupted sunlight as cereals.

Systems of this type are still widespread in remoter parts of Indonesia and Melanesia today. The Nuaulu of equatorial Seram (Ellen 1978) cultivate taro, yams, bananas, sugar cane, manioc, coconut, and sago (wild sago stands are also exploited) in multi-crop gardens where up to 15 different species may be grown together. Because the region has no dependable dry season, up to 10 burns may take place before planting can occur. It is not difficult to see that large-scale garden clearance would not have been a very viable option for Neolithic groups in such an environment, prior to the acquisition of iron tools. Another example comes from Mentawai, off the western coast of Sumatra, where sago, taro, and bananas are grown in swamps with very little clearing and no burning. Here, the cut vegetation is simply used as a mulch (Mitchell and Weitzell 1983). Neither of these groups grows cereals at all, and I rather suspect that vegecultural systems of this kind, which were eventually taken right through tropical Oceania, began to characterize Austronesian economic patterns increasingly after about 1500 BCE in the truly equatorial and ever-wet lowland zone.

The final phase in the tripartite sequence under discussion is so far only recorded historically and ethnographically. It involved a major but regionally localized shift toward intensive irrigated wet rice cultivation in terraced or grid-pattern embanked fields *(sawah)*, consequent perhaps upon population growth and probably reflecting awareness of contemporary intensive systems of agriculture in India and Mainland Southeast Asia. Such embanked fields for rice utilize water supplies derived from monsoon rains or fed in by artificial canals, and can offer one of the most delightful landscape experiences for modern visitors to the region (Figure 8.7). However, we still have no direct evidence for the existence of such intensive production systems in Island Southeast Asian prehistory. The success in the archaeological recognition of ancient rice fields through excavations and phytolith analyses in recent years in China offers hope, but all we can note at the moment is that the oldest inscriptions referring to irrigation in Java (presumably for rice) date from the eighth century CE (van der Meer 1979:8–9).

However, we should not forget that irrigation technology for wet fields was present in Neolithic China as early as 4000 BCE, and as suggested above was perhaps the first type of cultivation brought into Island Southeast Asia with the Neolithic. Prehistoric peoples in Oceania also had similar pond-field systems for cultivating aroids, using

Figure 8.7 Top: modern rice terraces (*sawah*) near Ceking, Bali, just planted with rice shoots (2015). Terraced rice fields before harvest, near Ende, Flores (2015). Source: photos by the author (see also color plate 17).

only stone tools and no traction animals. This might imply a common origin amongst Malayo-Polynesian-speaking populations for irrigation and wet fields generally, although Kirch and Lepofsky (1993) have argued against this. Nevertheless, according to Reid (1994), the linguistic terminology for rice agriculture and terracing in Mountain Province in northern Luzon descends from Proto-Nuclear Cordilleran, a reconstruction that can probably be located within the Neolithic or Early Metal Age. However, the famous Ifugao terrace complexes in their present forms, most famously at Banaue (Bellwood 2007: Plate 41), appear to be more recent (Acabado 2009).

Moving eastwards beyond Borneo into Wallacea, we find that rice faded rapidly in importance prior to 1950, even though it is very widely eaten today, and it never penetrated into or beyond New Guinea at all (Spencer 1966). But why was rice not carried by migrating Neolithic populations into and across Oceania? In my *Prehistory of the Indo-Malaysian Archipelago* I suggested that rice faded owing to the inherent unsuitability of the equatorial environment for its cultivation, and that early Austronesians were not entirely a population of avid rice cultivators but also contained sub-populations with maritime or foraging adaptations (as suggested by Sather 1995). Some of these sub-populations might have been precisely the kind of people we might expect to sail away by boat, probably without rice, to exploit the resources of new islands.

Dewar (2003) has since developed a climatic argument that increasing unreliability of rainfall inhibited rice cultivation moving east through Island Southeast Asia towards eastern Melanesia. Neither Dewar nor I see much evidence so far for an early pre-rice phase of tuber and fruit cultivation in China or most of Southeast Asia, until one approaches the acknowledged and independent focus of fruit and tuber domestication in New Guinea, especially in its highlands. As stated, it is possible that this New Guinea form of vegetative food production spread with arboriculture and tuber cultivation into adjacent Melanesian lowland regions, including parts of eastern Indonesia (Donohue and Denham 2010; Lentfer et al. 2010). But the evidence for this is at present rather limited.

However, was an unsupportive environment the only reason for the non-spread of rice eastwards? This cereal undoubtedly found very supportive climatic and soil conditions in some non-equatorial islands south of the equator, such as Java and Bali, and it must have been transferred across the equator to reach them. This suggests that varieties that were insensitive to a day-length trigger for germination were selected for quite early on in the Austronesian migration process. Indeed, there is no obvious reason why rice should have disappeared altogether on approaching New Guinea. After all, as noted, many Pacific Island populations developed very intensive methods of wet field cultivation for aroids, and the New Guinea Highlands had a very long tradition of draining and managing swamps for the cultivation of *Colocasia* taro. So it is hard to imagine that the environment was totally to blame.

Nevertheless, rice, as a cereal grain crop, might have held little value for the indigenous Papuan populations of eastern Indonesia and Melanesia (including New Guinea), especially in competition with the dominant mode of tuber and fruit horticulture using vegetative methods of planting, as pointed out also by Barton and Denham (2016). As Pelzer (1948:7) once noted, "a plant, the introduction of which involves a change in methods of cultivation, [will only be] accepted under pressure." New Guineans did not have grain crops and relied on tubers and plants such as bananas and sugar cane that were planted vegetatively and not by seed. Also, while mid-Holocene New Guineans did indeed manage water levels for raised-bed and drained fields in swamps, they did not use the embanked wet field methods typical for wet taro in Malayo-Polynesian-speaking communities in eastern Island Melanesia and Polynesia. So, a non-adoption of rice by Papuans is perhaps to be expected. But its failure to travel with Neolithic populations into other uninhabited regions of Oceania still remains surprising, given the suitability of many Oceanic islands for wet taro production.

I think the answer here may also need to be an historical one, involving the precise directionality of Island Southeast Asian Neolithic colonization into Oceania. For many years, it has been assumed (including by me in *Prehistory of the Indo-Malaysian Archipelago*) that this emanated from eastern Indonesia at about 1350 BCE, most likely from Halmahera, and reached the Bismarck Archipelago by following the northern coastline of New Guinea. But as noted above there is no strong linguistic or archaeological evidence for this scenario, and linguistic evidence has already been presented that New Guinea proper was not a migration route, either coastal or inland, for early Malayo-Polynesian-speaking populations migrating eastwards into Melanesia and Polynesia. Archaeologically, Lapita pottery only occurs in late form around the southeastern coasts of the island. The very rare occurrences of sherds akin to Lapita pottery in Indonesia might reflect the same back movement from Melanesia as that represented by the presences of New Britain and Admiralty obsidian in the site of Bukit Tengkorak in Sabah. This implies that the first Malayo-Polynesians to settle in the Bismarck Archipelago (or somewhere close by) traveled through small islands to the north of New Guinea – perhaps through western Micronesia or the Admiralties. These early movements across wide ocean gaps were perhaps one reason why rice was not successfully carried into Oceania beyond the Mariana Islands.

Farmers Who Adopted Rainforest Hunting and Gathering

Not all of the agricultural prehistory of Island Southeast Asia has followed a trend from simple to more complex in terms of infrastructure and population density. A few non-Negrito populations in Borneo and Mindanao went the other way, switching from some form of agricultural ancestry into hunting and gathering. Elsewhere (Bellwood 2005:37–39), I discuss such switches in Borneo, southern New Zealand, and the Great Basin of North America as a specific adaptation to agriculturally marginal or impossible terrains.

The Punan[19] occupy many forested areas of inland Sarawak and northern interior Kalimantan (Figure 4.4). Traditionally they dwelt in temporary camps of a few families, hunting pigs, monkeys, and other forest animals with blowpipes, exploiting stands of a small dryland species of wild sago (*Eugeissona utilis*) that grows below 1000 m, and collecting the fruits of wild rambutan, durian, and mangosteen trees.[20] Nowadays, most Punan live in sedentary villages, grow maize and manioc by shifting cultivation on hillsides, and use rifles and 40 horsepower outboard motors. But they still hunt wild boar and other forest animals quite avidly from rainforest camps, as I observed on a visit to the headwaters of the Kapuas River with Indonesian archaeologist Vida Kusmartono in 2014.

Linguistically, there is no apparent unity amongst the Punan; many groups seem to be related closely to nearby cultivators, an important point stressed by Hoffman (1986).

Ethnographically, many groups collected forest items such as beeswax, birds' nests, camphor, and rattan for trade purposes, often leading to close relationships with the longhouse communities of ranked agricultural populations such as the Kenyah and Kayan. Such close relationships may have caused acculturation in some Punan societies, as witnessed by their sporadic adoptions in the past of cultivation (Nicolaisen 1976), ironworking, and systems of ranked headmanship (Arnold 1958). These features may reflect the fact that the Punan have always straddled the boundary between settled horticulture and forest hunting and gathering, with only some groups shifting entirely toward the latter economic mode.

Since the first edition of *Prehistory of the Indo-Malaysian Archipelago* was published in 1985, the Punan have come to play an important role in debate about hunters and gatherers in deep interior equatorial rainforests (see Chapter 5). If the present-day Negrito populations (who are not represented in Borneo) are descendants of ancient and preagricultural forest foraging groups in Peninsular Malaysia and the Philippines, then who are the Punan? Are they "genuine" hunter-gatherers like the Negritos, or (as I infer) the products of a switch into foraging from a partially agricultural ancestry? According to Hoffman (1986), the Punan developed initially as commercial hunter-gatherers linked to and derived from agricultural populations. Sellato (1994) presented a diametrically opposed view, that the Punan were always hunter-gatherers and have only recently come into contact with cultivators.

Like Clifford Sather (1995), I prefer a middle road. If the linguistic reconstructions of early Austronesian society described in Chapter 6 are correct, then clearly there is little scope for any widespread and ancient Austronesian hunting and gathering adaptation in Indonesia without any linkage to agriculture. Unlike the Philippine Negritos, the Punan have probably not been foragers since the Pleistocene. However, as Sather points out, the initial Austronesian expansions into the archipelago probably carried a mixed economy based on agriculture, fishing, and foraging. As Austronesians penetrated upriver into the rainforests of Borneo, with their extensive stands of sago and varied animal faunas, some groups, especially those already accustomed to a coastal foraging economy, might have been tempted to turn to upriver foraging nomadism (Brosius 1988). Others might have been refugees from feuds in agricultural villages, as suggested recently by Blust (in press). From this viewpoint, the Punan/Penan have always had some contact with cultivators, but as subsistence foragers rather than as the commercial foragers suggested by Hoffman.

Furthermore, if the Punan adaptation was totally independent of the Austronesian agricultural tradition, we would expect to find independent populations of Punan everywhere throughout the deep interior rainforests of Borneo. Yet we do not. They are, in fact, very restricted in distribution (Figure 4.4). The Punan live only where there are nearby agricultural populations and it is essential here to realize that there were, and still are, extensive areas of uninhabited rainforest in interior central and northern Borneo, visited only by occasional hunting parties, where neither farmers nor Punan dwell at all. I see little alternative to regarding the Punan as having penetrated the rainforest by riverine routes, hand in hand with Austronesian-speaking Neolithic agriculturalists.

It also cannot be overlooked that all Punan are of recent Asian biological origin like the majority of Filipinos and Indonesians. They are lightly pigmented with straight black hair (Figure 4.2c). People did enter the remote interior of Borneo long before the Neolithic, presumably Australo-Papuan or Negrito in cranial morphology, but no identifiable skeletal remains and few phenotypic traces in modern populations survive. Most likely, the Pleistocene and early Holocene foragers in the deep interior of Borneo were very few in number, many fewer than in Peninsular Malaysia or the Philippines, where the Holocene coastlines were much closer.

In fact, we now have some important archaeological evidence that allows us to assess the prehistory of the Punan. Vida Kusmartono has recently excavated two caves called Diang Kaung and Diang Balu in the headwaters of the Kapuas River, in Hovongan territory, the Hovongan being classified as a Punan group by Wurm and Hattori (1983: Map 41). In these two caves, discussed previously in Chapter 5, hunters left an ephemeral record between 14 and 10 kya, a similar time span to the main late Paleolithic phase of occupation at Niah. The record is then blank until just before 1000 BCE, when a small amount of Neolithic pottery made an appearance in Diang Kaung (Fage and Chazine 2010:38), and in much greater quantity a nearby open site called Nanga Balang. But the greatest density of material occurred in the two caves after 500 CE, and especially after 1500 CE, when the Hovongan perhaps hunted in the region with iron weapons, and using pottery. Diang Balu also yielded a quantity of rice husk in a pit, directly C14-dated to 1500 CE, although the source of this rice, whether Hovongan or from another agricultural group, remains uncertain.[21]

Given the evidence from these upper Kapuas sites, the Hovongan can hardly be the direct descendants of Paleolithic foragers who have inhabited the region continuously since 10 kya, unless they were living elsewhere. The caves were not occupied for most of that time span. It is more likely that the Hovongan entered the region during the Neolithic, as people who were once part of a lowland Malayo-Polynesian-speaking and Neolithic farming group.

The conclusion about the part-agricultural ancestry of the Punan can be stressed even more forcefully with respect to the Tasaday of Mindanao, a foraging group who achieved media prominence through their "discovery" in 1970.[22] The Tasaday band was living in a cave in the interior Mindanao rainforest at an altitude of about 1300 m above sea level. In 1972 it comprised 13 adults and 14 children (12 boys and 2 girls – not a good ratio for survival). The culture of this group was described as being simple in the extreme: a number of widespread Austronesian customs such as tattooing, betel chewing, and tooth filing were practiced, but the people did not hunt, had no baskets or carrying devices, lacked the bow, and used only flaked or edge-ground stone tools. The food supply came mainly from fruits, wild yams (the tops of which were replanted after harvest), grubs, and hand-caught fish and frogs.

Since their discovery, the Tasaday have moved in and out of controversy, with many scholars claiming that they were deliberately created "fakes," ordered into the cave by politicians linked to timber and mining companies during the Marcos era in the Philippines (see Headland 1992 for a full discussion of different viewpoints). However, I prefer, with Lawrence Reid and Bob Blust, to regard them as a genuine but very recent conversion to foraging, perhaps as a result of a feud or epidemic that caused their ancestors to flee and hide in the rainforest. Linguistically, the Tasaday speak a dialect of the Manobo languages of the nearby cultivators and their separation appears to have occurred after the arrival of the Spanish in the Philippines (Reid 1992; Blust in press). They are/were of interest because they show how important in prehistory might have been a refugee lifestyle, and also how difficult it can be to move from food production into successful full-time foraging in a rainforest context.

Domesticated Animals in the Island Southeast Asian Neolithic

An Invited Perspective by Philip J. Piper

Between 2500 and 1500 BCE, human populations migrated into Southeast Asia from southern China and Taiwan, bringing new modes of sedentary settlement and a broad range of material culture. It is traditionally believed that these early Austroasiatic- and Austronesian-speaking communities introduced three domestic animals – the pig, dog, and chicken – as a "package" to Southeast Asia. However, there is currently no evidence to support such an exclusive correlation. There is also no strong evidence to indicate that any of these animals, apart perhaps from the dog, arrived in Island Southeast Asia (beyond Taiwan) prior to 2500 BCE. Recent genetic and zooarchaeological studies suggest several routes of translocation into the region.

Pigs and Dogs

In Mainland Southeast Asia, domestic pigs and dogs have been identified in sedentary Neolithic settlements in Vietnam from 2200–2000 BC onwards (Bellwood, Oxenham et al. 2011; Sawada et al. 2011). All domestic pigs in Island Southeast Asia likely originated in central China along the Yangzi or Yellow rivers but acquired specific mtDNA signatures through introgressive capture as they were transported between regions (Larson and Fuller 2014). Two distinctive haplotypes are recorded in Island Southeast Asia, indicating that the geographic spread of pigs certainly followed more than one route. One of these haplotypes, known as the Pacific clade, records a pig translocation via a route from southern China or northern Vietnam, through Indonesia and into Oceania (Larson et al. 2010). It occurs at Uattamdi in the Moluccas, at Liang Bua on Flores, and at Lapita sites in Melanesia by the middle to late second millennium BCE (Larson et al. 2007), also by 1100 BCE on Pulau Ai in the Banda Islands (Lape 2000). Pacific clade pigs and Polynesian chickens (see below) have both been directly dated to 1000–700 BCE at Teouma in Vanuatu (Petchey et al. 2015).

A second, more enigmatic pig domestication involved the Philippines, where domestic pigs were present by around 2000 BCE in the open site of Nagsabaran in the Cagayan Valley and in the Batanes Islands by at least 1200 BCE (Amano et al. 2013; Piper et al. 2009; Bellwood and Dizon 2013). These pigs were associated with Neolithic artifacts with clear parallels in Taiwan (Hung et al. 2011), but modern and ancient genetic evidence suggests they did not originate in Taiwan and were derived via introgression and/or admixture with wild boar on Lanyu Island, between the Philippines and Taiwan, or by introduction from an as yet unknown source. They are not related to the Pacific clade. There is currently no evidence that Lanyu pigs were ever transported beyond the Philippines during prehistory (Larson et al. 2007).

Apart from the above, morphometric analysis has indicated that domestic pigs of East Asian origin but unknown mtDNA haplotype were present by 1500 BCE at Minanga Sipakko and Kamassi in the Kalumpang region of West Sulawesi (Anggraeni et al. 2014; Linderholm et al. unpublished data). A single pig molar from later in the archaeological sequence at Kamassi (after 1000 BCE) has produced a Pacific clade aDNA signature. However, the precise timing and routes of translocation for domestic pigs through Island Southeast Asia will remain uncertain until larger samples of ancient DNA can be recovered from the Philippines, Borneo, Java, and Sulawesi.

Dingoes have been a primary focus of research into canid introductions into Island Southeast Asia, because archaeological and genetic data indicate an early translocation into Australia by at least 1500 BCE. Oskarsson et al. (2011) have proposed a southern Chinese origin for the dingo lineage and a route of movement through Mainland Southeast Asia and Indonesia similar to that proposed for the Pacific clade of pigs. A much more complicated scenario was suggested by Sacks et al. (2013), whereby the first dogs possibly came from pre-Neolithic South Asia (though no point of origin was specified), later to be replaced during the expansion of farming communities across the region. They argued that dingoes are more likely to have originated on the Asian mainland than from Taiwan, although the latter cannot be entirely discounted. Savolainen et al. (2004) argued that the dingo was probably introduced into the region during the Austronesian expansion. Dog skeletons buried whole between 2800 and 2200 BCE at Nanguanli and Nanguanlidong indicate that potential source populations of dogs were present in southwest Taiwan prior to migration into the Philippines (Hung and Carson 2014).

The earliest tentative records of dogs in Island Southeast Asia are a canid third left metatarsal from Callao Cave in the Peñablanca region of northern Luzon, dated by association (with charcoal) to around 1500 BCE (Mijares 2007; Piper et al. 2013), and a dog occipital fragment from Pasimbahan Cave on Palawan similarly dated to around 1700 BCE (Ochoa et al. 2014). Indirect evidence from gnawed bones for a presence of dogs at Kamassi dates also to 1500 BCE, but actual dog bones are only present there from 1000 BCE onwards. Dog bones are dated from about 1200 BCE at Uattamdi in the Moluccas (Hull 2014). In Timor, a dog burial in the cave of Matja Kuru 2 has been directly dated to around 1000 BCE (Veth et al. 2005).

Biometric analysis indicates similarities in stature between the Timor dog and other prehistoric and contemporary "village dogs" across Island Southeast Asia and the Pacific (Gonzalez et al. 2013). These village dogs appear to be morphologically unrelated to Australian dingoes and perhaps represent an entirely different lineage and introduction. This fits neatly with the conclusion from modern genetic data, reached by Sacks et al. (2013), that there were two different dog introductions before 1000 BCE, one reaching Australia and the other spreading through Island Southeast Asia into Oceania. The apparent absence of the dingo from the Pacific supports a separate, independent translocation event for it, and Fillios and Taçon (2016) have recently argued for a pre-Neolithic introduction to Australia from Sulawesi. But interpretations of dingo origins and routes of translocation still suffer from a lack of archaeological and ancient DNA samples from across Island Southeast Asia. It appears that the Southeast Asian village dog was the lineage that was introduced into Oceania, but the absence of dogs in early Lapita sites suggests they arrived later in Melanesia than pigs and chickens (Anderson 2009).

Chickens

Chickens are present in Neolithic settlement sites in central and northern Thailand from 1800 BCE onwards, where they were possibly domesticated (Storey et al. 2013). It is thus possible that some chickens were translocated from the vicinity of Thailand into Vietnam and Peninsula Malaysia, where they were potentially transported into Island Southeast Asia via a western Indonesian route. Both the modern Indonesian haplotype within chicken mtDNA genetic haplogroup D and the Pacific clade of pigs can be traced across most of Island Southeast Asia and into Near Oceania, where they might have been introduced by Lapita populations (Larson et al. 2007; Herrera et al. in press).

Physical remains of chickens are still absent from the Neolithic archaeological record of the Philippines. But a second haplotype within mtDNA haplogroup D, known as the Polynesian clade or "Austronesian chicken," is found in modern chickens in the Philippines and nowhere else in Island Southeast Asia (Herrera et al. in press). The antiquity of this haplotype is confirmed by its identification in Lapita contexts at Teouma in Vanuatu at between 1100 and 700 cal. BCE (Thomson et al. 2014; Petchey et al. 2015). Its geographic distribution suggests a direct introduction from the northern Philippines into the Solomon Islands and Vanuatu. Furthermore, this chicken haplogroup was the only one translocated beyond Vanuatu into Remote Oceania, including Polynesia.

The presence of both the Indonesian and Polynesian mtDNA haplogroup D clades of chicken in Vanuatu, but the absence of the former further to the east, implies staggered arrivals in the Lapita zone. Presumably, the Polynesian clade was carried into Remote Oceania from the Philippines prior to the arrival of the Indonesian clade (Herrera et al. in press; see also Anderson 2009). The presence of both Pacific clade pigs and Polynesian clade chickens in the earliest archaeological deposits at Teouma (Hawkins 2015) raises the possibility that domestic animals arrived on Melanesian islands such as Vanuatu from two or more source populations within a remarkably short timeframe.

Bovidae

Very little is currently known about the domestication and introduction of bovines into Island Southeast Asia. Phylogenetic studies suggest that the domestic swamp buffalo may have originated from the wild *Bubalus arnee* in China some 4000 years ago (Yang et al. 2008). Taurine cattle domestication is thought to have taken place in western Asia around 8500 BC, giving rise to the humpless *Bos taurus*, whereas the humped South Asian zebu (*Bos indicus*) was domesticated around 6500 BCE (Zhang et al. 2013). In northeast Thailand, bones of domesticated *Bos indicus* and *Bos* sp(p.) undiff. are reported from Neolithic contexts dated to around 1500 BCE at Non Nok Tha and Ban Non Wat (Higham and Leach 1972; Kijngam 2011), but are absent so far in Neolithic Vietnam. Currently, the only secure record of any domesticated bovine of late Neolithic or Early Metal Age date in Island Southeast Asia is from Nagsabaran in Luzon, where water buffalo bones become common after 500 BCE (Amano et al. 2013). It is likely that the water buffalo became relatively widespread shortly after this time.

Little is known about the timing and arrival of goats into Island Southeast Asia, but it is generally thought that maritime trade between India, Burma, Thailand, Malaysia, and Indonesia led to the translocation of domesticated goats (and perhaps zebu cattle) by about 400 BCE. Goats could also have been transported from southern China into Island Southeast Asia but there are currently no prehistoric archaeological records of goat in Bronze or Iron Age contexts in Mainland Southeast Asia. The earliest goat remains of possible Chinese origin have been identified at the sites of Anaro, Pamayan, and Savidug Ijang on the Batanes Islands after 1000 CE (Piper et al. 2013).

In Island Southeast Asia, Glover (1986) reported caprine remains after 500 BCE from Uai Bobo 1 and Uai Bobo 2 caves in Timor. Goats are now securely dated from 200 BCE at Pacung and Sembiran on the north coast of Bali, in clear association with imported Rouletted Ware from the Indian subcontinent (Calo et al. 2015). On current evidence it is possible that the goat was introduced at least twice to Island Southeast Asia; firstly from India to western Indonesia and secondly from China to the Philippines.

Domestic Animals in Cultural Context

The relative social and economic importance of domestic animals in the Neolithic of Island Southeast Asia is partly reflected in the comparative frequencies of occurrence in the zooarchaeological record and in the way animals were treated before and after death. For example, at Nagsabaran in the northern Philippines, the low frequency of domestic pig bones compared to wild boar implies that the former were not maintained simply for food. Rather, they might have played significant social and ideological roles, hence being slaughtered only on particular political and/or ritual occasions. Variability in the role of dogs at Nagsabaran is also evident; cut marks on some bones indicate butchery and consumption, but a complete dog burial dating to 500 BCE also implies emotional attachment to an animal perhaps used as a hunting companion or guard dog (Amano et al. 2013).

Neolithic Fishing

Deep-sea fishing and open-ocean voyaging might also have their origins in the Neolithic of Taiwan and the northern Philippines. For example, at the site of Eluanbi in southern Taiwan there is evidence that local communities had developed specialized technologies for hunting large pelagic fishes by at least 1700 BCE. The substantial quantities of fish bones recovered primarily comprised large, fast swimming predatory species such as sailfish, tuna, and dolphinfish, as well as big sharks and deep-sea groupers (Li 2002; Campos and Piper 2009). Successful hunting of these species would have required multi-crewed vessels and sailing technology to capitalize on the use of trolling lure hooks similar to those used by prehistoric Micronesians and Polynesians. The inhabitants of Eluanbi produced on site, primarily from deer metapodials, a range of fishing equipment including one-piece angling and composite angling or trolling hooks, and fishing gorges.

The only other location where the deliberate targeting of pelagic migratory fish has been identified before 500 BCE in Island Southeast Asia is at Savidug on Sabtang in the Batanes Islands, where butchery and processing evidence suggests that the contemporary technique of dividing dolphinfish longitudinally and hanging them to dry can be traced back to at least 1000 BCE (Campos 2013).

Neolithic Translocations

After 1500 BCE there is clear evidence for deliberate translocation of a range of wild and commensal animals from the Asian mainland and Sunda islands eastwards across Wallace's Line. They include several species of *Rattus* that either hitched a ride between islands and/or were deliberately transported as a food resource. Other potential stowaways include the Asian house gecko (*Hemidactylus frenatus*), house sparrow (*Passer domesticus*), and Asian tree frog (*Kaloula pulchra*). Some species were deliberately transported, perhaps to increase economic resources on resource-poor Wallacean islands, including the Javan sambhur deer (*Rusa timorensis*), the Celebes warty pig (*Sus celebensis*), and perhaps the northern common cuscus (*Phalanger orientalis* – from New Guinea). Others were potentially introduced for other reasons, such as the rat-catching common palm civet (*Paradoxurus hermaphroditus*). Heinsohn's (2003) list of more than 58 oriental and Indo-Malayan taxa provides a useful indication of the diversity of wildlife transported by people around Island Southeast Asia and Australasia, although the timings for these translocations are being constantly revised (see Chapter 5).

Summing Up the Island Southeast Asian Neolithic

I emphasize again the enormous importance of the Neolithic era in creating the peoples and languages who inhabit the greater part of Island Southeast Asia today. The spread of red-slipped pottery, with the later additions of distinctive incised and stamped forms of decoration, appears to mark a second millennium BCE dispersal of Neolithic populations southwards from the Philippines into central and eastern Indonesia, and rapidly onwards beyond the northern coastline of New Guinea into the distant islands of Oceania. With this pottery traveled many other items of material culture, including stone adzes and bark cloth beaters, although a number of technological items also disappeared gradually from the repertoire as people entered the Pacific, including (eventually) pottery and loom weaving. The same fate appears to have occurred with rice as people approached the unfavorable climatic conditions for its production along the equator, and also as they met the very different indigenous populations of the New Guinea region, with their non-cereal systems of food production and vegetative rather than seed planting.

At a similar time and later, these western Pacific agricultural populations, of different genomic origin from the Asian Neolithic newcomers, spread from the Papuan population source region in New Guinea into the islands of eastern Indonesia and Melanesia, many adopting Malayo-Polynesian languages in the process. In the Melanesian archipelagoes beyond the Solomon Islands this spread occurred after the first ancestral Polynesian and presumably Malayo-Polynesian-speaking colonists arrived (Skoglund et al. 2016).

The Neolithic of western Indonesia remains a little obscure, but the same population change that occurred in China, Taiwan, and Island Melanesia can be traced at Gua Harimau in Sumatra. This involved admixture between an indigenous population with an Australo-Papuan craniofacial morphology and an immigrant Asian Neolithic one (Chapter 5), with the latter becoming dominant eventually in northern and western regions of Island Southeast Asia. Associated with this morphological change was a switch from folded burial postures without grave goods into supine extended postures with grave goods such as pottery and body ornaments. In the eastern islands of Southeast Asia the evolutionary tendency over time was different, in that the indigenous Australo-Papuan genome remained dominant, as discussed in Chapter 4, with the transition zone between predominantly Asian and predominantly Australo-Papuan occurring remarkably close to where Alfred Russel Wallace originally placed it in the 1860s (Figure 5.1).

Contacts with the Austroasiatic-speaking populations of the mainland of Southeast Asia also arise as a possibility, but I see little direct evidence for strong contact, beyond the minor possibilities noted for western Borneo and southern Sumatra. There is certainly no evidence for a widespread establishment of Neolithic cultures of Mainland Southeast Asian origin in Indonesia prior to the arrival of Neolithic assemblages of Taiwan and Philippine immediate origin. Domestic pigs and chickens, however, as described by Philip Piper, could support the existence of some mainland connections, albeit never sufficiently numerous to lay down a new layer of human population and Austroasiatic language beyond the Thai-Malaysian Peninsula and the Nicobar Islands.

Notes

1. References for the crops, arboriculture, and vegetative systems of planting in this section include Barton and Denham 2016; Bellwood 2011b; Denham 2013; Gunn et al. 2011; Spencer 1966.
2. Freeman 1957 for Iban pottery; Perak Museum collections, Ipoh, Malaysia for Malay pottery.
3. Wooden coffins also occur in the cave of Kain Hitam, also in Gunung Subis, in apparent association with Early Metal Age artifacts. Kain Hitam is best known for its undated red ochre wall paintings of humans and boats.
4. Yvette Balbaligo, pers. comm. at 2009 IPPA conference, Hanoi.
5. Ipoi 1993; Ipoi and Bellwood 1991; and older references therein.
6. West Malaysian Neolithic archaeology is not discussed in this book since the Malay Peninsula is not part of Island Southeast Asia. The living descendants of the peninsular Neolithic remain Aslian (Austroasiatic)-speaking (Semang and Senoi, see Bellwood 1993, 2007).
7. Although in fairness to Roger Blench (2010: Figure 1) he only suggests such an arrival in a restricted area of western Sarawak.
8. Bellwood 1976, 1981; Tanudirjo 2001.
9. Peter Lape and Shiung Chung-ching (pers. comms at 2009 IPPA conference, Hanoi) also note the presence of red-slipped tall and internally concave rims in the Pulau Ai site, like those from early Neolithic contexts in Batanes and the Cagayan Valley of Luzon (Figure 8.3), in addition to a single sherd of circle-stamped pottery.
10. Bellwood and Koon 1989; Bellwood 1989; Chia 2003.
11. Similar circle- and dentate/punctate-stamped pottery with a possible date of 1000 BCE comes from the site of Mansiri in the interior of North Sulawesi (Christian Reepmeyer pers. comm). In this case, the stamped zones were separated by horizontal bands of red paint in a manner remarkably similar to Lapita pottery from Vao Island in Vanuatu (Bedford 2006). The significance of this observation remains to be determined.
12. Wikipedia (https://en.wikipedia.org/wiki/Bada_Valley) tells us rather mysteriously that the statues date from the fourteenth century CE. I have no idea where this date comes from.
13. I must here thank Derek Reid of Melbourne, Australia, an amateur archaeologist who attended the 1990 Congress of the Indo-Pacific Prehistory Association in Yogyakarta, and several subsequent ones. He gave me copies of 35 mm slides of the Bada and Besoa Valley carvings, taken by himself and his wife Margaret on a visit in 1983. I must also thank an anonymous person who came to my office around the same time and allowed me to photograph the pottery human figure shown as Plate 10c. He had purchased it in Sulawesi as having come from the Kalumpang region, but I can now find no record of his name.
14. Burley 2013 (archaeology); Valentin et al. 2015 (bioanthropology); Skoglund et al. 2016 (genetics).
15. For summaries see Flenley 1985a, 1985b, 1988; Maloney 1985, 1994.
16. Flenley 1988; Stuijts 1993; and Jones et al. 2016 for the Kelabit Highlands of Sarawak.
17. E.g., Sémah et al. 2003 for Ambarawa in Central Java, Stevenson et al. 2010 for Paoay Lake in Ilocos Norte, northern Luzon.
18. Lentfer et al. 2010; Gunn et al. 2011; Denham 2011.
19. Also called Penan, as reviewed by Needham 1954. Sellato 2007 splits the difference and calls them "Pnan."
20. Hose and McDougall 1912; Sellato 1994; Sather 1995.

21. Vida Kusmartono is currently preparing her PhD thesis on this material at ANU. See Kusmartono et al. 2016.
22. Fernandez and Lynch 1972; Nance 1975; Yen and Nance 1976. Nance records a Tasaday claim that their ancestors were fleeing an epidemic.

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Chapter 9
The Early Metal Age and Intercultural Connections in Island Southeast Asia

The Early Metal Age in Island Southeast Asia was associated with the introduction of new technologies, raw materials, and trade items from South Asian, Vietnamese, Tai, and Chinese sources. It commenced with the introduction of cuprous (copper or bronze[1]) artifacts, such as the socketed axes and bracelets placed with burials dated between 600 and 300 BCE in Gua Harimau in southern Sumatra (Simanjuntak 2016). However, both copper/bronze and iron artifacts were widely present together in much of Island Southeast Asia by the third and second centuries BCE (Calo et al. 2015). The Early Metal Age continued until the appearance of Indic (Sanskrit) inscriptions and the oldest Indic religious constructions, dated roughly between the third and fifth centuries CE. With the bronze and iron technologies also came ornaments from South Asia, especially beads made of gold, glass, agate, and carnelian, together with Rouletted Ware inspired by contacts with the Hellenistic world and the Roman Empire. Newly introduced domestic plant and animal species from South Asia included finger millet (originally of African origin), mung beans and other legumes, sesame, goats, and possibly zebu cattle. Cotton textiles and long-grained *indica* rice were also introduced from South Asia during the first millennium CE (Castillo et al. 2015; Castillo et al. 2016).

Although the most widespread Malayo-Polynesian migrations had already occurred in Island Southeast Asia prior to this period, it apparently did witness the highly significant movements of ancestral Chamic-speaking peoples to Vietnam, Malayic-speaking peoples to Sumatra and Peninsular Malaysia, and the ancestral Malagasy to Madagascar. All these groups evidently originated linguistically in Borneo (Chapter 6), with archaeological connections for Vietnam also extending into the central and southern Philippines (Favereau and Bellina 2016) (Figure 9.1). Early Metal Age populations and trade also trickled eastwards into the Moluccas and western Melanesia, including New Guinea. Small numbers of Indian males arrived in the western archipelago as well, according to genetic evidence (Kusuma et al. 2016).

The Early Metal Age is still a fairly new concept within Island Southeast Asian prehistory, such that George Coedès (1975:7) was persuaded to observe for Southeast

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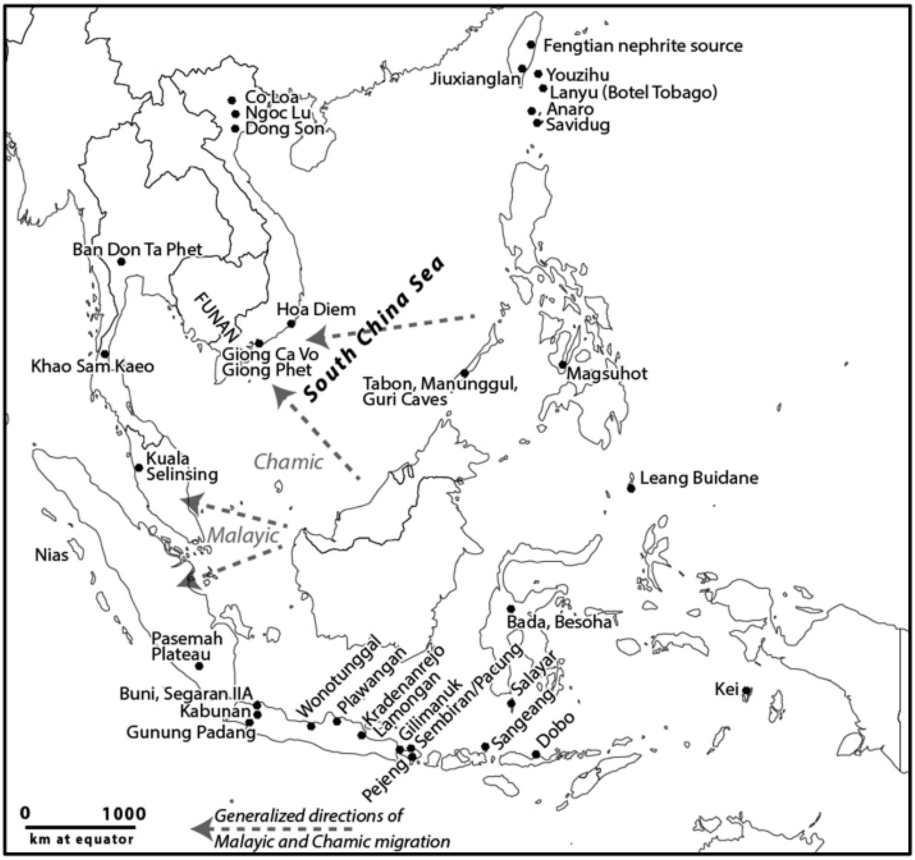

Figure 9.1 Early Metal Age sites in Southeast Asia, with possible migration routes for ancestral Malayic and Chamic peoples.

Asia generally, less than 50 years ago: "In most cases, we pass without transition from the late Neolithic to the first Indian remains." To a small degree, Coedès might have been right, in the sense that many undated "Early Metal Age" artifacts and assemblages that exist in museums today might have been manufactured long after Hinduism and Buddhism became established amongst the elites, although this is often hard to prove owing to poor documentation and dating.

However, not everything associated with the Indic cultural period of early history (post-300/500 CE) necessarily had to be stamped with a "made in India" logo and cultural style. It is obvious that pre-Indic styles of artifacts in metal and other materials must have continued in production and use amongst the non-Indicized bulk of the population until relatively recent times. For the Philippines, most of Borneo, and many of the remoter eastern regions of Indonesia, it would be quite acceptable to continue the Early Metal Age into ethnographic times, as in the case of the small bronze drums (*moko*) of East Javanese or Balinese manufacture still kept in villages and used for bride-price payments in eastern Flores, Pantar, and Alor in eastern Nusa Tenggara (Du Bois 1944; Calo 2014).

The Early Metal Age (referred to also as the Paleometallic Age in Indonesia) thus linked the late Neolithic forwards into the early historical era, through a time span of between 500 and 1000 years, depending on the region of concern. I see no need at this point to stamp a specific chronology on the Early Metal Age, given the amount of regional variation and the difficulty of knowing just when actual metal production, as opposed to import of exotic items, commenced in different areas. Nevertheless, the Early Metal Age stands out not just because of new technologies, but also because of its contemporaneity and overlap with some of the greatest cultural complexes of the ancient world, not least those of the Romans, Parthians, Mauryans, Sungas, Kushans, and Han.

The Arrival of Metallurgy in Island Southeast Asia

Recent intensive programs of archaeology in northeastern Thailand and Vietnam have established an initial presence of bronze working between 1300 and 1100 BCE, with iron working coming in around 500 BCE (Higham 2014). This means that the mainland of Southeast Asia had successive Bronze and Iron Ages like many other regions of Eurasia, although no such succession is yet clearly established in the islands.[2]

The ultimate source of copper/bronze technology in Southeast Asia was probably the Middle East, via Bronze Age western and central China, with both India and China being likely proximate sources for the later appearance of smelted and wrought iron in Southeast Asia (Bellina and Glover 2004). Apart from the new finds in Gua Harimau, which could suggest a slightly earlier arrival of cupreous metal, previous archaeological evidence in Island Southeast Asia supported a co-introduction of both bronze and iron metallurgy together about 500 to 1000 years after beginning of the Bronze Age in northern Thailand and Vietnam. However, we must be careful to distinguish here between an importation of exotic metal objects and an actual arrival of metallurgical knowledge and the infrastructure to locate and mine raw materials. Exactly when people began to smelt iron and cast copper/bronze "on the ground" in Island Southeast Asia remains uncertain, but finds of casting molds for socketed axes and other items in Indonesia, the Philippines, and Taiwan would suggest around 2000 years ago.

This chronology for metallurgical production, as opposed to simple importation, puts its introduction into the islands during the period of Chamic and Malay linguistic expansion from Borneo to the Vietnam and Peninsular Malaysian coastlines, around the BCE/CE boundary. This was also the time when bronze drums from Vietnam began to arrive in Island Southeast Asia, and I am tempted to claim a non-coincidental link between these island-to-mainland (and doubtless back again) Early Metal Age human migration episodes and the actual movement of metallurgical knowledge.[3] The introduction of metallurgy, for both bronze and iron, would have required a movement of skilled artisans in the first instance with the requisite production knowledge. People who had previously fired only earthenware pots in bonfires could hardly have jumped without instruction into high temperature metallurgy using kilns, crucibles, and bellows.

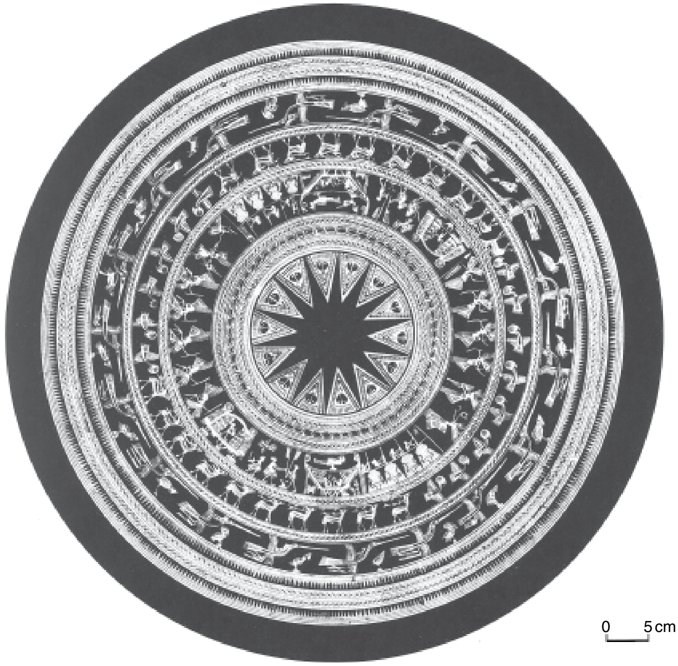

Figure 9.2 The decorated tympanum of the Heger 1 style Ngoc Lu 1 bronze drum, northern Vietnam. Drums with clear decoration of this kind are assumed by art historians to be the original type, with the "scrambled" designs being of younger age. Diameter 79 cm. Source: reproduced from Pham (1990:5), courtesy of Social Science Publishing House, Hanoi.

Before the appearance of iron, the copper and bronze artifacts found on the mainland of Southeast Asia included socketed axes and spearheads, tanged spearheads and arrowheads, and other small items such as knives, fish-hooks, and bracelets. Most such artifacts could be made using bivalve piece molds of terracotta or sandstone, using an inserted plug if a socket was required. The Dong Son archaeological assemblages of northern Vietnam are of considerable importance here because of their large-scale production activities (Pham 2004). The earliest copper/bronze items found in Island Southeast Asia are generally of Dong Son style, rather than of direct Indian or Chinese inspiration, although movements of metallurgical knowledge into Indonesia from further south in Vietnam as well as the Thai-Malaysian Peninsula cannot be ruled out.

The classic Dong Son phase of northern Vietnamese protohistory began between 500 and 300 BCE with many of the utilitarian bronze items listed above, as well as with an elaborate repertoire of Heger style 1 kettledrums (Figures 9.2, 9.3), daggers with anthropomorphic handles, and situlae (bucket-shaped containers), all made using lost wax (*cire perdue*) casting technology. The stylistically oldest Dong Son drums in northern Vietnam, termed Heger type 1 by art historians, have remarkable decorative friezes of human, animal, and geometric ornament (Figure 9.2) (Bernet Kempers 1988; Pham 1990). Such friezes occur, albeit with considerable simplification and schematization (Figure 9.3), in all the later drums of this type, including those exported to Indonesia.

Figure 9.3 Top and side views of the Heger 1 style Salayar drum, with its distinctive friezes of elephants and peacocks flanked by schematized river boats (top) and marching warriors (center). Tympanum diameter 103 cm, height 92 cm. Source: reproduced from Schmeltz (1904).

The first appearance of iron in northern Vietnam, also in the Dong Son phase, perhaps reflected a Chinese origin. Han Dynasty domination of Yunnan, and northern Vietnam to as far south as Hue, overlapped with the later stages of the Dong Son culture, meaning that there are undoubted Chinese imports in a number of the northern and central Vietnamese sites, including a great deal of iron. However, these occurrences cannot be used to support the derivation of Dong Son bronze metallurgy as a whole from the Sinitic-speaking (Shang, Zhou, Qin, and Han) dynasties of central China (c. 1500 BCE to 200 CE). The local genius expressed in the drum, situla, and axe forms, plus the importance of lost wax casting (a technique only rarely used at this time in China), indicate quite clearly that both the Viet-Muong (Austroasiatic) and Tai-speaking manufacturing communities of northern Vietnam, Guangxi, and Yunnan during the Early Metal Age possessed vital traditions of bronze metallurgy that had a dramatic impact on many other regions of Southeast Asia.

The Dong Son culture of northern Vietnam has a number of other features that merit attention. This society had an economy based on intensive rice production, presumably in rain-fed or irrigated embanked fields using plows and buffalo traction, which supported densely settled and fortified settlements such as the remarkable site of Co Loa near Hanoi (Kim 2015). The intensified production supported an upper ruling echelon whose wealthy burials have been found in many sites, often in log coffins or segments of long river boats, the latter like those depicted in head-hunting raids on the sides of the Heger 1 drums and situlae (Bellwood et al. 2007). These elites were able to support a degree of craft specialization associated in many other areas with literate civilizations. It is therefore not surprising that such professionally made items as the magnificent Heger 1 bronze drums, and perhaps the techniques necessary for the manufacture of lesser bronze tools and weapons, should have had such an impact on the contemporary societies of Island Southeast Asia.

A large number of artifacts of precise Dong Son affinity, especially Heger type I drums, have survived in villages or turned up as chance finds without coherent archaeological contexts in the Sunda chain of Indonesia, mostly Java, Sumatra, Nusa Tenggara, and the southern Moluccas, with examples occurring as far east as the Kei Islands (southern Moluccas) and also the Bird's Head of New Guinea (Cendrawasih Peninsula: Bernet Kempers 1988; Calo 2014) (Figure 9.1). They are rare in Borneo and absent on the Sulawesi mainland, the northern Moluccas, and the Philippines. Their distribution does overlap in the west with that of the earliest recorded Indian contact, so it may be that many of these exotic bronzes were transported secondarily, long after their dates of manufacture, within the trade (especially spice trade) networks of the earliest historical Indic states in the Malay Peninsula and western Indonesia. However, their absence (so far) in the clove-producing region of the northern Moluccas warns against any one-to-one link between drums and spices. It is also worth remembering that northern Vietnam at the time of manufacture of these drums was under very definite Sinitic and not Indic influence.

Not all of the Heger 1 drums found in Indonesia, however, are of northern Vietnam "pure" Dong Son style. One of the most significant Indonesian examples is the "Makalamau" drum from Sangeang Island near Sumbawa, with its figures in possible Han Dynasty and also Kushan or Satavahana (northern and central India) costumes of the early centuries CE (von Heine Geldern 1947; Alkazi 1983). Heine Geldern (1947) suggested that this was cast in Funan (southern Vietnam) around 250 CE. Other drums of possible southerly origin in Vietnam include that from Kei with its deer- and tiger-hunting frieze, and that from Salayar Island, immediately south of Sulawesi, with a frieze of elephants and peacocks (Figure 9.3). Regardless of exact origin, all these are scenes that would presumably have been unfamiliar to the inhabitants of the eastern Indonesian islands where the drums eventually came to rest, so on these grounds alone it is clearly most unlikely that they were cast locally.

In terms of style and a frequent high lead content, it still looks as if most of the Indonesian Heger 1 drums were manufactured somewhere in Vietnam, many during the period of Chinese domination in the north after the second century BCE. However, the Chinese conquest could also have prompted a southward escape of Dong Son metalworkers, as implied by Heine Geldern with his Funan origin for Makalamau. Indeed, Bernet Kempers (1988) has visualized refugees fleeing the bloodshed of Chinese conquest, especially after the final military incorporation of northern Vietnam as a province of Han China in 43 CE. Imamura (1993) has also suggested that some of the youngest Heger 1 drums with "scrambled" motifs might have been cast in Indonesia itself, as certainly were the Pejeng-style drums to be discussed below.

In terms of manufacture, Bernet Kempers (1988) has described how each Heger 1 drum was cast in one piece. Wax slabs were laid over a drum-shaped clay core and impressed with the river boat and warrior procession patterns using baked clay or stone molds, while some of the more naturalistic patterns, such as the house scenes and exotic animals, were incised individually into the wax. The wax was then sealed in a clay outer mold held in place by driven "spacers" and melted out prior to the pouring of the molten bronze. This *cire perdue* (lost wax) method can still be seen in use today in Mandalay (Burma) for casting temple Buddha statues and miniature bronze drums.

The Dong Son Heger 1 drums of Indonesia have recently been recorded in detail by Ambra Calo (2014), who suggests that the oldest specimen comes from Kabunan in West Java, with its parallels in the refined decoration of the Ngoc Lu (Figure 9.2), Hoang Ha, and Co Loa drums of northern Vietnam. This specimen could possibly date from the second century BCE. Over 50 Heger 1 drums of a chronologically intermediate stylistic affinity are known from the western islands of Indonesia, and another stylistically younger group of about 25 occur from Sangeang and Salayar eastwards to Papua. Calo and Bernet Kempers both regard the eastern ones as the youngest because of their rather disintegrated (scrambled) decorative patterns derived from the flying bird and warrior friezes and boat motifs on the oldest Vietnam drums. They might also have had a single source, and all drums found east of Bali have four frogs cast in relief around their tympana (Bernet Kempers 1988; Imamura 1993).

A fairly rapid result of this external introduction of finished bronze goods into the Indo-Malaysian Archipelago was clearly the actual establishment there of local metalworking centers. There have been several finds of stone or terracotta valves from the bivalve molds used for casting cuprous axes from sites in Java, Sabah, the Talaud Islands, Palawan, and Batanes, all of which show quite conclusively that some casting of either local or imported raw materials was being carried out during the early to middle first millennium CE. Evidence for the beginning of one or more Indonesian casting traditions can also be seen in a number of quite splendid copper or bronze objects that are not in a classic Dong Son style. In one group is the almost 2 m high hourglass-shaped drum with remarkable decoration of human faces, kept on a high pavilion in Panataran Sasih temple at Pejeng in Bali (first recorded by Rumphius in 1690), together with a number of similar but smaller Pejeng-type drums from this island and Java (Figure 9.4).[4] Some of these Pejeng-type drums were clearly made in Bali because a fragment of a volcanic tuff stamp for impressing a running triangular motif, like that on the Pejeng drum itself, into the surface of a wax mold was found at Sembiran on the north coast of Bali, dated by Indian imports to the first

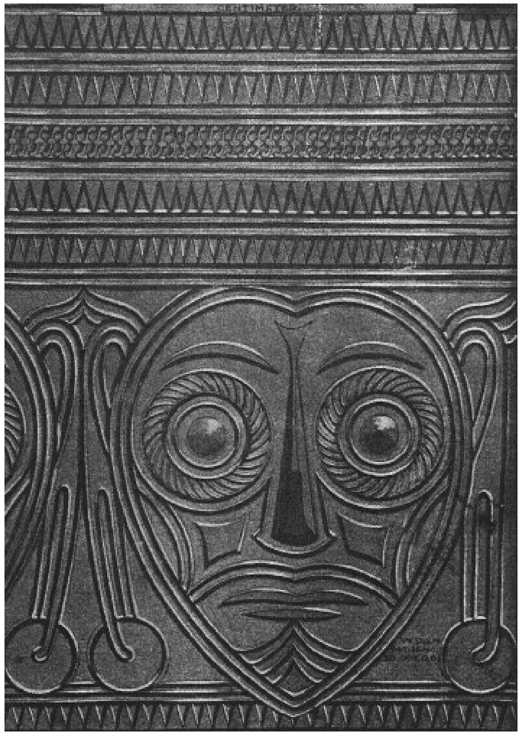

Figure 9.4 Human face motif on the side of the 1.86 m tall Pejeng drum, stored in the Panataran Sasih temple in Pejeng, central Bali. Source: Bernet-Kempers (1988: Plate 3.01e). Reproduced with permission of Taylor & Francis.

two centuries CE (Ardika and Bellwood 1991) (Plate 14h). Four more decorated stamp pieces, one with a human face design similar to the Pejeng ones, are kept in the village of Manuaba in Bali.

Pejeng-type drums have also been found in direct association with Heger 1 drums at Kradenanrejo (Lamongan) and near Semarang in Java. One was found by villagers digging a well at Pacung near Sembiran, and this appears to be from a layer contemporary with the one that yielded the Sembiran stamp fragment. The Pacung drum, like the others of this type, had its body and tympanum cast separately (McConnell and Glover 1990). In this specimen the tympanum is of bronze, the body of copper.

There are many other bronze items of non-Indic affinity found in many places throughout Indonesia that resemble stylistic features of both Heger 1 and Pejeng-type drums, alas normally undated and with no recorded contexts of discovery (van Heekeren 1958). They include flasks and ceremonial axes with face masks like those on the Pejeng drum, clapperless "bells," human statuettes, knobbed bracelets, a remarkable bronze canoe model from Dobo village on Flores, a bronze back strap weaver from Flores, and a series of daggers or short swords with iron blades and bronze handles from Prajekan and Lumajang in Java. These items were discussed and some illustrated in *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007), but I avoid listing them again because none have good contexts and many were probably made well after the Early Metal Age. The Flores weaver, for instance, has a thermoluminescence date on its baked clay casting core of about 600 CE.[5]

"Indigenous" Early Metal Age Assemblages and Monuments in Island Southeast Asia

Before moving to a survey of the current state of research on the beginnings of Indian contact with Island Southeast Asia, I will first briefly review those assemblages that appear to date to the Early Metal Age and which do not contain artifacts of *demonstrated* Indian origin. Dating is often extremely poor for these sites, but in general they contain Early Metal Age markers such as bronze and iron artifacts, and glass and carnelian beads. The latter, especially when faceted or etched, no doubt reflect Indian inspiration, but the precise geochemical sourcing of glass and carnelian to specific manufacturing areas is still uncertain. Natural occurrences of carnelian and other semi-precious stones occur widely in Indonesia, especially in Java, but glass can be easily reworked from melted-down source materials of disparate origin (Carter 2016). So an actual Indian origin for glass and carnelian cannot be assumed unless it is demonstrated. A suggested presence of Indian artisans making glass beads and bracelets in Khao Sam Kaeo in Peninsular Thailand, perhaps as early as the fourth century BCE (Glover and Bellina 2011; Bellina 2014), supports a theory of local manufacture, albeit not necessarily by indigenous craftsmen.

Stone Monuments and Carvings: Indonesia

Island Southeast Asia still has many celebrated living "megalithic" cultures that erect and/or carve large stone monuments – on Nias Island, amongst the Bataks of northern Sumatra, in parts of northern Borneo, amongst the Toraja in Sulawesi, and in some of the Lesser Sunda Islands. None of these cultures, so far, have archaeologically documented antecedents and they are essentially the subject matter of ethnography. As such, I do not consider them here.

As far as archaeological stone monuments of likely Early Metal Age date are concerned, one of the main concentrations in Indonesia lies on the 70 km long Pasemah Plateau around Pagaralam in southern Sumatra, recorded in wonderful detail long ago by van der Hoop (1932; van Heekeren 1958:63–79). A fairly simple megalithic tradition also occurs widely in the adjacent Lampung district at the southern tip of the island, in association with glass beads and impressed pottery (Sukendar 1979). It contains "dolmens" with one or more capstones over uprights forming a chamber, and upright stones that often form single or double alignments.

The Pasemah monuments themselves are quite striking and have attracted attention since 1850. They include more groups and alignments of upright stones, stone blocks with carefully hollowed cup-like mortars, troughs with human heads carved on their ends, simple terraced platforms, dolmens with very large capstones (some in the form of massive underground chambers), slab graves, and some remarkable stone carvings of humans and animals.

The slab graves excavated by van der Hoop (1932) at Tegurwangi contained large numbers of glass beads and a few metal objects – copper or bronze spirals, a gold pin, and a corroded iron lance. As in the Peninsular Malaysian slab graves (below), the acid soil had dissolved all traces of bone. One of the Tegurwangi graves and several megalithic chamber graves at Tanjungara (Figure 9.5c; de Bie 1932) and Kotaraya Lembak (Soejono 1991) still preserved on discovery traces of polychrome wall paintings showing human figures and water buffalo. Another stone chamber grave at Kotaraya Lembak has a quite remarkable frontal figure of a cockerel in fighting stance painted in four colors (Bellwood 2007: Figure 9.10).

The human and animal statues are the most striking elements of the Pasemah monuments, carved in a dynamic style in relief or in the round on large stone blocks. Men are shown riding on water buffalo or elephants (Figure 9.5b, d), wearing bracelets, necklaces of oblong plaques and what appear to be faceted beads, anklets, headdresses (or "helmets" for van der Hoop) with peaks at the back, loincloths, tunics, and earplugs. Animal and human heads are often carved in considerable detail, while bodies can be disproportionately small or simply not portrayed, depending perhaps on the original shape of the stone. Some reliefs also show combat themes of men fighting tigers or snakes, although the elephants and water buffalo are more often in situations demonstrating human control and possibly domestication or taming.

The most important chronological indicators on these carvings are the Heger 1 drums shown on the Batugajah (Figure 9.5d) and Airpurah (Air Puah) reliefs and painted on a Kotaraya Lembak chamber wall (Soejono 1991:19). These could indicate a date in the early or middle first millennium CE, although some may overlap in time with the period of the Srivijaya trading state on the plains to the east around Palembang, after 670 CE.[6]

In Java, slab graves also occur in association with poorly dated Early Metal Age assemblages, here again with iron tools, bronze rings, and beads of glass and faceted carnelian (Bellwood 2007:290–291). There are also a number of localities in western Java with complexes of stone-paved terraces and platforms that appear to belong to a pre-Indic architectural tradition. Sukendar (1985) has described an excellent example built of prismatic basalt columns located on a terraced hilltop 895 m above sea level at Gunung Padang, south of Cianjur (Figure 9.6). This site has recently come into the news and activities there are described by Daud Tanudirjo in Chapter 6. Similar terraced sites occur in the northwestern comer of Java at Lebak Sibedug (van der Hoop 1932: Plate 204) and Arca Domas (van Tricht 1929).

These structures probably served as open-air temples or gathering places, rather like the *marae* of Polynesia. Stone human statues of fairly simple shape are also known from localities widely distributed through Java and Bali (Mulia 1980; Sutaba 1997). Unfortunately, it is impossible to date these monuments and statues, notwithstanding

Figure 9.5 (a) fully sculpted head of a ?warrior with a back-pointing headdress (compare with those in (b) and (d)), length from chin to back 1.12 m, exact source unknown but recorded in Pageralam by van der Hoop in 1932. (b) fully sculpted man astride a buffalo, with necklace, back-pointing headdress, and anklets, 1.93 m high, Pematang, Pasemah. (c) massive subterranean stone burial chambers at Tanjungara, Pasemah. (d) relief carving of a man with a back-pointing headdress flanking an elephant, wearing anklets, and carrying a Heger 1 drum on his back, total length 2.17 m. From Batugajah, Pasemah, but now in the museum grounds in Palembang. For a similar carving at Wonotunggal in north-central Java, see Satari (1981). Sources: photos (a) and (b) are from van der Hoop (1932: figures 39 and 73); courtesy of W.J. Thieme. Photos (c) and (d) are by the author.

some of the remarkable chronological claims for Gunung Padang,[7] although one statue of this type near Bandung carries an inscription, possibly secondary, dated to 1341 CE (Suleiman 1976:8).

The island of Bali is also renowned for its highly distinctive lidded sarcophagi, carved from soft volcanic tuff, found mainly at sites in the central and southern interior of the island.[8] These have separate bodies, high-domed lids, and knobbed projections on their ends sometimes carved into human or turtle-like heads (Figure 9.7). A range of sizes was produced to accommodate both flexed and extended burials. The grave goods include glass and carnelian beads, some rather indeterminate iron objects,

Figure 9.6 View of part of the terraced complex of prismatic basalt enclosures at Gunung Padang, south of Cianjur, West Java. The monument is undated and is currently the scene of considerable debate. Source: photo by Vida Kusmartono (see also color plate 16).

Figure 9.7 Sarcophagus elements of volcanic tuff (not necessarily originally associated) with human or turtle relief decoration and projections. From Taman Bali, Bangli, South Bali and stored in Museum Purbakala, Pejeng. Source: photo by the author.

and unusual ornaments and finger-sheaths made of spiraled bronze wire (Soejono 1977: Foto 67–70), and socketed bronze tools with crescentic and heart-shaped blades (Ardika 1987). The latter are closely paralleled in mid-first millennium BCE contexts in central Thailand.

Two such stone sarcophagi at Gilimanuk in western Bali, one with a lid shaped like a buffalo and the other with a stylized design apparently based on female genitalia, have been excavated in contexts perhaps dating to about 1500 to 2000 years ago (Soejono 1995). A stone sarcophagus and lid at Manikliyu were excavated next to a horizontal drum of Pejeng type that was also used for a burial (Ardika et al. 2013:66).

These sarcophagi appear to be of genuine Early Metal Age date and certainly predate any signs of Hindu artistic influence in the island. However, it is very possible that they overlap in date with the beginnings of Indian trade contact, as discussed later for the sites of Sembiran and Pacung in northern Bali.

Malayic Migration

In Peninsular Malaysia, stone slab-lined graves for extended inhumations (although the bones have always dissolved) like those in Sumatra and Java occur in southern Perak and northern Selangor states, associated with glass and carnelian beads and a most unusual industry of transversely socketed iron tools. This iron industry has been found in several other sites apart from the slab graves, and there appears to be a unity in terms of style. The forms were clearly described by Sieveking (1956a) and include axes (some with very long shafts, known colloquially as *tulang mawas*), knives, and sickles, all with shaft holes. In addition, there are some socketed spearheads and tanged knives (Bellwood 2007: Figure 8.9).

These iron tools and slab graves appear to be roughly contemporary with a rather enigmatic coastal site at Kuala Selinsing in Perak. The original assemblage from here was excavated by Evans (1932) and included a wheel-made, comb-incised ware like that from the early Indic-contact site of Oc Eo in southern Vietnam (Funan period, early to middle first millennium CE), a carnelian seal with an inscription in Pallava script, evidence for local blue glass and agate bead manufacture, glass bracelets, and lead slag. The site was evidently an estuarine pile village with human burials laid in canoe-shaped coffins (Sieveking 1956b). Further excavations at Kuala Selinsing (Nik Hassan Shuhaimi 1991; Davison 1991) confirmed that the location as a whole consisted of a series of mounds of earth and shell in a mangrove swamp, possibly deposited under the floors of pile dwellings.

As well as the comb-incised pottery, the Kuala Selinsing sites have also yielded incised and paddle-impressed pottery, the latter of the widespread type associated with sites in Sarawak and described in Chapter 8 as Tanjong Kubor ware (see examples in Figure 9.8). There are also tin ear pendants (tin is still mined widely in this region of Malaya) and a rather interesting collection of bones of pig, dog, and chicken, plus rice husks, coconuts, gourds, bamboo, areca (betel) nuts, pandanus and bamboo mats, and part of a dugout canoe.

This Peninsular Malaysian material, together with the slab grave connections with Sumatra and the paddle-impressed pottery connections with both Sumatra and Sarawak, is surely of relevance for any discussion of the origins of the Malayic-speaking populations of Peninsular Malaysia and Sumatra, as discussed by Bob Blust in Chapter 6. Linguistically, the Malayic-speaking populations as a whole, who include the Iban, Selako, and Kendayan of western Borneo, the Minangkabau of Sumatra, and of course the Malay-speaking peoples themselves, originated in western Borneo at a time when iron was already in use – that is to say, around 2000 years ago or just before (Blust 2005). Suggestions that non-Malayic Austronesian languages were spoken in Malaya before this time have been made (see Bellwood 2006 for a discussion of

Figure 9.8 Paddle-impressed pottery of the Early Metal Age and later. (a) Early Metal Age pot from Gilimanuk with check-stamped impression probably done with a carved wooden paddle, c. 1 CE (Museum Purbakala, Pejeng). This style of decoration is common in many Early Metal Age sites in Bali, Borneo, and Sumatra. (b, c) complete pots of Tanjong Kubor style from Muara Tebas, Sarawak River delta, and Sungei Lumut, Brunei, 700–1500 CE (Sarawak and Brunei Museums respectively). (d) Tanjong Kubor style paddle-impressed sherds and a bridged double-spouted sherd from Kupang, Brunei, 700–1500 CE (Brunei Museum). (g–i) undated but probably Early Metal Age paddle-impressed sherds from Gua Sireh, Sarawak (see Chapter 8). Source: photos by the author.

all this evidence), but a clear demonstration is still lacking. However, given an early Malayo-Polynesian linguistic presence in Sumatra, as discussed by Bob Blust in Chapter 6, the likelihood of at least some pre-Malayic presence in the Malay Peninsula is quite high.

My current understanding of the Peninsular Malaysian situation is that the Neolithic cultures there are of southern Thailand derivation (Bellwood 2007: Chapter 8), associated with the ancestors of the Aslian (Austroasiatic)-speaking Semang and Senoi. As noted in Chapter 8, those assemblages are very different stylistically from Neolithic assemblages in Sumatra and Borneo. It is thus likely that the peninsula was still settled mainly by Aslian-speaking populations, including along the coastline, when Malayic speakers arrived during the Early Metal Age from Borneo or Sumatra.

Burial Grounds and Their Significance

Given the absence of any coherently excavated Early Metal Age *settlements* in Island Southeast Asia, we are left with the substantial record from burial grounds. The burials of this period were either extended supine or flexed, with grave goods, or placed in large lidded jars which had their upper parts cut off (and then sometimes replaced) to allow insertion of the folded body and its goods. The practice of jar burial was predominant in the more easterly parts of Indonesia, but flexed primary burials in jars have also been uncovered with inhumation burials at many sites in Sumatra, Java, Bali, and Borneo, for instance in the Niah Caves (van Heekeren 1958; Soeroso 1997; Bellwood 2007; Lloyd-Smith 2013). Interestingly, I am not aware of any jar burial assemblages in the Thai-Malaysian Peninsula, an absence that supports the view that the Malayic arrival there could either have postdated jar burial behavior or emanated from beyond its range.

Since several of these jar burial sites were described in *Prehistory of the Indo-Malaysian Archipelago* I will here focus only on a few of the more interesting examples. Plawangan, on the central north coast of Java, has an interesting mixture of flexed or extended inhumations and burials of both adults and children in jars with inverted-vessel lids (Sukendar and Awe 1981; Prasetyo 1994–1995). In one case, a flexed child skeleton was placed inside an upturned Heger 1 drum together with small pottery offerings, a bronze spearhead and bracelet, glass beads, and gold eye and mouth covers (Soejono 1991). At another north Javanese site called Kradenanrejo, near Lamongan, a child was placed inside an upturned drum of Pejeng type with a Heger 1 drum on top as a cover, with carnelian, glass and faceted gold beads, a bronze container with Dong Son circle and tangent ornamentation, gold umbrella-shaped ornaments (hints of an overlap with Buddhism?), two bronze cups, and various other iron and bronze items (Bintarti 1985). Unfortunately, few of these Kradenanrejo items have ever been illustrated, and the Pejeng-style drum was destroyed when found.

Gilimanuk in western Bali is another important coastal burial site of the Early Metal Age that has produced extended burials and jar burials, some in double mouth-to-mouth jars, with associated paddle-impressed pottery (Figure 9.8a) and bronzes like those from the Bali sarcophagus sites (Soejono 1979; Santoso 1985). Other Gilimanuk grave goods include a tanged iron spearhead, an iron dagger with a bronze handle, and beads of gold, glass and carnelian. One Gilimanuk burial and a sarcophagus at Pangkungliplip also produced gold eye and mouth covers like those from Plawangan and also from Segaran IIA in West Java. The Gilimanuk assemblage is dated between 200 BCE and 300 CE according to nine C14 dates (Bronson and Glover 1984:41).

These rich burial assemblages from Java and Bali document the presence of an Early Metal Age elite that had access to high-quality items of bronze, iron, and gold. Perhaps these rich individuals were the ancestors of people of even higher status, a few centuries later, who felt able to adopt Indic names and religions and to rule their followers as living manifestations of the major Hindu and Buddhist deities.

However, the Early Metal Age in the northern and eastern parts of the Indo-Malaysian Archipelago was perhaps not quite so flamboyant, since these regions never fully entered the world of Indic ritual. The most elaborate assemblages here occur in the islands around the Sulawesi and Sulu seas (northern Borneo, Talaud, central and southern Philippines) and in parts of the Lesser Sundas, especially Sumba. A "little gem" for understanding jar burial behavior within the northeast Indonesian group is the small cave of Leang Buidane on Salebabu Island in the Talaud group of northeastern Indonesia (Bellwood 1976, 1981).

The jar burials here were originally placed on the floor of the cave but were smashed – presumably deliberately (Bellwood 1981:71) – in antiquity. The bone containers comprised a range of large globular jars with round bases and occasional tripod or ring feet, together with flat-based cylindrical vessels and roughly rectangular pottery boxes. All these large containers appear originally to have been lidded (illustrated in Bellwood 2007: Figure 9.14). The human bones (Bulbeck 1978) were mainly of young individuals under 40 years of age. The ratio of 36 individuals (based on teeth) to a minimum of 32 large vessels suggests that only one individual was placed in each container. The bones were mainly skulls, mandibles, and limb bones – pelvic bones and vertebrae appear to have been discarded or lost. The teeth revealed some evidence for betel staining, occasional tooth evulsion for females during life, and the Asian morphology was presumably directly ancestral to that of the present population.

The accessory vessels and other items found with the remains of the Leang Buidane jar burials form a homogeneous stylistic group and define a Buidane culture that appears to have occupied Talaud for much of the first millennium CE. The small pots include round-based carinated vessels with quite elaborate horizontal zones of incised and paddle-impressed decoration (Plate 11i, j), distinctive high-necked flasks with a polished red slip, and a range of cooking vessels. The carinated vessels in particular have an angular cross-sectioned rim that is also characteristic of this phase in the sites of Agop Atas and Agop Sarapad in Sabah (Bellwood 2007: Figure 9.15).

The other artifacts found in Leang Buidane include shell bracelets and beads, part of a glass bracelet, beads of agate and carnelian, coral flask stoppers, and a penannular pottery earring. The stone beads are particularly interesting; the majority are either spherical or elongated faceted red carnelians with a precision in drilling that probably indicates an Indian origin and a use of metal drills, although the shapes are chronologically complacent and belong to types common in both India and Southeast Asia throughout the past 2000 years (Plate 11c, d). However, there are three black agate beads with designs etched in white (Plate 11a) that are paralleled very precisely in late first millennium BCE layers in major Gangetic and Indus sites such as Hastinapura (Lal 1954–1955: Plate LV), Taxila (Dikshit 1952:35), Kausambi, and Chandraketugarh.[9] Identical beads are also reported from contexts dated to around 2000 years ago at Khao Sam Kaeo in southern Thailand and Hoa Diem in southern Vietnam (Plate 11b; Yamagata 2012). However, in a location as remote as Talaud the beads might have been in circulation for many years prior to their eventual burial.

Leang Buidane has also produced metal artifacts, including a number of indeterminate pieces of iron. The copper or bronze objects include bracelet fragments, a bronze cone, and a copper socketed axe. Three baked clay valves of the bivalve molds for casting axes and other cuprous objects were also found (Plate 11f), indicating that metal casting was carried out locally, although this may have been confined to melting down and recasting of artifacts that were originally imported. In general, the Buidane metallurgy fits conformably within the range reported from this date in Sabah and the Philippines, and the copper and bronze working seems to have been restricted to bivalve mold techniques without the use of wax.

The islands of Southeast Asia contain dozens of jar burial sites like Leang Buidane, most with limited recording, poor preservation, damage due to looting, and alas no accurate dating. Well-known Philippine examples described in my *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007:302–303) include the Kalanay Cave assemblage excavated by Solheim (2002) on Masbate Island in the central Philippines, a huge quantity of undated sherdage collected by the Guthe Expedition (1922–1925) from caves in the central Philippines (Solheim 2002), a jar burial assemblage from Magsuhot on Negros Island described by Tenazas (1974), and a series of collections from Tabon and other caves in west-coastal Palawan (Fox 1970; Kress 1978). Manunggul chamber B in the Tabon cave complex has a single radiocarbon date of about 200 BCE putatively connected with iron, glass bracelets, glass and carnelian beads, and also five etched agate beads similar to those from Leang Buidane. Some of the Tabon Caves also contained bronze axe casting molds, gold beads, and Fengtian (Taiwan) nephrite three-pointed *lingling-o* and animal-headed ear pendants (Plate 13d) of distinctive types discussed in her contribution below by Hsiao-chun Hung. These nephrite objects in particular are very well dated in several sites in the Philippines and Vietnam to the Early Metal Age, to between 300 BCE and 300 CE.

Another Philippine open-air jar burial site with *lingling-o* ear pendants is the Savidug Dune Site on Sabtang Island in Batanes. This has yielded large lidded burial jars C14-dated to 500 to 1 BCE, some cut open at their widest points to receive former burials (Figure 9.9), although almost all bone had decayed. Associated with these burial jars were an axe casting mold, a small piece of copper, and two more three-pointed *lingling-o* ear pendants of Fengtian nephrite (Bellwood and Dizon 2013). As Hsiao-chun Hung discusses below, the site of Anaro on Itbayat Island in Batanes actually has a working area for the manufacture of these three-pointed *lingling-o* ornaments, although this site yielded no burials.

Figure 9.9 A complete burial jar (57 cm in greatest diameter) under excavation in 2007 at Savidug Dune Site, Sabtang Island, Batanes, with the lower part of its red-slipped bowl-shaped lid still in place. The upper part of the vessel was removed by chiseling around the inside in antiquity and then put back, presumably to admit a primary burial, of which no bones survived. Source: photo by the author.

Elsewhere in Indonesia, another remarkable jar burial site is undoubtedly the large urnfield of Melolo on eastern Sumba. This open site was first investigated during the 1920s and 1930s and then again in 1985. It has produced an alignment of large, close-set burial urns with round-based vessels as lids, containing fragmentary secondary burials, stone adzes, stone and shell beads, shell bracelets, a few metal items, and some small accessory pots. Of the latter, the only kind adequately reported is an elegant high-necked flask with incised geometric and anthropomorphic designs filled in with a white paint (van Heekeren 1956). It appears that some of these flasks were provided with a burnished red slip. The form is not, to my knowledge, found in Neolithic assemblages, and the high-necked flask with a globular body and sometimes a burnished red slip can perhaps be regarded as a clear marker of the Early Metal Age (Bellwood 2007: Figure 9.18, Plate 60).[10] The form transcended local cultural areas.

Chamic Migration

There is one final topic to be discussed in connection with jar burials, and this is the Chamic settlement of central and southern Vietnam.[11] It will be recalled that the suggested evidence for Malayic penetration of the Malay Peninsula around 2000 years ago revolved around slab graves with presumably extended supine burials and iron artifacts. But no such slab grave connection exists with coastal Vietnam, despite the close cousinship of the Malayic and Chamic languages. Vietnam Early Metal Age prehistory in the center and south of the country was unequivocally associated with the custom of jar burial.

The Chams of history are best known to us from their remarkable brick temples to Indic deities dating from the late first and early second millennia CE, which they built before succumbing to Vietnamese pressure from the north. Before these Chams of history, whose inscriptions go back as far as the fourth century CE, archaeologists have revealed the late prehistoric Sa Huynh culture in central Vietnam, distributed in its classical form from Hoi An down to Nha Trang. Added to this is a series of Dong Nai Valley affiliated sites extending southwards to the coastal vicinity of Ho Chi Minh City.

Unfortunately, all of these are burial sites, whereas most Chamic era sites are settlements or temples. Hence it is difficult to determine clearly if Sa Huynh and its southern affiliates were ancestral Chamic and thus Malayo-Polynesian-speaking. Most archaeologists, including me (Bellwood 2007) and Ian Glover (2015), have suggested at various times that they were, but with new discoveries it is now clear that only the southern "Dong Nai" sites had unequivocal links with the Early Metal Age jar burial sites of the Philippines and Borneo, the latter island being the most likely linguistic homeland for the Chams. The Sa Huynh culture proper of central Vietnam has thus been pushed a little to one side in this debate.

In the past, it was normal to equate the northerly Sa Huynh culture proper with the ancestors of the historical Chams (e.g., Solheim 1967), simply because the southern sites have only become known recently and the early comparisons were driven by the concept of a Sa Huynh-Kalanay pottery complex associated with the research of Solheim (2002). However, this Sa Huynh proper, or the "Northern Sa Huynh" (500 BCE to 100 CE) of Lam My Dzung (2011), despite being the one described in most earlier accounts (e.g., Bellwood 1978:191–194; Bellwood 2007:271–275), only relates directly to Island Southeast in having *lingling-o* and animal-headed ear ornaments of Taiwan nephrite. Some of its most distinctive characteristics, especially the tall cylindrical burial jars with angular hat-shaped lids, are absent in Early Metal Age assemblages in Island Southeast Asia. Furthermore, many aspects of Northern Sa Huynh pottery decoration can be traced back into the Neolithic of northern Vietnam, and hence were probably associated with Tai or Viet-Muong populations rather than Austronesians (although, of course, this cannot be demonstrated clearly, and an Austronesian presence in Neolithic northern Vietnam cannot be ruled out entirely).

In fact, it is the sites of Lam My Dzung's "Southern Sa Huynh" or Dong Nai culture that now reveal the closest relationships with Early Metal Age assemblages in Borneo and the Philippines. Hoa Diem in Cam Rang Bay and the twin sites of Giong Ca Vo and Giong Phet near Ho Chi Minh City have globular burial jars like the Borneo and Philippine ones, often with their upper parts cut off to take the burial, and shallow bowl-shaped rather than angular lids. These sites have mixes of jar burial and extended inhumation like many Early Metal Age sites in Island Southeast Asia.[12] Giong Ca Vo in particular has large quantities of glass and Taiwan nephrite ear ornaments, some found in position on the ears of the dead, with many beads of glass, carnelian, and gold (Dang and Vu 1995; Nguyen 2001).

Hoa Diem (Yamagata et al. 2012) dates a little later than Giong Ca Vo, closer to the second century CE, and has Eastern Han Dynasty Chinese imports such as copper or bronze *wuzhu* coins. However, it is the small accessory pots found in or around the Hoa Diem globular and lidded burial jars (Figure 9.10f) that most clearly resemble some of the Kalanay pottery in the central Philippines, particularly the small carinated bowls with shell-edge stamping (Figure 9.10a, b) and a carinated jar form with nipple-shaped protrusions like a series of breasts (Figure 9.10c, d). Nipple-shaped modeling also occurs on some of the contemporary and very remarkable red-painted anthropomorphic burial jars from Maitum, southern Mindanao (Dizon 1996) (Figure 9.10e). In addition, as Hirofumi Matsumura and colleagues note in Chapter 4, the human crania from Hoa Diem are very close in craniofacial dimensions to those from the Neolithic to Early Metal Age burials of Gua Harimau in southern Sumatra, whereas those from Giong Ca Vo relate more to Mainland Southeast Asian populations.

There is also pottery from the burial caves of Tham Phu Khao Thong (Chumphon Province) in southern Thailand and Ko Din on Samui Island[13] that has decoration almost identical to that on the polychrome three-color ware from Sarawak, the Tabon Manunggul cave B "ship-of-the-dead" jar (Fox 1970: frontispiece) and some of the painted pottery with red spirals from Maitum. Some of this was described for Sarawak in Chapter 8 and it is likely to be of late Neolithic or Early Metal Age date.

So, was the first arrival of the Chamic-speaking ancestors of the Chams of history in the vicinity of Cam Rang Bay, from where they spread north to admix with existing Sa Huynh populations who already had their own jar burial tradition, and south along the northern coastline of the Thai-Malaysian Peninsula? While no Malayo-Polynesian languages exist in southern Vietnam or Thailand today, apart from recent Chamic movement into the Mekong Delta and Moken on the western side of the Peninsula, the possibility that others once existed there and have been replaced by Mon and Thai has been raised by linguist Bob Blust (1994). One wonders also about the possibility of an earlier Malayo-Polynesian-speaking population (pre-Malayic) in Vietnam, one perhaps ancestral to the Moken, but no obvious linguistic evidence as yet supports this view (Thurgood 1999). However, there is some archaeological evidence in support (Hung et al. 2013), focused on the likely pre-Sa Huynh presence of red-slipped pottery and similar baked clay penannular earrings in both central Vietnam and the northern Philippines. But in this case the linguistic links can hardly be Chamic.

The connections between southern Vietnam and the Borneo-Philippine region in the early Metal phase (and possibly the preceding Neolithic) may be important when considering the evidence in the Sa Huynh sites and Island Southeast Asia for iron metallurgy. In both areas the iron repertoire as a whole includes many socketed tools such as spades, picks, and axes, and there are also unsocketed sickles, tanged knives, spindle whorls, rings, and spiral bracelets. In fact, the Chamic connection into Vietnam could have been instrumental in the introduction of iron metallurgy into Island Southeast Asia.

Figure 9.10 Early Metal Age pottery from Hoa Diem (Cam Ranh Bay, southern Vietnam) and the Kalanay and Maitum complexes in the central and southern Philippines. (a, b) almost identical shell-edge stamped bowls with faceted carination from Hoa Diem (a) and Kalanay Cave, Masbate. (c, d) almost identical jars with carinations formed by a row of nipples from Hoa Diem (c) and the central Philippines (d, exact location unknown). (e) anthropomorphic burial jar lid from Maitum, Sarangani, southern Mindanao; the individual has a faint necklace of red painted beads, perhaps carnelian. (f) Hoa Diem burial jar with an upturned footed bowl for a lid, the latter decorated with horizontal zones of dentate-stamped infilling. Sources: courtesy of Khanh Hoa Provincial Museum (Vietnam), National Museum of the Philippines, and University of the Philippines Press. Photo (b) from Solheim (2002: Plate 8); photo (d) by Hsiao-chun Hung; all others by the author.

Nephrite and Other Early Metal Age Exchange Networks across the South China Sea

An Invited Perspective by Hsiao-chun Hung

In the past decade, archaeological studies have revealed intensive Early Metal Age exchange systems stretching across the South China Sea.[14] Many new items and technologies were involved in this long-distance trade (Plate 12) and several networks of movement can be traced. Two of the main raw materials with identifiable geochemical origins were nephrite (jade) from Fengtian near Hualian, located in a tectonically unstable region of eastern Taiwan, and muscovite mica (often termed "Mindoro jade") from southern Mindoro Island in the western Philippines. Glass beads and objects of bronze, gold, and iron also traveled, but these are not so clearly traced to specific sources.

Outside central and northern Vietnam with China, which had other nephrite sources, many of the nephrite ornaments found in Early Metal Age contexts around the South China Sea are geochemically traceable to Fengtian in eastern Taiwan (located in Figure 91). Between 500 BCE and 100 CE, this Taiwan raw material was used for making two very specific forms of ear pendant, distributed in a 3000 km diameter zone that included Taiwan, the Philippines, Sarawak, central and southern Vietnam (but not Dong Son northern Vietnam), and southern Thailand (Hung et al. 2007). These ear pendants are either circular with three pointed external projections (so-called *lingling-o*, a term of northern Luzon origin), apparently manufactured in sets of four from large square blanks (Plate 13p), or they are elongated with a deer-like animal head carved at each end (Plate 13d). Very similar artifacts were made of New Zealand South Island nephrite by Maoris at European contact, doubtless reflecting some form of now-untraceable common artistic descent maintained within expanding Malayo-Polynesian societies (Bellwood and Hiscock 2013).[15]

To provision the nephrite industry, sawn square and flat blanks of Fengtian nephrite were worked in locations near the source by sawing, using stone knives with copious quantities of abrasive quartz sand and water (Plate 13e, f). These blanks were then exported to specialized workshops outside Taiwan, where they were further worked to shape, perhaps using hollow bamboos and sand for drilling out the central cores. Excavated examples of such workshops exist at Youzihu on Ludao Island and Lanyu Island High School (Taiwan), Anaro on Itbayat and Savidug on Sabtang (Batanes Islands), Guri Cave (Palawan), Giong Ca Vo (southern Vietnam), and Khao Sam Kaeo (Peninsular Thailand). These sites contain a discarded range of pelta-shaped pieces and drilled-out disc-shaped and cylindrical cores, together with other fragments of grooved and cut nephrite debris.

The sawn square blanks of Taiwan nephrite from Giong Ca Vo in Southern Vietnam and Khao Sam Kaeo in Peninsular Thailand are identical to those that occur in the Pinglin workshop near the Fengtian nephrite source in eastern Taiwan (Hung and Iizuka 2013, in press). However, most of the workshops outside Taiwan appear small-scale compared to that at Pinglin, which covers many hectares, suggesting the movement of a few skilled and itinerant craftsmen to serve demand in communities located around the South China Sea. Perhaps, from their distribution, these communities were mostly of Philippine and Malayo-Chamic (Austronesian) ethnolinguistic identity. Other, not yet identified, nephrite sources in central Vietnam were also used by Sa Huynh people to make the same types of ornaments.

In addition to the Fengtian nephrite, ornaments of green Mindoro muscovite have a similar time-depth and distribution, most commonly in the Philippines, but also at Bukit Tengkorak in Sabah and Khao Sam Kaeo in southern Thailand (Hung and Iizuka in press). Guri Cave in the Tabon cave complex on Palawan has abundant evidence for the production of green muscovite ornaments.

Indonesia also has Neolithic or Early Metal Age green stone ornaments, but not yet of identified nephrite. A well-made green stone bead about 2.2 cm in diameter, with a 3 mm drilled hole, was excavated at the Neolithic site of Kamassi in West Sulawesi (Chapter 8). It is of a nepheline that could be of Sulawesi origin.[16] In Central Java, the Tipar-Ponjen workshop complex in Purbalingga Regency contains several locations with drilled-out cores and unfinished bracelets, some possibly of nephrite.[17] The chronology and sources of the Indonesian raw materials need further investigation.

At the same time as Taiwan nephrite was traveling to points located on either side of the South China Sea (Hung and Bellwood 2010; Hung and Iizuka in press), Indo-Pacific glass beads and carnelian/agate beads were finding their way from India to Early Metal Age communities in Southeast Asia, eventually reaching Taiwan (Wang and Jackson 2014; Hung and Chao 2016). With the beads perhaps traveled bronze, iron, and glass production technologies (Hung and Chao 2016). Interestingly, Taiwan thus received most of its Early Metal Age influences from India and Southeast Asia, rather than from Warring States, Qin and Han Dynasty China. Chinese settlement in Taiwan did not occur in quantity until the seventeenth century, after the brief occupation by the Dutch and their expulsion by Coxinga (Zheng Chenggong).

Jiuxianglan, on the southeast coast of Taiwan, is an excellent representative of Taiwan's Early Metal Age (Li 2005), yielding a nephrite double animal-headed pendant and a three-pointed *lingling-o*, together with many artifacts of glass, agate/carnelian, bronze, and gold. There are also casting molds for the production of copper/bronze earrings (Plate 9.12, 9), other small ornaments, and possibly knife handles. The particular styles and forms of the casting molds used at Jiuxianglan were absent in contemporary China, but closely resemble examples dating between 100 BCE and 500 CE in Thailand and southern Vietnam (Hung et al. 2013). Extensive accumulations of condensed ash and iron slag in

Jiuxianglan further indicate local iron production. Although only one gold bead was found, gold fragments attached to baked clay also suggest the possibility of production on site.

Interestingly, Jiuxianglan is the only site in Taiwan to have produced finished Fengtian nephrite ornaments of the two types discussed. Since the site has no evidence for a jade workshop, it raises the intriguing possibility that nephrite was exported to an overseas workshop and then the finished ornaments were imported back into Taiwan. In this regard, the *lingling-o* and animal-headed ear ornament designs might well have had extra-Taiwan origins.

Current evidence thus suggests that craftsmen of different cultural origin linked together a network of workshops and trading ports (entrepôts) during the Early Metal Age in Island Southeast Asia, including Taiwan. Archaeological research in Mainland Southeast Asia has also confirmed the coexistence of local Early Metal Age production traditions (Carter 2012) and itinerant craftsmen (Bellina 2007, 2014). As a matter of comparative interest, itinerant craft specializations are well recorded in Southeast Asian and Melanesian ethnography. For instance, the Basai of northern Taiwan exchanged their labor, craft skills (iron smithing), and specialized products for rice, millet, and other subsistence needs. They also served as trading middlemen, as recorded by the Spanish priest Jacinto Esquivel in 1632 (Wong 1995:107, 1999; Borao 2001:166). In China, the Hmong population has been famous for manufacturing silver ornaments since the Qing Dynasty, with both sedentary and itinerant production strategies (Yin 2007). Itinerant strategies have apparently been present in Southeast Asia since about 500 BCE, perhaps before, although it was only around this time that Taiwan nephrite spread beyond its zone of Neolithic distribution in Taiwan, Batanes, and northern Luzon.

The Arrival of Indian Influence in Island Southeast Asia

The previous text has a number of references to artifacts of *putative* Indian origin, such as some of the commonly found monochrome glass, carnelian, or etched agate beads. But there are also a number of sites that have artifacts of *definite* Indian origin (Glover 1990), especially pottery. The so-called Buni cultural complex of looted graves on the western coast of northern Java has produced gold and carnelian beads, with a range of carved-paddle-impressed and incised pottery with a variety of forms, including ring-footed vessels, high-necked flasks, and knobbed lids. But of greatest significance here are three flat-based dishes of highly distinctive imported Indian Rouletted Ware; one each from the sites of Kobak Kendal, Cibutek, and Cibango (Walker and Santoso 1977).

Another location termed Segaran IIA at Batujaya, to the east of Buni, has produced more sherds of imported Rouletted Ware (Manguin and Indradjaja 2011), in this case with extended burials, one with a gold eye cover of a type found also in some of the

Early Metal Age burial sites in Java and Bali (Miksic 1990), as discussed above. Because this rather exciting material has been found in the same part of western Java as the oldest inscriptions in Sanskrit with an Indian script (e.g., the Purnavarman inscription engraved in a Tamil or Pallava Grantha script at Tugu, possibly of fifth century date; Noorduyn and Verstappen 1972), it is apparent that the Buni sites may contain information directly relevant to the initial period of contact between India and Java, presumably between about 100 BCE and the first few centuries CE.

The finding of a single clove at Segaran IIA is also of enormous importance since this spice, together with the nutmeg from Banda, was one of the main attractors for Indian, Islamic, and European contact with Indonesia. Cloves grew originally in small volcanic islands to the west of Halmahera (especially Ternate and Tidore) and are reputed to have been known in Rome according to Pliny's Natural History (70 CE). The site of Mantai in Sri Lanka has clove remains dated to 500–700 CE, but the specimen from Segaran IIA appears to be the oldest example found outside the Moluccan homeland.

The most important sites connected with early Indian contact with Indonesia are those of Sembiran and Pacung, located about 500 m apart on a former marine embayment on the central northern coast of Bali.[18] Here, evidence for early Indian contact from around the BCE/CE boundary has come to light in prolific quantities. Excavations through coastal alluvial sediments down to about 3.5 to 4 m depth (Plate 14a) have yielded many pieces of Rouletted Ware, together with sherds of molded vessels of Arikamedu types 10, 18, and 141 (Wheeler et al. 1946), a black-slipped sherd with a scratched line of Kharoshthi or Brahmi characters, the above-mentioned fragment of a tuff stamp for decorating the wax preform of a Pejeng type drum, and another tuff core for casting the socket of a cuprous tool (Plate 14f–j).

The local pottery at Sembiran and Pacung is of incised and impressed Early Metal Age types (Plate 14b–e), the latter similar to much of the sherdage from Gilimanuk (Figure 9.8a). Some, especially a black-slipped ware, has rice chaff temper. There are also rims with external corrugations almost identical to a series from the sites of Mitangeb and Anaro in the Batanes Islands, here well dated by C14 to between 1 and 600 CE (Bellwood and Dizon 2013: Figure 6.10). Some of the Sembiran and Pacung local pottery also copied Indian shapes (Calo et al. 2015). Several burials have been excavated at Pacung, both jar burials and inhumations in flexed postures, and some of the burial jars had their tops cut off to admit the body, as in many other Indonesian Early Metal Age sites. These two sites have also produced Indian mung beans and rice phytoliths (Doreen Bowdery in Ardika 1991).

Sembiran and the Buni complex bring back the question of the origins and date of the initial Indian contacts with western Indonesia. The Indian-style carnelian and etched agate beads that occur in Mainland Southeast Asian sites such as Ban Don Ta Phet, Khao Sam Kaeo, and Giong Ca Vo can perhaps be dated from the fourth century BCE onwards. The Rouletted Ware (which has so far been found outside India/Sri Lanka only in Indonesia, southern Thailand, and Vietnam) was originally dated to the first and second centuries CE by Wheeler et al. (1946), owing to its association with Roman imports of this period, including coins and Italian Arretine pottery, at the site of Arikamedu in Tamil Nadu. Begley (1986) has since pushed this dating back into the second century BCE.

Rouletted Ware has been recovered from excavations along the whole eastern coast of the subcontinent, from Anuradhapura in Sri Lanka (Deraniyagala 1986) to sites as far north as Sisupalgarh in Orissa (Odisha) and Chandraketugarh in West Bengal. It is in these northerly sites that the very distinctive etched agate beads shown in Plate 11 occur in late first millennium BCE contexts. The sites with Rouletted Ware in south India and Sri Lanka also have utilitarian pottery decorated with carved-paddle-impressed and stamped patterns (Ray 1997; Selvakumar 2011) that do not occur in prehistoric Indian assemblages, but which find suggestive parallels in the paddle-impressed pottery of the Buni complex, Sembiran, and Gilimanuk. It would be premature to suggest a definite link between India and Indonesia from this type of pottery on present evidence, especially given that Solheim (1990) for many years favored a southern Chinese origin for the Southeast Asian paddle-impressed wares as a whole (which are common in Han Dynasty contexts and which belong in his "Bau-Malay" pottery complex). However, I believe that the possibility of a Malayo-Polynesian source for the Indian examples does at this time deserve careful consideration.

One further point about this burgeoning evidence for Indian trading contact with Indonesia around 2000 years ago concerns its impact on those regions beyond the "core" Indianized regions in Sumatra, Java, and Bali. It is worth repeating that the far-flung distribution of Heger 1 drums might have had much to do with the activities of Indian traders, especially via those trade networks that surely extended from Java and Bali into the Moluccas for cloves, nutmeg, and other spices destined for the Mediterranean, India, and China. But, more than this, it has been my observation during many years of fieldwork that Early Metal Age pottery assemblages all over the archipelago are remarkably similar, especially in its eastern regions, whether they be from the Philippines, Borneo, Java, Bali, Talaud, or the Moluccas.

Indeed, the Papuan-speaking peoples of northern Halmahera even appear to have first adopted pottery making at this time, perhaps as a result of increasing trade contacts (Bellwood forthcoming). However, one cannot attribute these similarities to population movement in the way that one can for the commencement of the Neolithic – there is no good evidence for any substantial degree of population migration at this time, beyond the movement of traders, some of whom actually came from India according to recent genetic analysis (Kusuma et al. 2016).

The major movements of the Malayo-Polynesians out of Island Southeast Asia were long over by 2000 years ago, except to Vietnam and Peninsular Malaysia, and of course to Madagascar (as well as across Polynesia far to the east). Madagascar is not a central concern of this book, but it is currently a scene for considerable research by linguists and geneticists, who favor a settlement from Indonesia around 650 CE by speakers of a language related to Ma'anyan of southeastern Kalimantan, one which already carried some Sanskrit loan words (Serva et al. 2012). Genetically, the Malagasy still carry clear signatures of an Indonesian origin (Kusuma et al. 2015), although genomic research interestingly points to a possible Bajau/Bajaw (sea nomad) origin rather than one from amongst the inland agriculturalist speakers of Ma'anyan.

After the Early Metal Age

My *Prehistory of the Indo-Malaysian Archipelago* (Bellwood 2007) contains several chapters and sections of chapters (especially chapters 5, 8, and 9) on the peoples of Island Southeast Asia as they are today, and on the historical events, from the arrival of Indic influence onwards, that have had a major impact upon the patterns of ethnography. Thus, in Chapter 5 therein I discussed the food-producing populations beyond the ranges of Hinduism, Buddhism, and Islam who retained basically Austronesian cultural traditions into ethnographic times. I also presented a comparative reconstruction of early Austronesian society and some aspects of post-Early Metal Age history (Bellwood 2007:152–154). Most of this descriptive material remains valid and is not repeated here.

However, I want to emphasize again, now we are at the end of our archaeological journey, that the living peoples of Island Southeast Asia owe the greater part of their cultural and biological ancestries to events of migration, selection, and admixture that occurred *long before* the first Indians arrived with glass beads around 200 BCE, or the first Moslems in Medieval times, or the Portuguese, or the Dutch. When we look at Borobudur, a magnificent Buddhist monument located near Yogyakarta, we do not see much that is quintessentially "Austronesian" or even specifically Javanese, except perhaps for the terraced and rather non-Indic foundation structure of the monument itself, and perhaps some of the vegetation and the outrigger ships carved on its panels. There are panels that depict scenes from "daily life" (such as pottery making) on the lowest terrace, but everything else is concerned with Indic religion and mythology. Even if the monument was constructed by Javanese labor (working under Indian Brahmin direction?), Borobudur is not really an "Austronesian" monument in the sense that we can use this concept for Gunung Padang in West Java (Figure 9.6), or a Polynesian *marae* such as the 10-stepped pyramid of Mahaiatea in Tahiti (Bellwood 1978:338–339). The magnificent Hindu temples at Prambanan are even less Austronesian in this regard. This does not make them any less wonderful or sublime as artistic and religious creations, but I think the point needs to be made.

Notes

1. Bronze is an alloy of copper and tin.
2. Analysis of the bronze and iron finds with burials in Gua Harimau in Sumatra might provide a different chronology for the arrival of these two metals in Indonesia, but we must wait and see.
3. Bob Blust (in press) has recently made a similar suggestion for the spread of longhouses from Austroasiatic cultures on the Southeast Asian mainland into Borneo.
4. Especially one from Manikliyu in Bali, which also has human face designs and which was found directly adjacent to a lidded sarcophagus of volcanic tuff.
5. http://nga.gov.au/BronzeWeaver/.
6. Annissa Gultom of Museum Sejarah Jakarta informs me that new research is being carried out on these Pasemah monuments by Balai Pelestarian Cagar Budaya Jambi, and that a new publication is expected.

7. https://en.wikipedia.org/wiki/Gunung_Padang_Megalithic_Site.
8. Van Heekeren 1955; 1958:54–58; Soejono 1977, 1995; Sukarto and Atmodjo 1979; Ardika 1987.
9. According to Dikshit (1952), this etching of white designs on carnelian or black agate bead exteriors was done by a liquid application of potash, white lead, and juice from the *kirar* bush (*Capparis aphylla*). The beads were then baked in red hot charcoal.
10. Bellwood 1981, 1988 for Talaud and Sabah; Calo et al. 2015 for Bali.
11. On Malayo-Chamic migration see Blust 1994, 2005; Thurgood 1999; Collins and Sariyan 2006; Milner 2008, and the following text.
12. But we cannot know if this was also the case in the Northern Sa Huynh because the acidic sandy soils of central Vietnam have removed all traces of bone. Hoa Diem and Giong Ca Vo have excellent bone preservation.
13. Bellina et al. 2012; Favereau 2015; Favereau and Bellina 2016.
14. E.g., Bellina 2013, 2014; Hung et al. 2007; Hung et al. 2013; Hung and Chao in press.
15. Direct contact between Taiwan/Philippines and New Zealand after 1250 CE, when New Zealand was first settled by Maoris, is obviously not a likely possibility.
16. Excavated by Budianto Hakim and identified by Yoshiyuki Iizuka and the author.
17. Sofwan Noerwidi, pers. comm.
18. Ardika 1991; Ardika and Bellwood 1991; Ardika et al. 1997; Calo et al. 2015.

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Chapter 10
Island Southeast Asian Prehistory: A Comparative Perspective

We have examined hominin and human affairs through about 1.5 million years of time, paying attention to the three successive species who have appeared in the record – *Homo erectus*, *Homo floresiensis*, and *Homo sapiens*. Knowledge of these species and of human evolution in general has increased greatly since the last revision of my *Prehistory of the Indo-Malaysian Archipelago* in 1997, just before the Flores hominins were discovered and when Middle Pleistocene stone tools were still a tenuous concept. Our knowledge of modern human migration into Island Southeast Asia has also increased with a torrent of genomic information, both on the relationships of modern populations and on ancestral admixtures with remote hominins such as Neanderthals and Denisovans.

The archaeological record has perhaps blossomed less spectacularly, but many new scientific techniques that work on discoveries made in the archaeological record have appeared and/or improved. Advances have occurred in excavation precision and sedimentary analysis, chronometric dating, zooarchaeology, archaeobotany, craniometrics, ancient DNA analysis, geographical sourcing of artifact raw materials, and dietary analysis through stable isotopes in bone. Linguists have utilized computational analysis to assist their comparative methods, and all of us, in all disciplines, now have access to an enormous body of easily accessible online data. Even the versions of Adobe Illustrator used for the illustrations in this book have improved out of hand – back in 1995 such technology was still obscure to all except a few initiated. With all this new knowledge at hand, what can we conclude?

Let me first recap on some of the major developments that occurred during the long prehistoric record of Island Southeast Asia. Exact arrival times for the various hominins whose remains have been found in the region are still hazy, even for modern humans, but perhaps we can all agree that Java was reached by Sunda land bridges before 1.2 mya, Flores across Wallacean sea gaps before 1 mya, Sulawesi by at least 100 kya, and Luzon by at least 65 kya. Modern humans reached Australia and New Guinea by 50 kya, but exactly when they first arrived in Sundaland is not quite so clear because of the lack of an obvious signature for modern versus archaic hominins in the stone tool record.

First Islanders: Prehistory and Human Migration in Island Southeast Asia, First Edition. Peter Bellwood.

Flores, however, perhaps scoops the pool in terms of excitement. Here we have evidence for an ocean crossing before 1 million years ago, followed by potential isolation from other hominins until the arrival of *Homo sapiens*. I say "potential" since stegodons did reach Flores at least once after 1 mya and the hominin fossil record from that island is not really strong enough to rule out later arrivals completely. But the potential implications for a 1 million year trajectory of isolated hominin evolution are striking, nevertheless.

Moving on from the first arrivals, one way to assess the developing "character" of Island Southeast Asian prehistory is to compare the trajectory described in the previous chapters with chronologically parallel trajectories in adjacent regions such as China, Mainland Southeast Asia, New Guinea / Melanesia, and Australia. For the archaic hominins, only China so far has comparative fossil material. Perhaps the most meaningful comparative statement that we can make here is that the Indonesian and Chinese hominins appear to have carried greater degrees of contemporary species separation and endemicity than do modern humans in the same regions. In other words, more than one archaic species existed at any one time, at least to as far east as Flores.

If this impression is not merely a reflection of chronological insecurity and small sample size, then the reasons for the archaic species diversity are probably the high degrees of regional isolation that obtained between them. Conversely, we see a greater extent and frequency of homogenizing migration during the prehistory of *Homo sapiens*, especially following their initial Late Pleistocene migration right through the region to reach New Guinea and Australia, and again later with Austronesian migration during the Neolithic.

Because the first modern humans had no clear impact on the course of lithic technology in Island Southeast Asia, in my view because of the lack of cold climate selection for Upper Paleolithic tool kits in the prevailing tropical conditions, we must seek their archaeological presence in other ways. Hence, we have an increasing focus by archaeologists on cave art, body ornaments, and maritime fishing and boating skills, some of which can be traced back towards 50 kya. Of course, humans could never have reached Australia without seacraft of some kind, even if they only used simple rafts. Given the achievement of *Homo floresiensis* in getting to Flores we can hardly claim *Homo sapiens* as the first hominin ever to cross sea, but they were certainly the first to cross wide expanses of sea, 100 km or more to formerly hominin-free places such as the Talaud Islands, the Admiralty Islands, and the Sahul continent itself.

Once modern humans were established through Island Southeast Asia we begin to see signs of regional differentiation, although not until after the LGM in terms of current evidence. By around 15 kya we find a developing focus on pebble and core tools (Hoabinhian) on the mainland and in Sumatra, as opposed to a contemporary focus on flake tools in the remaining islands. I strongly suspect that differences in available raw materials lay in part behind this apparent separation. However, this is the first time in the prehistoric record that we see such an archaeological distinction between the mainland and the islands. It is also worth comment that Island Southeast Asia during the late Paleolithic had closer lithic and technological links with New Guinea and Australia than with the Asian mainland.

During the early Holocene, after 11.7 kya, early Neolithic food-producing cultures developed in central China and slowly began to spread southward, reaching the southern provinces of China around 5 kya. At the same time, the indigenous Para-Neolithic cultures of the region from Guangxi down to Peninsula Malaysia developed from their Hoabinhian forebears by adopting pottery production and Neolithic polished stone technology. Pottery and polished stone were not new in themselves, since occasional occurrences of both go back in time much earlier in eastern Asia. But the Para-Neolithic of southern China and Mainland Southeast Asia reveals a kind of "intensification" in terms of large shell middens and cemeteries. Whether there was some adoption of food production at this time is still unclear. By 2500 BCE, however, these Para-Neolithic populations were undergoing a gradual genetic amalgamation with incoming populations of Asian Neolithic farmers. Today, they survive most strongly from a biological perspective amongst the Austroasiatic-speaking (Aslian) populations of the Thai-Malaysian Peninsula.

The early Holocene (late Paleolithic) archaeology of Island Southeast Asia reveals some very significant differences with that of the Para-Neolithic and continuing Hoabinhian of Mainland Southeast Asia, not least in terms of its high degree of regional variation. Despite the existence of a widespread background lithic industry of pebble and flake tools, there exist some highly distinctive island artifact expressions that are quite unparalleled on the Southeast Asian mainland. These include the backed-tool and microlithic Toalian of South Sulawesi, the Tingkayu biface industry of Sabah, the ground shell adzes of the Philippines and Moluccas, and the intriguing shell beads and fish-hooks of Timor-Leste and adjacent islands. In Island Southeast Asia there is no coherent sign so far of any Para-Neolithic combined polished axe and pottery production, except for occurrences of edge-ground stone axes alone at Niah and on Palawan.

Because of this high level of early to middle Holocene regional specialization I am inclined to suggest that claims for high levels of interaction in Island Southeast Asia prior to the Neolithic and Early Metal Ages are likely to be misguided. Toalian microliths only existed within Indonesia in South Sulawesi, except for the remarkable occurrences in Australia, which I would explain by a single late hunter-gatherer contact, with dingoes, from Sulawesi at around 4000–3500 years ago (Bellwood 2013). Pre-Neolithic bifaces have been found so far only in Sabah, shell fish-hooks and beads only in Timor and adjacent islands. Shell adzes may have been more widespread, extending into the Admiralty Islands north of New Guinea, but still appear to cling to the eastern rim of Island Southeast Asia. These regionalisms can hardly reflect a simple lack of research since dozens of rock shelters have been excavated into late Pleistocene levels all over Island Southeast Asia.

When we move into the Neolithic and later periods, the distinctive character of Island as opposed to Mainland Southeast Asian life is emphasized further, but in different ways. Neolithic cultures, and the languages and societies associated with them, imposed considerable levels of homogeneity over large areas of both the mainland and islands of Southeast Asia at the start of the Neolithic. However, these patterns of relative homogeneity were not a total unity since they began with rather different cultural expressions in Mainland and Island Southeast Asia, befitting origins in different regions.

Hence, for Island Southeast Asia we witness a dominant migration route from southern China through Taiwan and the Philippines into Borneo, Sulawesi, and the remaining regions of Indonesia. As this migration approached New Guinea it slowed markedly, except for those ancestral communities who were able to reach the islands of western Micronesia and Island Melanesia. Conversely, for Mainland Southeast Asia we witness different cultural assemblages, moving also from southern China, but this time from a more southern rather than an eastern focus of origin. These separate migrations led eventually to the formations of the Austronesian, Tai, and Austroasiatic language families of the present day.

One of the fundamental concepts used in this book is that of the farming/language dispersal hypothesis, a term coined originally by my colleague Colin Renfrew (Bellwood and Renfrew 2002). Established food-producing populations with transportable economies had advantages over lower-level economies, even if the latter sometimes had elements of food production. These advantages allowed them to expand in population numbers and territorial extent, in the cases of language families such as Austronesian (or Indo-European) eventually reaching vast areas of the earth's surface (Bellwood 2005, 2013). In the case of Island Southeast Asia this Neolithic population movement, attested through craniometrics and genetics as well as the archaeological record, led to the concurrent spread of the Austronesian language family, the greatest in extent anywhere in the world before 1500 CE.

However, it is perhaps necessary to quell any excessive enthusiam for vast Austronesian migrations on the scale of the many outpourings of colonists, refugees, and enslaved peoples during the recent centuries of the colonial era. Although the Malayo-Polynesian migration, between 4000 and 3500 years ago, out of Taiwan and through the Philippines is in my view an unassailable concept, we should certainly ask how large might have been the initial colonizing populations themselves. In this regard, it is quite obvious that Malayo-Polynesians have undergone very large degrees of admixture with surrounding Austroasiatic, Tai, and Papuan populations. Indeed, as far as Melanesia is concerned they might be said to have been absorbed into a predominantly Papuan genetic pool.

This kind of situation clearly rules out huge population imbalances always favoring immigrants as opposed to indigenous people. However, increasing birth rates following migrations could be a different matter altogether. While some Austronesian colonizing propagules might have been very small in initial numbers, others surely flourished with high birth rates in new and fertile regions that were previously either uninhabited or only lightly inhabited. We can read this comparatively from the expansive Neolithic archaeological settlement records in countries such as China, Taiwan, and Vietnam.

As well as birth rates, I should emphasize also that a relative ranking of the productive and demographic capacities of different subsistence economies should be taken into account in discussions about the genesis of admixed populations, such as Austronesians and Malayo-Polynesians, in prehistory. For instance, early speakers of Austronesian languages in Taiwan with domesticated rice, millet, and pigs would have had group-size advantages over indigenous late Paleolithic hunter-gatherers in Island Southeast Asia, even if the latter already had some investment in tuber and fruit production, albeit with no domestic animals and no cereals. In this regard, debates about how early Holocene and pre-Neolithic people in Borneo or Sulawesi promoted and harvested their yams and sago could be a little tangential to the real demographic issues that lie behind large-scale population history.

In the aftermath of Neolithic migration, by 1000 BCE, increasing numbers of major differences were visible between Island Southeast Asian peoples and societies and their external neighbors. China and much of Mainland Southeast Asia had by this time entered their Bronze Ages, attaining statehood in the case of central China. Island Southeast Asia was still Neolithic, with an independent focus to the east of early food-producing activity without Neolithic technology (apart from polished axes) in the New Guinea Highlands. Neolithic Mainland and Island Southeast Asia, however, were by this time reflecting some rather intriguing forms of differentiation.

Because of my recent research with colleagues on the southern Vietnam Neolithic, I have often been struck by how different were the mainland and island portions of Southeast Asia in their Neolithic and post-Neolithic human prehistories. The mainland today forms a single landmass with very large rivers, extensive deltas, and correspondingly broad and fertile valleys and intermontane plateaux. Deltas such as those of the Mekong and the Red were large shallow bays during early Holocene high sea level conditions until about 5000 years ago. However, the agricultural societies which spread over the region after 5000 years ago were developing in spreading alluvial landscapes that were constantly increasing in extent as forest clearance, sediment release, and mid-Holocene sea level stability (and minor regression) became established.

It is true that these processes also affected the islands of Southeast Asia, such that broad coastal plains eventually developed along the northern coastlines of Sumatra, Java, and Bali. But the Island Southeast Asian rivers themselves (apart from the Kapuas and Mahakam in Borneo) were much smaller than those on the mainland, shortened by the Holocene drowning of the continental shelves and island margins. The islands of Wallacea also had very narrow offshore shelves and only restricted areas of coastal plain.

These geographical (lowland, riverine, and coastal) differences between Mainland and Island Southeast Asia had a great impact on Neolithic societies, continuing well into historical times. Separated by extensive uplands, the large alluvial basins of Mainland Southeast Asia by Early Historical times supported many quite different and linguistically unrelated state-level wet-rice-growing populations (Bellwood 2015: Figure 3.3). Burmese and other Tibeto-Burman speakers occupied the Irrawaddy Valley, Tibeto-Burman Karen and Shan (Tai-speakers) occupied the Salween, Tai and Lao occupied the middle Mekong and Chao Phraya valleys together with the fertile Khorat Plateau formed by the Mun and Chi rivers, Austroasiatic Khmers occupied the lower Mekong and Tonle Sap, and Austroasiatic Vietnamese occupied the Red River and ultimately (after the fifteenth century) the Mekong delta.

The Malay and Cham (Malayo-Polynesian) arrivals during the Early Metal Age from Island Southeast Asia were partly excluded from this valley-bottom lifestyle by the prior occupants, being obliged to settle the less fertile and more rugged regions of the

Malay Peninsula and central Vietnam. Smaller societies without state organization occupied the intervening terrain, including Hmong and Mien immigrants of Yangzi origin who were obliged to settle the northern uplands with shifting dry farming, high above the densely populated and wet-rice-growing river valleys below.

If we compare this Mainland situation with that in Island Southeast Asia during the same historical time period, there are major differences. In the islands west of Timor and the Moluccas only one language group existed, Malayo-Polynesian within the Austronesian language family. The development of Indic state-level societies after 650 CE was rather heavily concentrated in Sumatra, Java, Bali, and to a lesser extent coastal Borneo, with no dominant focus on river courses for the reason that large rivers on the mainland scale simply did not exist. Around 1000–1450 CE, when a large number of ethnolinguistically discrete state-level societies existed on the mainland, we find only one powerful Hindu kingdom in the islands, that of Majapahit, centered in eastern Java. Smaller Hindu kingdoms existed in Bali, Sumatra and Nusa Tenggara, but elsewhere in Island Southeast Asia at this time, prior to the widespread appearance of Islam, the anthropological landscape consisted of small tribes and chiefdoms with considerable linguistic diversity and only small-scale developments of political centrality (Geertz 1963).

These mainland/island differences continue back into later prehistory. Thai and Vietnamese Neolithic villages are remarkable in their high degrees of nucleation, stratigraphic depth, and constructional detail. In southern Vietnam we have excellent examples of this at sites such as An Son, Rach Nui, and Loc Giang in Long An Province (Bellwood et al. 2011; Oxenham et al. 2015; Piper et al. submitted), where people constructed compacted and often lime-rich house floors, kept them clean by sweeping and dumping garbage, and undertook heavy-duty cooking around the edges of their rapidly growing tell-like settlement mounds. These mounds can rise 5 m above the alluvial landscapes in which they are situated and are often over a hectare in size.

In the islands, however, we find no nucleated and mounded villages like those in Vietnam or Thailand anywhere in the Neolithic or Early Metal Age archaeological record. This might just reflect deep burial, but I suspect also that the absence of broad river basins, deltas, and coastal plains on a par with those on the mainland inhibited the development of permanent-field wet rice agriculture and associated settlement stability. The broad Cagayan Valley of northern Luzon with its very large shell mounds and evidence for Neolithic rice may have been an exception, but the general rarity of permanent field agriculture would have rendered hillside shifting cultivation (swidden) as the most successful economic trajectory elsewhere, with nucleation perhaps only required in situations that needed some form of defence. We see a similar lack of tight and permanent settlement nucleation in the ethnographic records from the Pacific Islands, where cereals were not grown at all, even though quite large settlements developed in association with swamp cultivation in the New Guinea Highlands.

These differences between the mainland and the islands during the past 3500 years are striking. As far as Island Southeast Asia is concerned, they reflect the existence of a type of society with relatively high mobility and low levels of settlement sedentism and nucleation, exactly as we see amongst descendant societies in Oceania, especially Polynesia. Before the Early Historical period, such societies in Island Southeast Asia probably reached a chiefdom level of complexity in certain circumstances, but not statehood. This arrived with Indic cosmologies and the rise of the historical kingdoms after 700 CE, and it was probably at this time also that a greater reliance on irrigated wet rice developed in islands such as Luzon, Java, and Bali. Elsewhere in Island Southeast Asia, and especially in Wallacea, the prevailing landscape of shifting agriculture and settlement mobility favored an early decline in rice cultivation as populations spread eastward towards New Guinea, Melanesia, and Polynesia.

As a final point, I remain convinced that it was no coincidence that the greatly dispersed islands of Oceania were eventually settled, beyond the Solomons, entirely by Austronesian-speaking populations and not by sedentary wet-rice-growing Chinese, Vietnamese, Khmer, or Tai. I suspect that only the Malayo-Polynesians ultimately developed the maritime skills and portable economies that allowed such an achievement, as well as a willingness to adapt their ancestral subsistence economy to some quite major environmental gradations, especially that involved in moving from warm temperate through tropical to totally equatorial climatic conditions.

I finished the last chapter of *Prehistory of the Indo-Malaysian Archipelago* by asking what future existed for research in the region. There seems little point in listing yet again all the new sources of data that one can draw upon, including ancient DNA, currently being recovered from human remains in Sumatra and the northern Moluccas. Better to emphasize the importance of careful multidisciplinary research, in which attention to scientific detail does not deny the value of a broad knowledge-based comparative perspective. We need both perspectives, the micro and the macro if one wishes, or more contentiously perhaps the inductive (bottom-up data collecting) and the deductive (top-down hypothesis testing). I wish all my colleagues well in their searches for the truth about the past, or at least a convincing version of it.

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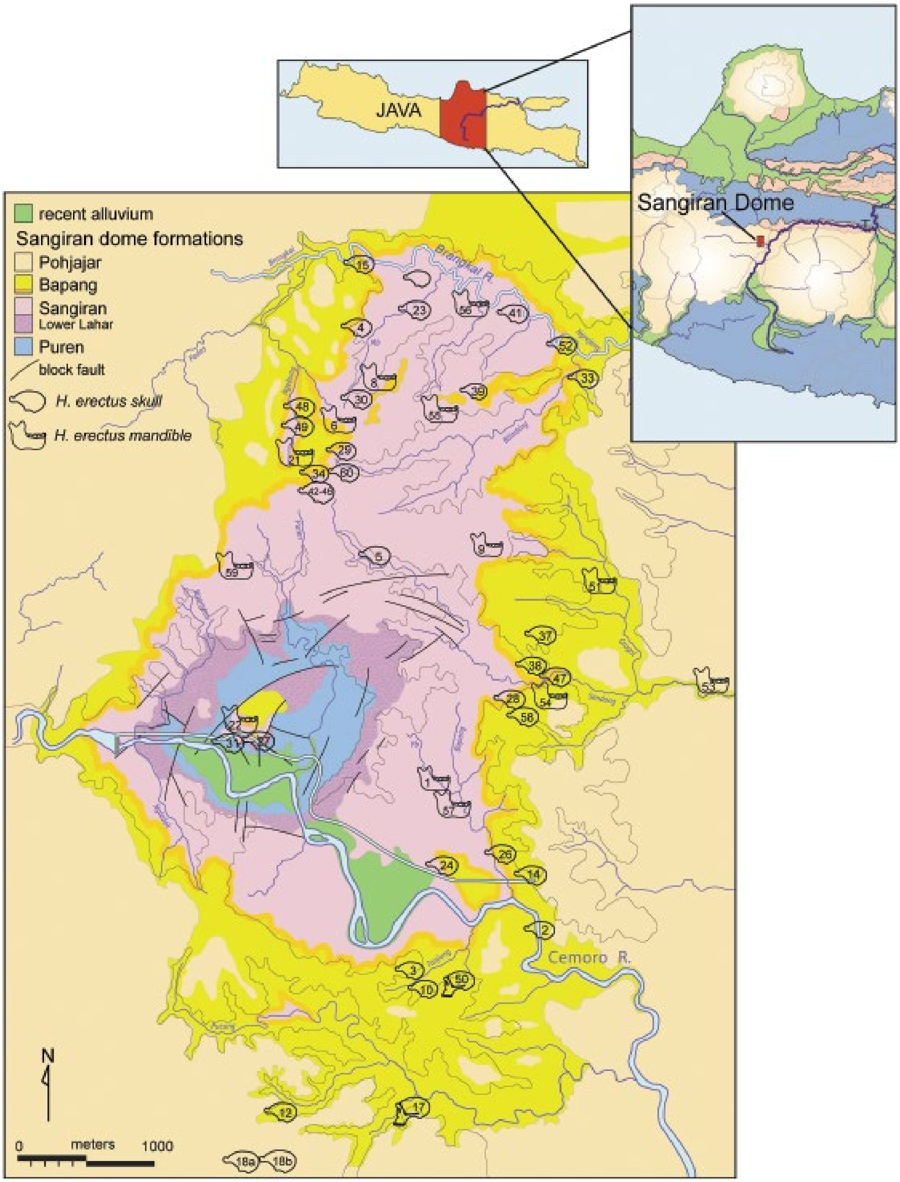

Plate 1 Geological formations exposed by erosion within the Sangiran Dome, with hominin find places indicated by crania or mandibles and numbered according to their order of discovery. Source: Bettis et al. (2009: Figure 1). Courtesy of E.A. Bettis III and *Journal of Human Evolution*. Reproduced with permission of Elsevier.

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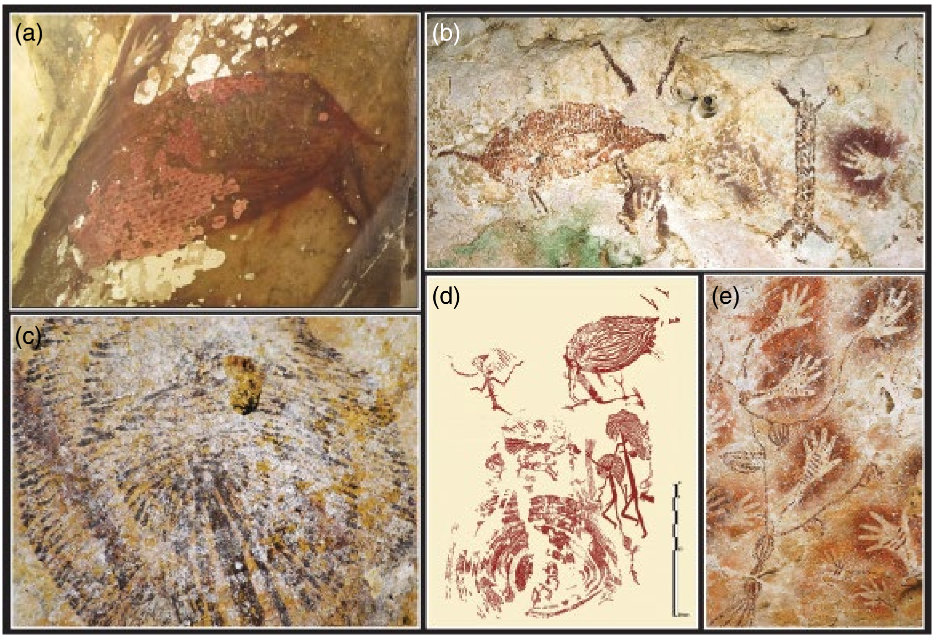


Plate 2 Red ochre rock art of presumed Pleistocene or early Holocene age from Sulawesi and Kalimantan. (a) a suid (babirusa or *Sus celebensis*) in red ochre with head obscured, drawn/ painted over an older hand stencil which can be seen faintly behind. The calcite skin covering the suid can be seen clearly. From Leang Pettakere in the Maros District of South Sulawesi. (b) a horned animal or insect with a lizard-like creature and a decorated hand stencil, Gua Harto, Sangkulirang, East Kalimantan. (c) close-up of a remarkable halo of "big hair" on a human figure, Sangkulirang, East Kalimantan. (d) anthropomorphic scene with deer in Gua Tamrin, Sangkulirang, East Kalimantan. (e) decorated hand stencils linked by a tree-like motif, Gua Tewet, Sangkulirang, East Kalimantan. Sources: A, photo by Anggraeni; (b)– (e), courtesy of Luc-Henri Fage (Fage and Chazine 2010).

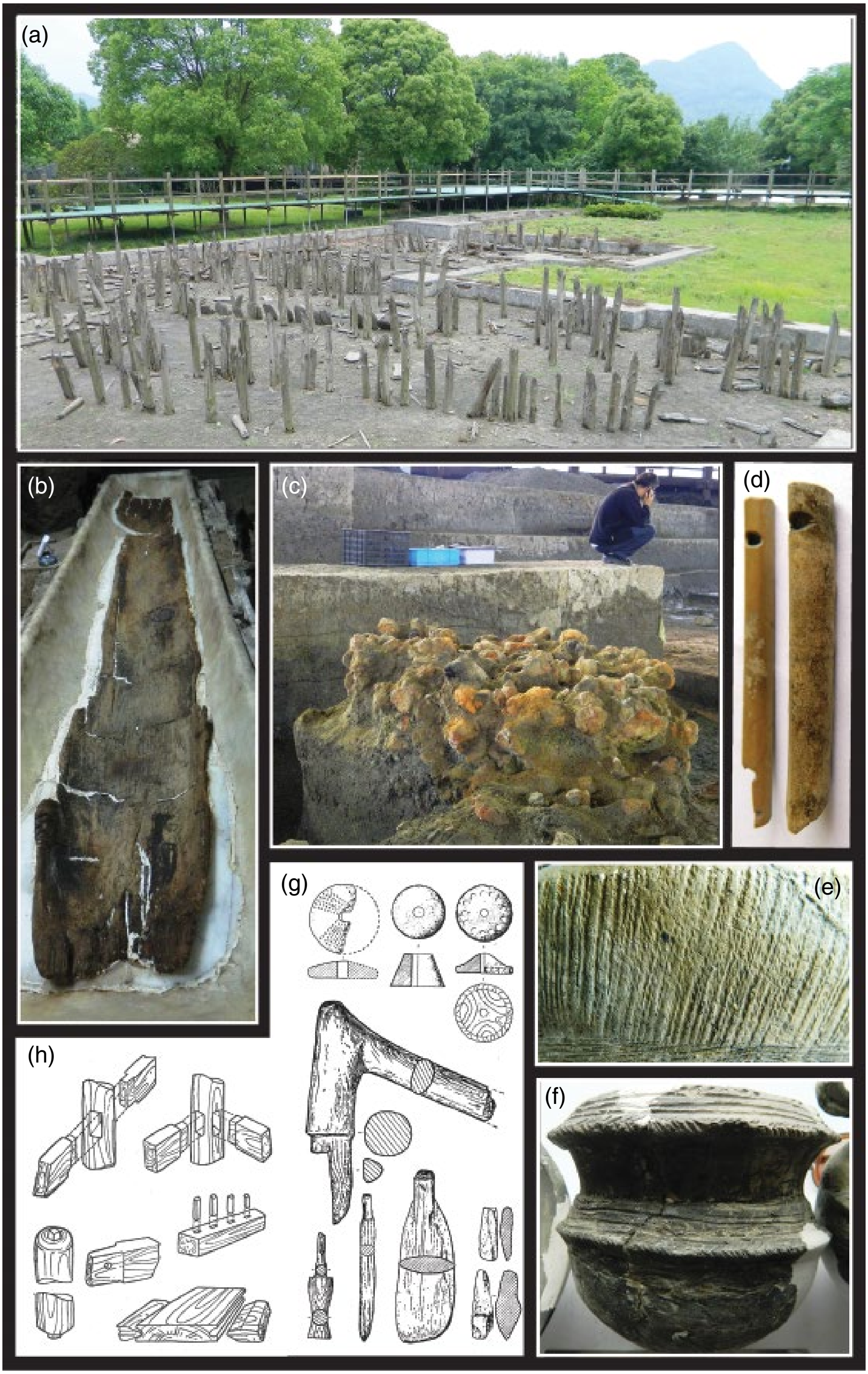


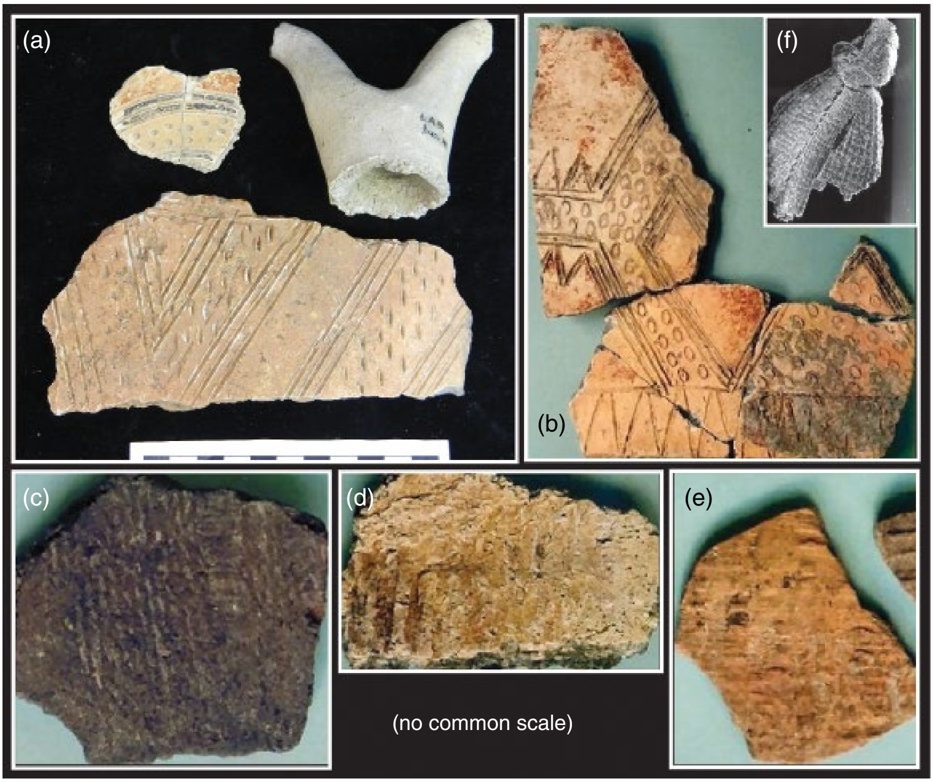
Plate 3 Aspects of early Neolithic life in the lower Yangzi region of southern China, c. 6000–4500 BCE. (a) rows of timber piles for longhouses at Hemudu. (b) excavated log canoe base, Kuahuqiao. (c) massive earth oven of fired clay balls at Tianluoshan. (d) bird bone flutes from Tianluoshan. (e) detail of cord-marking on a pot surface, Tianluoshan. (f) an incised and carinated cooking pot, Tianluoshan. (g) baked clay spindle whorls from Hemudu. (h) a variety of carpentry techniques and wooden objects (and two stone adzes, one stepped) from Hemudu. Source: all photos by the author; (g) and (h) from Chekiang (1978). These items are in the site museums at Hemudu, Kuahuqiao, and Tianluoshan, and there is no common scale.

Plate 4 Early Neolithic life c. 2800–2200 BCE at Nanguanli and Nanguanlidong, Tainan, Taiwan. (a), (b) cord-marked globular pots with incised decoration on rims and upper bodies, orifices 9–10 cm diameter. (c) incised rim with red-painted vertical bands. (d) double side-notched pebble net sinker c. 6 cm long. (e) *Placuna placenta* shouldered blade 7 cm across at shoulder. (f) handle of grooved stone bark cloth beater. (g) stone *patu*-shaped blade 11.5 cm long, a shouldered axe, and a slate perforated point. (h) dog burial. (i) cylindrical and 5 cm diameter biconical baked clay spindle whorls. Source: photos by the author, courtesy of National Museum of Prehistory, Taitung.

Plate 5 The late Neolithic settlement at Beinan, c. 1500–1000 BCE. (a) a row of stone house platforms, a parallel row of small and higher-walled storehouses, and slate slab-graves between the houses. (b) detail of river pebble and slate paving. (c) slab grave with nephrite contents including points and earrings (the bones have dissolved). These photos are from the original excavations in the 1980s. (d) overturned slate "ladder" that once presumably led up to a house on the stone platform behind, exposed in current excavation. (e) typical handled Beinan pot in red plain ware, mouth diameter 7.5 cm. Sources: (a)– (c), photos courtesy of Lien Chao-mei; (d) and (e), photos by the author; (e), courtesy of National Museum of Prehistory, Taitung.

Plate 6 (a–i) various motifs in punctate- and circle-stamped red-slipped and lime infilled pottery from Magapit, Cagayan Valley, c. 1500 BCE. (h) and (i) are the same pedestaled open bowl, shown upside-down on the right to reveal the decoration more clearly. (j) is part of a pedestal with cut-out decoration. (k) is a shell hook-like ornament 6.5 cm long from Anaro (c. 1200 BCE), and (l) is a similar broken example of volcanic rock 4 cm long from Magapit (c. 1500–1000 BCE). Source: photos courtesy of Kazuhiko Tanaka.

Plate 7 Punctate/dentate- and circle-stamped red-slipped pottery compared. 1: Nagsabaran, Cagayan Valley. 2: Achugao, Saipan, Mariana Islands. 3: Site 13, Lapita, New Caledonia. Source: reprinted from Hung et al. (2011: Figure 3), courtesy of Cambridge University Press.



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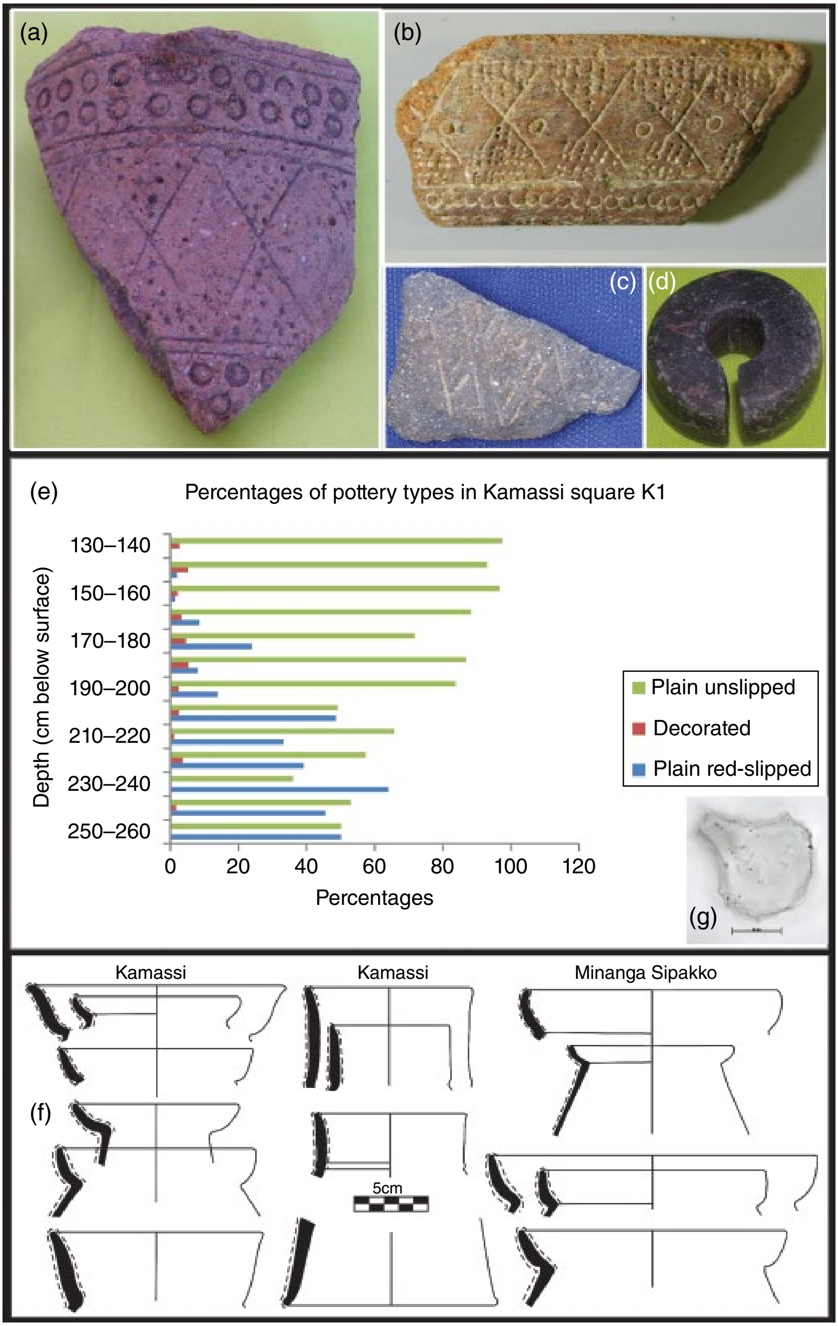

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Plate 10 The central Sulawesi complex of stone statues and burial jars. (a), (b) "Palindo," a male stone statue about 4 m high, and "Langke Bulawa," a smaller female statue with a string of large circular beads around its forehead, both in the Bada Valley (Kaudern 1938: Figure 55 gives a clear sketch showing the beads and genitalia). (c) a pottery "stopper" reputed to be from Kalumpang. (d) small statue at Tamadua, Poso. (e)–(g) stone burial jars and lids in the Besoa Valley, the lid in (f) with quadrupeds in relief. Jar (g) has eight faces like those on Palindo and Langke Bulawa, drawn clearly by Kaudern (1938: Figure 33). Sources: (a), photo courtesy of Truman Simanjuntak; (b) and (e)–(g), photo courtesy of Margaret Reid; (c) and (d), photo by the author.

Plate 11 Artifacts from the jar burial site of Leang Buidane, Salebabu Island, Talaud Islands. (a) Indian etched agate bead from Leang Buidane. (b) identical Indian etched agate bead from Hoa Diem, Vietnam (first to second century CE). (c) spherical carnelian bead. (d) faceted carnelian bead (note the very regular hole, drilled with a metal drill). (e) bronze bell. (f) three baked clay casting mold valves. (g) socketed copper axe. (h) two coral stoppers, presumably for a tall-necked flask (fragments of several were found in the site). (i) and (j) details of gouged, incised, punctate-impressed (i), and herringbone paddle-impressed (j) decoration on small carinated pots (not to scale). Source: photos by the author.

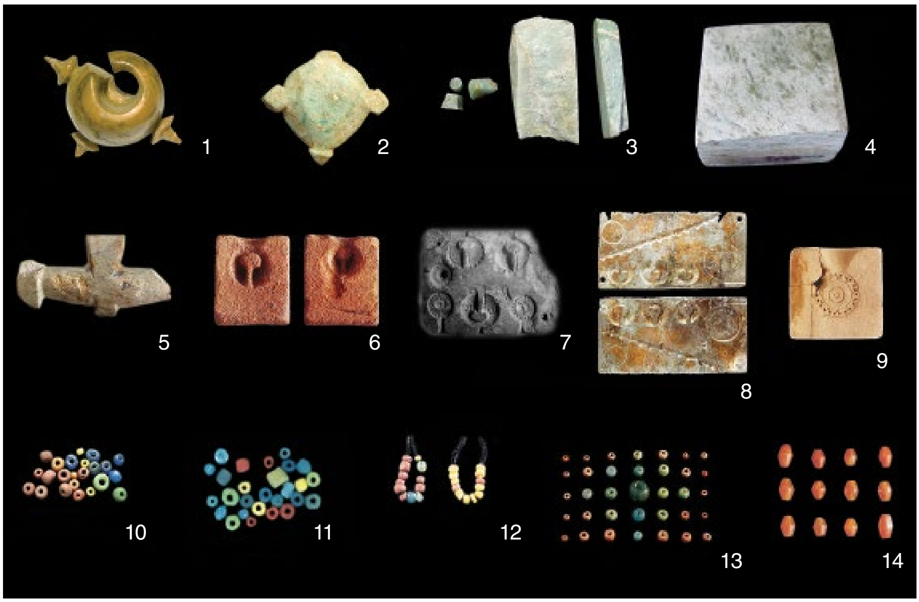

Plate 12 Major categories of artifacts or related manufacturing tools/skills distributed across the South China Sea after 500 BCE (from Hung et al. 2013: Figure 3). 1: typical three-pointed *lingling-o* of Taiwan nephrite from Go Ma Voi, central Vietnam. 2: unfinished three-pointed *lingling-o* of (possible) Philippine mica from Khao Sam Kaeo, southern Thailand. 3: worked Philippine mica from Khao Sam Kaeo. 4: square blank of Taiwan nephrite from Giong Ca Vo, southern Vietnam. 5: unfinished double animal-headed ear pendant of Taiwan nephrite from Khao Sam Kaeo. 6 and 9: stone casting molds from Jiuxianglan, eastern Taiwan (Li 2005:177). 7: stone casting mold from Chansen, Thailand (Indrawooth 2004:133), similar to those found in eastern Taiwan. 8: stone casting molds from My Lam, southern Vietnam. 10: monochrome glass beads from Tres Reyes, Marinduque, Philippines. 11: monochrome glass beads from Nagsabaran, Cagayan Valley, Philippines. 12: monochrome glass beads from Guishan, southern Taiwan (Li 2001: Plate 17). 13: monochrome glass beads from Jiuxianglan, eastern Taiwan. 14: faceted carnelian stone beads from Jiuxianglan, eastern Taiwan. Source: reproduced with permission of Taylor & Francis.

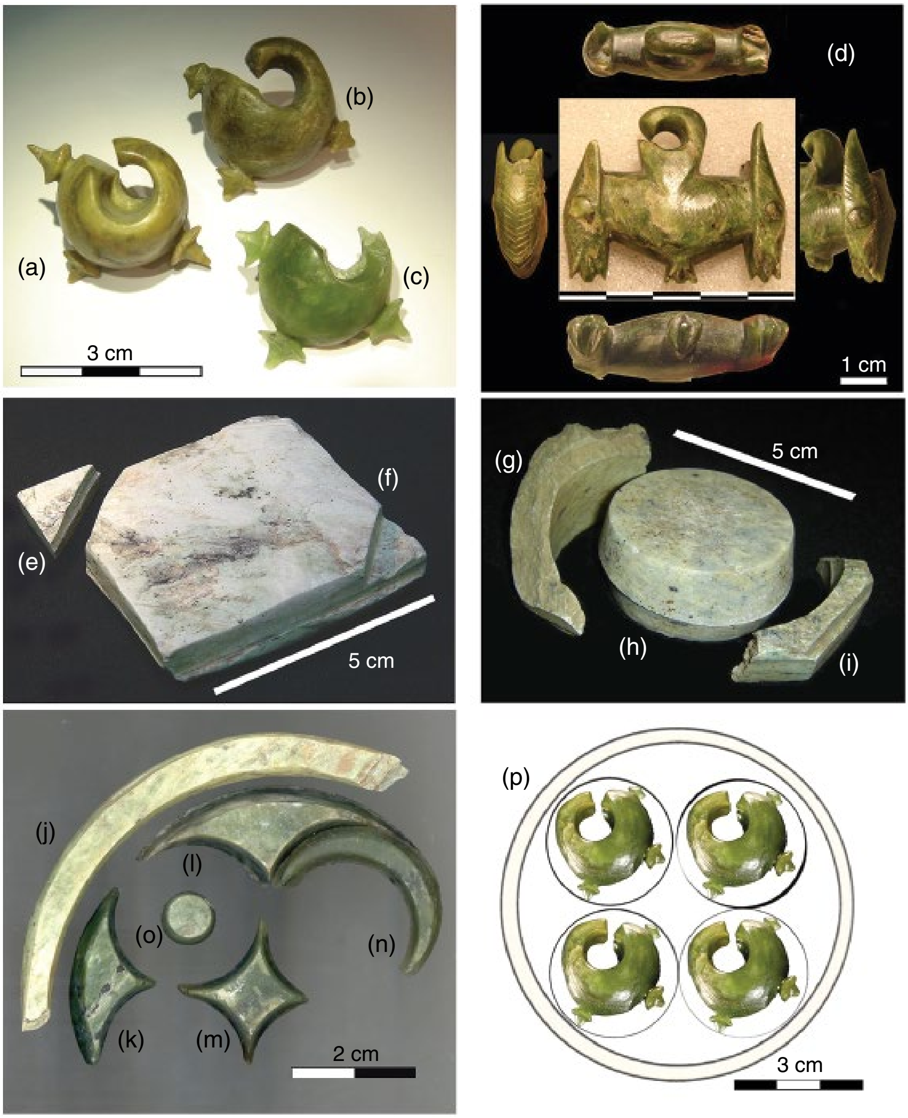

Plate 13 Early Metal Age green nephrite jade ornaments and manufacturing debitage (from Hung et al. 2007: Figure 1). (a)–(c) nephrite *lingling-o* penannular earrings with three pointed circumferential projections ((a), Go Ma Voi, central Vietnam. (b), Uyaw Cave, Tabon Complex, Palawan. (c), Duyong Cave, Tabon Complex). (d) double-headed animal nephrite ear pendant from the Philippines. (e)–(o) suggested manufacturing sequence for *lingling-o* ear pendants, as reconstructed from discarded raw material recovered at Pinglin, eastern Taiwan, and Anaro, Itbayat Island, northern Philippines (Bellwood and Dizon 2013: these pieces do not come from a single manufacturing event). Items (k)–(o) all come from Anaro and we infer that large discs resulting from bracelet manufacture were taken there from Taiwan, each to become a blank for four *lingling-o*s drilled in quadripartite fashion (p). Source: reproduced courtesy of National Academy of Sciences, USA.

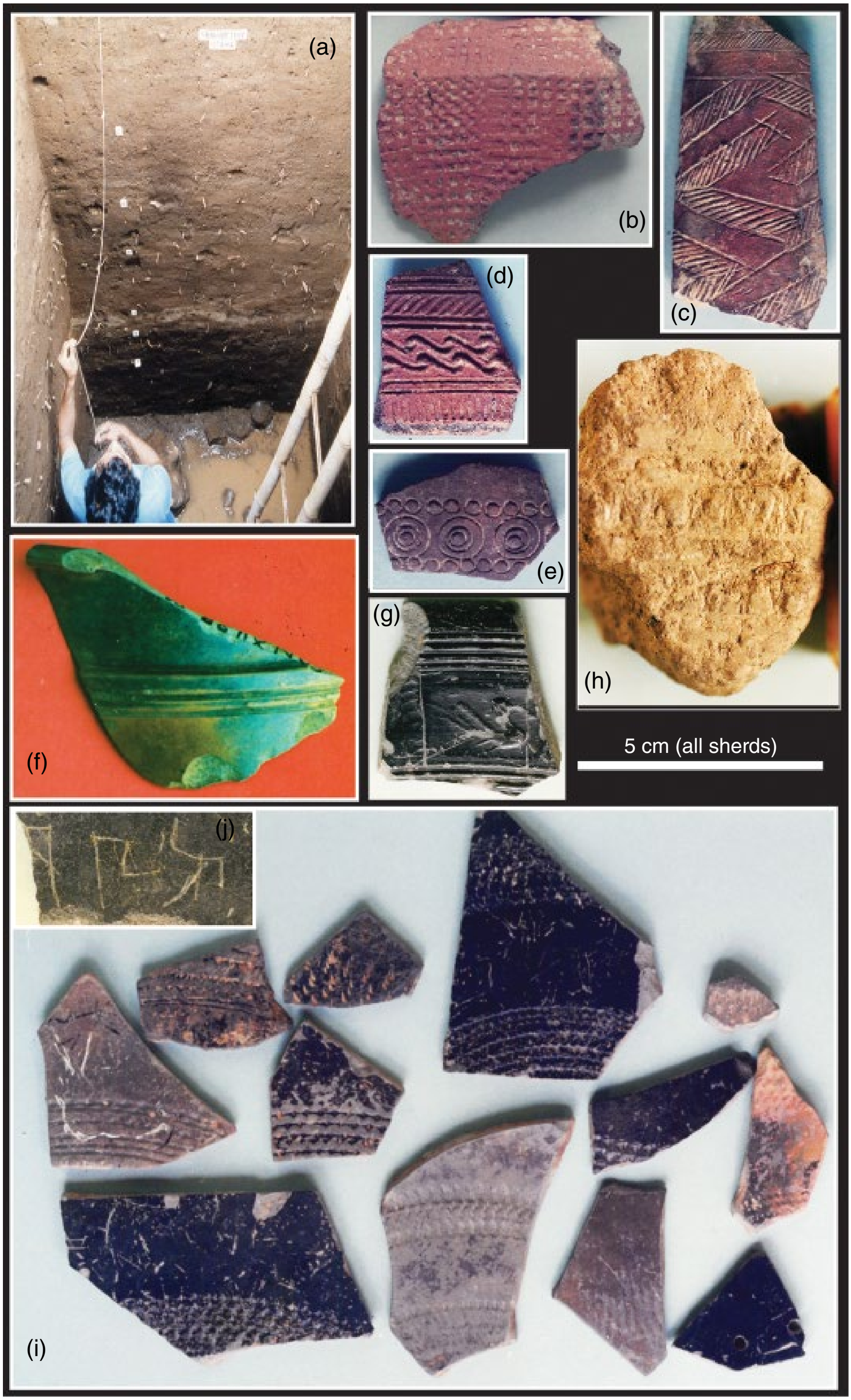

Plate 14 Sembiran, north Bali: Indian and locally made pottery. (a) Sembiran excavation by I Wayan Ardika in 1987: the layer with the Indian pottery is at the base of the square below the faint line of white volcanic ash. (b)–(e) locally made Early Metal Age pottery, with check-stamped (b), incised (c, d), and circle-stamped (e) decoration. (f) sherd of Arikamedu type 18 (Wheeler). (g) stamped sherd of Arikamedu type 10, reputedly influenced by first century CE Roman Arretine ware. (h) baked casting mold fragment, perhaps for a bronze drum, with a row of triangles, as on the Pejeng drum (Figure 9.4). (i) Indian internally rouletted bowl sherds (Arikamedu type 1, classic "Rouletted Ware"), with (j) a three-character graffito in Brahmi or Kharoshthi on a black-slipped sherd. Source: photos by the author.

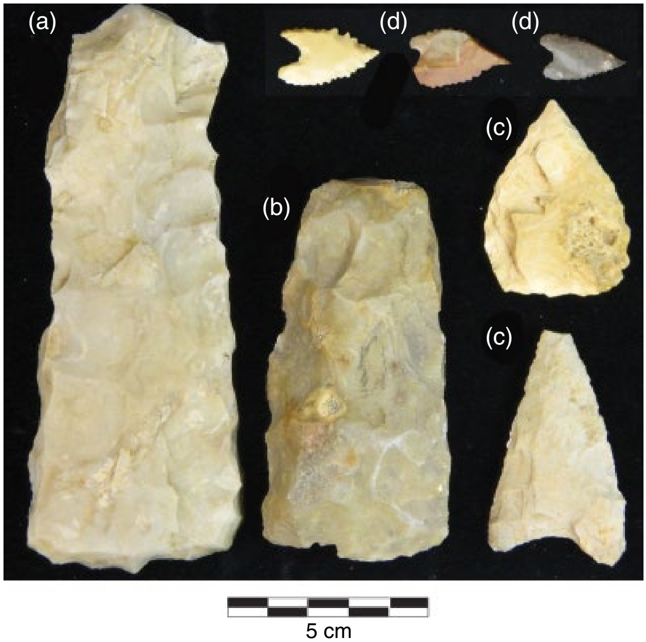

Plate 15 Neolithic flaked stone tools from Java and South Sulawesi. (a, b) quadrangular adze rough-outs on siliceous limestone, Punung, south Java (A from Bomo-Teleng workshop; B from Punung region). (c) points (flat and hollow-based) of siliceous limestone from the Punung region. (d) serrated and hollow-based Maros points from Leang Burung 1, South Sulawesi. Source: collections of the School of Archaeology and Anthropology, ANU (see Mulvaney and Soejono 1970, 1971).

Plate 16 View of part of the terraced complex of prismatic basalt enclosures at Gunung Padang, south of Cianjur, West Java. The monument is undated and is currently the scene of considerable debate. Source: photo by Vida Kusmartono.

Plate 17 Top: modern rice terraces (*sawah*) near Ceking, Bali, just planted with rice shoots (2015). Terraced rice fields before harvest, near Ende, Flores (2015). Source: photos by the author.