

# Peopling of the Pacific: A Holistic Anthropological Perspective

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## Abstract

The human colonization of the Pacific is an enduring problem in historical anthropology. Recent advances in archaeology, historical linguistics, and bioanthropology have coalesced to form a set of models for population movements and interactions in Oceania, which have been tested on independent data sets. Earliest human movements into Near Oceania began about 40,000 years ago, resulting in great cultural, linguistic, and genetic diversity in this region. About 4000 years ago, the expansion of Austronesian speakers out of Southeast Asia led to the emergence of the Lapita cultural complex in Near Oceania. The Lapita expansion into Remote Oceania, commencing about 1200 BC, led ultimately to the settlement of the vast eastern Pacific, ending with the colonization of New Zealand about AD 1250. Polynesians probably reached the coast of South America, returning with the sweet potato and possibly the bottle gourd. Polynesian influences on New World cultures remain a topic of debate.

*In these Proes or Pabee's as the[y] call them... these people sail in those seas from Island to Island for several hundred Leagues, the Sun serving them for a compass by day and the Moon and Stars by night. When this comes to be prov'd we Shall be no longer at a loss to know how the Islands lying in those Seas came to be people'd, for... it cannot be doubted but that the inhabitants of those western Islands may have been at others as far to westward of them and so we may trace them from Island to Island quite to the East Indias.*

James Cook, 1769 (In Beaglehole 1955, p. 154)

In the late eighteenth century, James Cook and other European voyagers of the Enlightenment puzzled at how even the most remote of Pacific islands had been discovered and peopled by indigenous populations, spawning varied theories and a sizeable literature (Howard 1967). A century later, scholars such as Fornander (1878) synthesized Polynesian oral traditions into historical accounts of dubious veracity, tracing Polynesians back to mythical homelands in South Asia. The advent of modern anthropology in the early twentieth century led to a re-engagement with the “problem of Polynesian origins” (Kirch 2000, pp. 20–27). However, with the methods of archaeology and physical anthropology still underdeveloped, comparative ethnology dominated. The results ranged from Handy’s (1930) *Kulturkriese* diffusionism to Rivers’s (1914) division of Oceanic peoples into the “Kava” and the “Betel people.” Buck’s (1938) sweeping synthesis, forged in a mid-twentieth century cauldron of racial prejudice, invoked flawed essentialist notions of human biological types to trace “Caucasoid” Polynesian migrations around the fringe of “Negroid” Melanesia (see Kirch 2000, pp. 24–27).

As stratigraphic archaeology commenced in the Pacific following World War II, the ethnologists lost interest in historical questions, and the search to trace the origins of Oceanic peoples shifted increasingly to anthropology’s other subdisciplines. Archaeological fieldwork began in earnest in Polynesia in the 1950s and 1960s, and began to make major strides in Melanesia and Micronesia in the 1970s and

1980s. At the same time, a small but energetic group of linguists tackled the historical relationships among the 2000 or more languages spoken throughout the Pacific. This launched a productive and continuing engagement between linguists and prehistorians, who recognized the potential of testing each other’s models against independent data (Green 1999). And, as the old physical anthropology was transformed into a modern bioanthropology, the unparalleled human biological diversity of the Pacific proved fertile ground for testing new methods of population genetics (Hill & Serjeantson 1989, Friedlaender 2007).

The past 30 years, especially, have seen an explosion of new archaeological, linguistic, and bioanthropological data and interpretation bearing on the long-standing questions of when and how people entered the Pacific and managed to discover and colonize virtually every one of its thousands of islands. The founders of four-field anthropology, such as Sapir (1916), envisioned the power that a holistic approach could bring to historical questions, but they lacked the tools to fully implement it. In the Pacific, this potential has now been realized through the interdisciplinary collaboration of archaeology, historical linguistics, and bioanthropology. To be sure, not all of the questions have been answered, but immense forward momentum has been gained, as this essay seeks to demonstrate.

## MULTIDISCIPLINARY ADVANCES IN KNOWLEDGE

### Archaeology

By 1980, three major conclusions could be advanced based on accumulating evidence from archaeological excavations, accompanied by an increasingly robust radiocarbon chronology: (a) Polynesia was the last part of the Pacific to have been settled, and the immediate homeland of the Polynesians was in the Tonga-Samoa region; (b) a distinctive ceramic series named Lapita linked the earliest sites in Tonga and Samoa with sites scattered throughout

island Melanesia, thus bridging the classic ethnographic divide between Melanesia and Polynesia; and (c) the large island of New Guinea had the greatest time depth, with demonstrated Pleistocene settlement (Golson 1972). However, significant debate ensued about whether Lapita represented a population intrusion into Melanesia from Southeast Asia, or whether it was an indigenous development in the New Guinea-Bismarck Archipelago region (Allen 1984). This debate has at times been caricatured as competing “fast train to Polynesia” versus “tangled bank” models (Terrell 1986, Diamond 1988, Oppenheimer 2004). In part, the debate revolves around the question of whether phylogenetic signals of human history (i.e., homologous changes) are detectable in linguistic and genetic patterns of variation in the Pacific, or whether intergroup contact and reticulation has been so pervasive as to have erased such phylogenetic history (Bellwood 1996, Terrell et al. 1997, Kirch & Green 2001, Greenhill & Gray 2005).

The multi-institutional Lapita Homeland Project (LHP), launched in 1984, sought to address this debate within the ambit of the Bismarck Archipelago. The project’s several field teams acquired invaluable new data on Lapita sites (Gosden et al. 1989), but also demonstrated that human populations had moved into the large islands of New Britain and New Ireland in the Pleistocene, by about 36,000 BP (Wickler & Spriggs 1988, Allen & Gosden 1991, Smith & Sharp 1993). Building on the impetus of the LHP, archaeological excavations in both pre-Lapita and Lapita sites throughout island Melanesia have continued unabated over the past three decades (Kirch 1997, Galipaud & Lilley 1999, Clark et al. 2001, Summerhayes 2007, Sheppard et al. 2009). One outcome has been a resolution of the fast train/tangled bank debate in favor of the interpretation of Lapita as the outcome of a population intrusion (specifically, of Austronesian language speakers) into the New Guinea–Bismarck region. At the same time, Lapita is seen as something more complex than demic expansion alone, summed up in Green’s Triple-I model of intrusion,

innovation, and integration (Green 1991, Kirch 1997).

A fundamental conceptual revision to come out of the LHP and subsequent research is the abandonment of the nineteenth century, racist division of Oceania into Melanesia, Micronesia, and Polynesia (proposed by the French explorer Dumont D’Urville in 1832) and its replacement with the categories of *Near Oceania* and *Remote Oceania* (Green 1991). Near Oceania incorporates New Guinea, the Bismarck Archipelago, and the Solomon Islands as far as San Cristobal and Santa Anna, whereas Remote Oceania includes the rest of the Pacific proper. These new divisions are based on the archaeological demonstration that Near Oceania has a significantly greater time depth of human settlement, extending back into the Pleistocene, whereas human incursions into Remote Oceania did not begin until around 4000 BP (in western Micronesia) and were not completed until as recently as 1000 BP. The old tripartite categories still find use as geographical shorthand terms, and Polynesia has proven to be a meaningful culture-historical category, as all Polynesian populations and languages prove to be descendants of a common clade (Kirch & Green 2001). But Melanesia has no explanatory value other than as a geographic space; to speak of Melanesian peoples implies nothing about common origins or relationships in any genetic sense.

### Historical Linguistics

The integrity of a widespread *Austronesian* language family (sometimes referred to in older literature as Malayo-Polynesian), including approximately 1200 modern languages spread from Madagascar to Easter Island, was well established by the mid-twentieth century (Blust 1996). Significant advances came from the 1970s onwards with delineation of the place of the *Oceanic* subgroup of Austronesian, and of the internal branching structure and relationships of the Oceanic languages, which include most of the languages spoken in island Melanesia (outside of New Guinea) and

Micronesia, and all of those in Polynesia (Pawley 1972; Ross 1988, 1989). The Oceanic subgroup and the historical relationships among its languages are now well understood, even to the point of detailed reconstructions of Proto Oceanic vocabulary and culture (Pawley & Ross 1993). Moreover, it is widely accepted that Proto Oceanic was the language of the earliest Lapita populations in Near Oceania (Pawley & Green 1984; Kirch 1997, pp. 88–96). Recently, work on the genetic relationships of Oceanic and other Austronesian languages has benefited not only from traditional comparative linguistic methods but also from the application of cladistic procedures derived from biology (Gray & Jordan 2000, Hurler et al. 2003, Greenhill & Gray 2005, Gray et al. 2009).

A large group of languages centered in New Guinea with a few isolates in the Bismarcks and Solomons (numbering perhaps 950 languages) proved more refractory to historical linguistic analysis due to their immense variation. Initially lumped as non-Austronesian, this negatively defined category has been replaced with the term Papuan, while recognizing that this is not a single language family (Foley 1986, Pawley 2007). Rather, Papuan incorporates at least 23 distinct families that appear to be unrelated to each other (at least such relationships are not detectable on present evidence), and another 10 isolates (Ross 2005). The largest single family grouping within Papuan is the Trans-New Guinea Phylum, which includes between 350 and 450 languages dispersed across the island of New Guinea (Pawley 2007).

The emerging picture of Pacific historical linguistics is thus one of extraordinary diversity confined within Near Oceania (the Papuan languages), along with the Oceanic subgroup of Austronesian that displays clear internal relationships due to relatively shallow time depth, but is dispersed from Near Oceania all the way to the geographic extremes of Remote Oceania. At the broadest level, there is remarkable congruence between the archaeological and linguistic evidence for deep-time, Pleistocene settlement of Near Oceania (giving rise to the protean Papuan languages), and late Holocene

expansion of Lapita and post-Lapita populations into Remote Oceania (corresponding to the spread of Oceanic languages).

## Bioanthropology

Physical anthropologists in the early decades of the twentieth century attempted to describe and classify Pacific peoples based on such categories as skin color, hair type, and through large series of metric indices. Beginning in the 1970s, some of these older data were reanalyzed using new multivariate statistical methods (Howells 1970, Pietrusewsky 1970, Houghton 1996) yielding new insights into the relationships among Pacific populations. These methods, however, had their limitations, and Howells, for example, was still led to write that the Melanesians “were so protean and varied as to resist satisfactory analysis” (1970, p. 192). The major breakthrough came with a modern bioanthropology that adopted the methods of population genetics and molecular biology, especially through sequencing of mitochondrial DNA (mtDNA) and nonrecombining Y-chromosome (NRY) DNA (Hill & Serjeantson 1989, Martinson et al. 1993, Boyce et al. 1995, Martinson 1996, Melton et al. 1998, Friedlaender 2007, Friedlaender et al. 2008). One of the first major discoveries was that Polynesians and island Southeast Asians shared a particular nine-base-pair deletion in mtDNA, sometimes called the Polynesian motif (Hertzberg et al. 1989, Lum et al. 1998, Lum & Cann 1998, Merriwether et al. 1999). This evidence appeared to strengthen the archaeolinguistic argument in favor of a fast-train dispersal out of Southeast Asia. Subsequent work on NRY variations, however, showed that the dominant Y haplotype in Polynesians is likely to be of Melanesian (Near Oceanic) origin (Kayser et al. 2000, Su et al. 2000, Hurler et al. 2002). This apparent contradiction in the mtDNA and NRY evidence can be resolved through a model of matrilineal residence in the early Oceanic-speaking (i.e., Lapita) populations, whereby Melanesian men were recruited into Lapita communities (Hage

& Marck 2003; Kayser et al. 2006, 2008; Jordan et al. 2009). These data also provide support for a slow-boat model of Polynesian origins, whereby "... Polynesian ancestors originated from East Asia but genetically mixed with Melanesians before colonizing the Pacific" (Kayser et al. 2008, p. 1362; Vilar et al. 2008). A period of sustained gene flow between ancestral Polynesian and Melanesian populations is also evidenced by the presence of an  $\alpha$ -thalassemia deletion, which confers resistance to malaria, and must have been transferred to the ancestral Polynesian populations in Near Oceania before their dispersal to Remote Oceania, where malaria is generally absent (Hill et al. 1985, Martinson 1996).

In addition to testing models of Austronesian expansion into the Pacific, recent molecular studies have made significant contributions to understanding genetic diversity within Near Oceania. The various studies of mtDNA and NRY variation in northern Melanesia summarized above support an interpretation of great time depth in this region; microsatellite diversity gives estimated divergence ages of between 32,000 and 50,000 years for haplotypes that developed in Near Oceania (Friedlaender 2007, p. 92). Moreover, Papuan-speaking language groups (typically inland populations) are genetically the "most distinctive" in island Melanesia (Friedlaender 2007, p. 232). These findings correlate well with the archaeolinguistic model of Pleistocene settlement of Near Oceania by ancestors of Papuan-speaking groups.

Finally, the new molecular methods have also been applied to other organisms as proxies for human movement. The Pacific rat (*Rattus exulans*) was carried by voyagers from Near Oceania into Remote Oceania, either as a food item or as an inadvertent stowaway. mtDNA phylogenies of *R. exulans* show the presence of three major haplogroups, the distributions of which are consistent with the Triple-I model of Lapita origins in Near Oceania (Matisoo-Smith & Robins 2004). Recent genetic analysis of a human bacterial parasite, *Helicobacter pylori*, showed two distinct populations: (a) an hpSahul population with an estimated divergence age of

23,000–32,000 years, which is confined to Near Oceania; and (b) hpMaori, which is believed to have accompanied Austronesian expansion out of Taiwan at about 5,000 years ago (Moodley et al. 2009).

## NEAR OCEANIA

### Pleistocene Arrivals

The first arrival of people in Near Oceania must be understood within the context of Pleistocene biogeography and dynamic sea levels. For much of the later Pleistocene, lowered sea levels resulted in New Guinea being joined to Australia (and the latter to Tasmania), making up the supercontinent of Sahul. To the east, the Malay Peninsula was similarly joined to the Indonesian island arc as far east as Bali, along with Kalimantan, a vast area known as Sunda. Between Sunda and Sahul lies the island world of Wallacea in which water gaps were continuously present, making Wallacea a major barrier to plant and animal dispersal. The human colonization of Sahul, including Near Oceania, thus required some form of water-crossing ability, and it is increasingly evident that some kinds of simple watercraft—such as bamboo rafts, bark boats, or dugout canoes—must have been involved (Irwin 1993). This was true not only for crossing Wallacea, but for moving from New Guinea into the Bismarck Archipelago and the Solomons, where the islands were always separated from each other by water gaps (**Figure 1**).

Upwards of 150 archaeological sites dating to the Pleistocene have been recorded in Sahul (Smith & Sharp 1993). Once humans had entered the continent, they spread rapidly over all of its varied ecosystems from the tropical north to the temperate south, displaying a remarkable adaptability. Within Near Oceania proper, the earliest archaeological evidence remains that at Huon on the northern coast of New Guinea, where split-cobble waisted blades have been bracketed between 60,000 and 40,000 years BP (Groube et al. 1986). The large islands of New Britain and New Ireland both have evidence



**Figure 1**  
Map of Near Oceania, showing the location of key archaeological sites.

for occupation by around 35,000 BP (Allen & Gosden 1991, Pavlides & Gosden 1994, Allen 1996), Buka in the northern Solomons was settled by around 28,000 BP (Wickler & Spriggs 1988), and Manus sometime before 13,000 BP (Fredericksen et al. 1993).

Space limitations preclude a review here of cultural developments within Near Oceania during the late Pleistocene and early Holocene (but see Kirch 2000, pp. 70–84; Spriggs 1997). Suffice it to say that this period of thirty millennia provided the time depth necessary both for the emergence of a high degree of linguistic diversity (the Papuan languages), and for the evolution of human biological diversity including the various indigenous Near Oceanic mtDNA and NRY haplogroups referred to earlier (Friedlaender 2007).

### **Austronesian Incursion and Lapita Origins**

It was into this landscape of cultural, linguistic, and biological diversity that a new population (or populations) with origins in island

Southeast Asia moved beginning around 4000–3500 years BP, an eastwards advancing prong of the larger Austronesian expansion (Bellwood 2005, Donohue & Denham 2010). Aside from being marked by their obvious linguistic identity, these immediately pre-Oceanic speakers possessed at least two critical technological complexes: (a) ceramics and (b) the sailing outrigger canoe. Although there have been claims for pre-Lapita ceramics on New Guinea, there is no evidence thus far throughout the Bismarcks or Solomons for pottery making prior to Lapita. The Austronesian origins of the outrigger sailing canoe, or *\*wan̄ka* to use the Proto Austronesian word, are especially well attested on linguistic evidence (Pawley & Pawley 1994). Although these pre-Oceanic speaking voyagers also possessed a horticultural economy, this was not new to Near Oceania, where various tuber, fruit, and nut-bearing plants had already been domesticated. Nor was sophisticated shell working necessarily an Austronesian innovation, as there is evidence for shell tool manufacture in the Bismarcks at a quite early date.

The aceramic to ceramic transition in Near Oceania is still a phenomenon of active research and debate, in part exacerbated by violent eruptive events on New Britain that blanketed parts of that island with thick tephra (the W-K2 event) around 3600 BP, probably causing major population disruptions (Specht 2009). However, sites containing the distinctive dentate-stamped Lapita ceramics appear quite rapidly in the Bismarck Archipelago, possibly as early as 3500 BP in Mussau (Kirch 2001), but certainly by 3300–3000 BP at a number of localities (Specht & Gosden 1997, Summerhayes 2001). The immediate homeland of these pottery-making groups is likely to be the Sulawesi-Halmahera region, where similar pottery (but lacking the distinctive dentate stamped decoration) has been recovered (Kirch 1995). This is also consistent with linguistic evidence, since the closest external subgroup to the Oceanic languages are those of the South Halmahera-West New Guinea subgroup; both of these are branches of the Eastern Malayo-Polynesian languages (Kirch & Green 2001, figure 2.1).

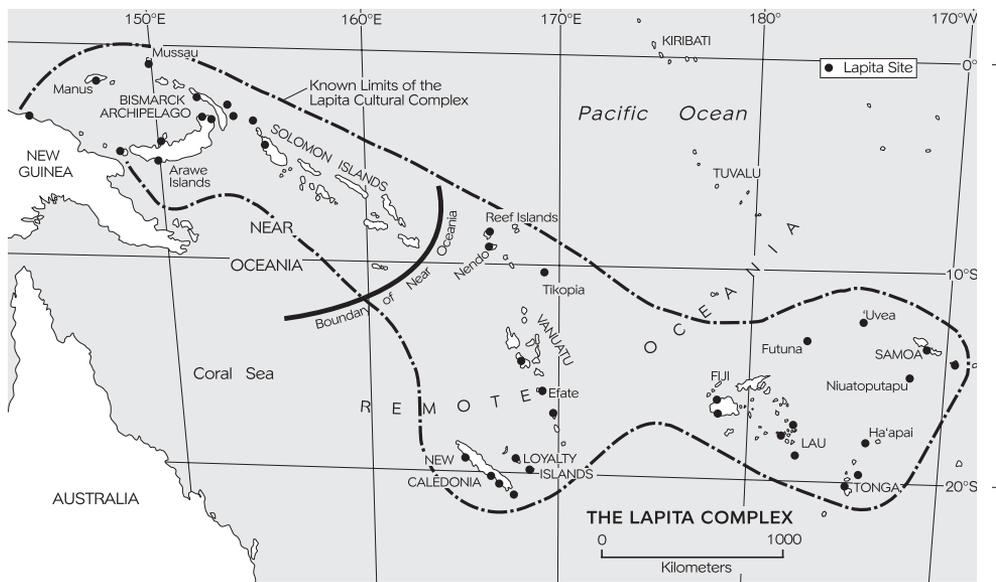
As noted earlier, the emergence of Lapita in the Bismarcks has been debated in terms such as “fast train,” “tangled bank,” and “slow boat.” While there is little doubt that a demic intrusion of pre-Oceanic speakers from island Southeast Asia was a key part of the process, a strictly fast train model can be rejected in favor of a slow boat in which the intrusive populations not only interacted with pre-existing Papuan-speaking communities in the Bismarcks, but intermarried with them as well. The complex patterns of genetic and linguistic diversity found today in Near Oceania (Friedlaender 2007, Friedlaender et al. 2008) can only be explained as the outcome of such complex cultural, linguistic, and genetic exchanges. (The tangled bank model is also rejected, as it implies that no phylogenetic signals of the homologous relationships among these populations can be detected.) The best overall model for Lapita origins remains Green’s (1991) Triple-I hypothesis, which posits that Lapita emerged out of a combination of intrusion, innovation, and integration processes.

## REMOTE OCEANIA

### The Lapita Expansion

Throughout the late Pleistocene and most of the Holocene, humans were confined to the geographically restricted region of Near Oceania, not venturing farther than the eastern end of the Solomons (San Cristobal and Santa Anna islands). Even the main Solomons may have been quite sparsely populated until the advent of Lapita, in part due to the rapid decline in terrestrial biodiversity as one moves from New Guinea and Bismarcks eastwards, limiting the potential resources for hunters and gatherers. Nonetheless, the Bismarcks to the Solomons comprise a chain of almost continuously inter-visible island masses, which would have facilitated discovery of new islands and subsequent voyaging between them. Beyond Santa Anna, however, one encounters the first significant gap of 380 km of open ocean before landfall is reached in the Santa Cruz group. Beyond this, distances become even more formidable—some 800 km from northern Vanuatu to Fiji, for example. Making such long ocean crossings required seaworthy sailing craft, which the Lapita people had evidently perfected with a variant of the *\*wan̄ka* outrigger canoe. Moreover, the colonization of Remote Oceania—which is far more biotically depauperate than is Near Oceania—also necessitated the ability to transport both crop plants and domestic animals to newfound islands. Although island colonizers may have relied heavily for the first few months on abundant wild birds and seafood, in the long run the success of new colonies depended on the establishment of horticultural production systems.

The timing of the Lapita expansion out of Near Oceania into the southwestern archipelagoes of Remote Oceania (**Figure 2**) has been narrowed down by extensive radiocarbon dating to the three centuries between 3200 and 2900 BP, a time span equivalent to roughly 15 human generations. The earliest Lapita settlement in the Reef-Santa Cruz group, the Nangu site (SE-SZ-8), was occupied around



**Figure 2**

Map of the southwestern Pacific, showing the division between Near Oceania and Remote Oceania, and the extent of the Lapita Cultural Complex.

3200 BP (Green et al. 2008). From there colonization seems to have proceeded rapidly down through Vanuatu, across to the Loyalty Islands, and to La Grande Terre of New Caledonia. Sand (1997) puts the initial settlement of La Grande Terre at between 3000 and 2900 BP. The wide ocean gap between Vanuatu and Fiji was crossed by between 3050 and 2950 BP (Anderson & Clark 1999, Clark & Anderson 2009), and Lapita colonization continued rapidly into the Lau and Tongan archipelagoes. Extensive dates from Lapita sites in the Ha'apai group of Tonga indicate initial settlements in place by 2850 BP (Burley et al. 1999). Samoa, along with Futuna and 'Uvea, were also settled at approximately this same time. Thus the Lapita expansion brought human settlement as far east as the Tonga-Samoa region, what is commonly known as Western Polynesia. At this point, further long-distance exploration to the east apparently halted, and would not be resumed until the later Polynesian diaspora in the first millennium AD.

### Micronesia

Micronesia, one of D'Urville's three original divisions of Oceania, lies mostly north of the equator, stretching from Palau and the Marianas in the west, through the Caroline Islands, to the Marshall and Kiribati archipelagoes in the east, a distance of nearly 5000 km. Many of its islands are coral atolls, punctuated by such high volcanic islands as Chuuk, Pohnpei, and Kosrae. Biologically, Micronesian populations tend to share many traits with Polynesians based on either traditional morphometric analyses (Pietrusewsky 1970), or on more recent mtDNA analyses (Lum & Cann 1998, 2000).

The historical linguistic picture for Micronesia, which has been greatly clarified in recent years (Jackson 1986, Rehg 1995), is critical for understanding the settlement history of this vast region. Although all extant Micronesian languages are Austronesian, they do not all fall within the Oceanic subgroup, an exception within Remote Oceania. Specifically, the Chamorro (Marianas) and Palauan

languages spoken in the westernmost archipelagoes belong to the Western Malayo-Polynesian subgroup of Austronesian, and are thus more closely related to many of the languages spoken in the Philippines and Indonesia. In contrast, all of the languages spoken in the Carolines, Marshalls, and Kiribati constitute a distinct subgroup of Oceanic languages, referred to as Nuclear Micronesian (Bender & Wang 1985), which is inferred to have derived from the initial breakup of Proto Oceanic. Finally, the language of Yap, which lies between Palau and the Carolines, has been shown to be an Oceanic language that has been modified through several phases of external contacts and borrowings (Ross 1996).

The historical linguistic evidence thus offers a three-part sequence for the peopling of Micronesia. An initial group (or groups) of Western Malayo-Polynesian speakers moved into Palau and the Marianas directly from island Southeast Asia. A second population (or closely related populations) would likely have originated in the Solomons-Vanuatu region, as a northern extension of the Lapita phenomenon at the time that the Proto Oceanic speech community was breaking up. This Proto Nuclear-Micronesian speech community may have been emplaced on more than a single island, possibly constituting a dialect chain spanning at least the high islands (and probably some atolls) of the central-eastern Micronesian region. Finally, Yap is likely to have been settled directly from the Bismarck Archipelago, but was then in later contact with islands both west and east.

Archaeological evidence increasingly supports the model offered by historical linguistics. The western island chains were the first to have been colonized, and early ceramics in the Marianas, such as those from the Achugao Point site radiocarbon dated to 1930–1630 BC (Butler 1994), display stylistic similarities with pottery from the Philippines and Sulawesi. In Palau, sediment cores with evidence for anthropogenic disturbance have been dated to as early as 2350 BC (Athens & Ward 2001), and pottery-bearing sites are known by 1250 BC (Liston 2009). In the Carolines, the earliest

documented settlements appear on the volcanic islands of Chuuk, Pohnpei, and Kosrae, all marked by calcareous sand-tempered ceramics associated with *Tridacna*-shell adzes and *Conus*-shell ornaments, all similar to late Lapita forms (Kirch 2000, pp. 173–175). Radiocarbon dates indicate settlement of these high islands in the last century or two of the first millennium BC. Similar-aged deposits have been excavated in the Marshall Islands (Weisler 2001), although these lack pottery. However, many atolls throughout central and western Micronesia may not have begun to form stable *motu* islets until well into the first millennium AD, following a late Holocene drop of about 1 m in sea level. Thus the atoll adaptations so characteristic of Micronesia are likely to be relatively recent developments. The archaeological picture for Yap is still enigmatic, as no primary settlement sites have as yet been identified or excavated.

## The Polynesian Diaspora

Of the three regions defined by D'Urville in 1832, only Polynesia has stood the test of time as a meaningful unit of cultural history. As Kirch & Green (2001, pp. 53–91) argue, Polynesia constitutes a phylogenetic unit, a distinct clade. Biologically, Polynesian populations have long been noted for their relative homogeneity (Houghton 1996). Molecular analysis suggests that the founding population entering the Western Polynesian region passed through a constricted demographic bottleneck (Flint et al. 1989, Martinson et al. 1993, Harding & Clegg 1996). Linguistically, it is well established that all of the extant Polynesian languages form a single, well-defined subgroup of the Oceanic branch of Austronesian (Marck 1996). The Proto Polynesian interstage, which developed in the Tonga-Samoa region during the first millennium BC, is marked by roughly 1300 lexical innovations (Marck 2000). The initial breakup of Proto Polynesian (which probably constituted a dialect chain linking the islands from Tongatapu in the south up through Vava'u and Niuatoputapu to Samoa) led to two

distinct branches: Tongic and Proto Nuclear Polynesian. The Eastern Polynesian languages derive from the Nuclear Polynesian subgroup, as do the Outlier Polynesian languages.

Whereas Western Polynesia is well established as the homeland region within which Ancestral Polynesian culture and Proto Polynesian language developed (Green 1981), debate has centered on the question of when Polynesians began to expand beyond the core homeland to settle Eastern Polynesia (Kirch 1986, Irwin 1992, Spriggs & Anderson 1993, Anderson 2001a). A long pause of at least 1000 years' duration lapsed between the initial Lapita settlement of Tonga-Samoa, and the subsequent expansion of Polynesian populations to the east. However, questions of just when long-distance voyages of colonization to the east commenced, how rapid was expansion into Eastern Polynesia, and how much time elapsed before Eastern Polynesia had been completely settled have been the focus of much recent research. Archaeological work in the 1950s and 1960s, in the Marquesas, Easter Island, and Hawai'i, led to interpretations of Eastern Polynesian colonization as early as AD 300, but the validity of many of the earlier radiocarbon dates has been called into question (Spriggs & Anderson 1993).

A considerably later chronology for initial Eastern Polynesian settlement has now emerged from the redating of key sites and assemblages, using improved methods such as accelerator mass spectrometry (AMS)  $^{14}\text{C}$ . Among these are Ha'atuatua and Hane in the Marquesas (Anderson et al. 1994, Rolett & Conte 1995, Rolett 1998, Conte & Anderson 2003), the Bellows Dune and Halawa Dune sites in Hawai'i (Tuggle & Spriggs 2000, Kirch & McCoy 2007), the Maupiti and Vaito'otia sites in the Society Islands (Anderson & Sinoto 2002), along with several Archaic sites in New Zealand (Anderson & Wallace 1993, Anderson et al. 1996, Higham et al. 1999, Hogg et al. 2003). Newly discovered early sites in the Cooks, Mangareva, and Henderson-Pitcairn groups have added significantly to the corpus of chronological data (Kirch et al. 1995, Weisler 1995, Conte & Kirch 2004, Green & Weisler

2002), as have excavations in the Anakena beach site on Easter Island (Steadman et al. 1994, Hunt & Lipo 2006). The emerging picture is one of a fairly rapid Polynesian colonization of the chain of islands stretching from the Australs to Mangareva, Pitcairn-Henderson, and finally to Easter Island that occurred between roughly AD 800 and 1000. Hawai'i also seems to have been settled no earlier than AD 800 based on evidence from sediment cores and AMS dating of Pacific rat bones (Athens 1997, Athens et al. 2002). New Zealand was clearly the last of the major Polynesian islands to be discovered and settled, between about AD 1250 and 1300 (Hogg et al. 2003). However, the large and centrally situated Society Islands archipelago remains a gap in our knowledge of early sites, with the oldest evidence consisting of anaerobically preserved domesticated coconuts in a coastal swamp on Mo'orea Island (Lepofsky et al. 1992); clearly, more investigation in the Society Islands is warranted.

In contrast with earlier views that the settlement of Eastern Polynesia was accomplished by random drift (Sharp 1956), it is now certain that these widely dispersed islands were discovered as the result of purposive voyages of exploration enabled by a sophisticated canoe technology and navigational abilities (Finney 1996, 1997; Anderson 2001a,b). Here prehistorians have been aided by the knowledge gained from the experimental voyages of the *Hokule'a* and other replicated Polynesian double-hulled voyaging canoes (Finney 1994). Although there is some disagreement on this point, it is likely that the large ocean-going double-hulled sailing canoe (as opposed to the simpler sailing canoe with outrigger) was invented and perfected in the Western Polynesian homeland during the so-called "long pause" (Finney 2006). It was certainly the existence of this canoe type, with its vastly expanded range and cargo capacity that enabled the peopling of Eastern Polynesia. Moreover, it is increasingly evident that long-distance voyaging continued to link many of the Eastern Polynesian islands well after initial settlement, and the geochemical sourcing of basalt adzes in particular has demonstrated the

existence of widespread interaction networks (Weisler 1998, Collerson & Weisler 2007).

The sequencing of mtDNA from extant populations and archaeological remains of the Pacific rat has also contributed to the emerging picture of Eastern Polynesian dispersals (Matisoo-Smith 1994, Matisoo-Smith et al. 1999, Matisoo-Smith & Robins 2004). These results indicate two separate introductions of *R. exulans* into the Hawaiian archipelago, lending independent support to archaeological and linguistic claims that Hawai'i had multiple voyages from central Eastern Polynesia. Hinkle (2004) analyzed molecular diversity in the Polynesian transported *ti* plant (*Cordyline fruticosa*), showing distinct Western and Eastern Polynesian clades; low levels of difference between the sterile Eastern Polynesian *ti* populations are consistent with a shallow time depth.

## CONTACTS WITH THE AMERICAS

The theory that Eastern Polynesia, if not the Pacific islands more broadly, might have been peopled from the Americas has been proposed many times over the past two centuries (Howard 1967). It was most famously championed by Thor Heyerdahl (1952) who popularized the theory with his *Kon-Tiki* raft voyage. Most archaeologists never took Heyerdahl's ideas seriously, and none of the archaeological, linguistic, or biological evidence reviewed above lends any support to the intrusion of indigenous Native American populations into the Pacific in pre-Columbian times. However, the reverse proposition—that Polynesians sailed to the coasts of South and/or North America, making contact with populations there—seems increasingly likely, and has provoked recent debates.

The strongest evidence for Polynesian contact with South America is the sweet potato (*Ipomoea batatas*), a plant of undoubted American origins that was widely cultivated in Eastern Polynesia (especially in New Zealand, Hawai'i, and Easter Island) at the time of European contact. Yen's (1974) extensive

research on sweet potato distribution and variation led him to propose a "tripartite hypothesis" of the plant's distribution, in which sweet potato arrived in Eastern Polynesia in pre-European times, with the Polynesians themselves as the most likely transferors. The discovery and dating of carbonized sweet potato tubers (parenchyma) in the Tangatatau Rockshelter on Mangaia in the Southern Cooks (Hather & Kirch 1991) provided direct evidence that sweet potato had been transferred into central Polynesia by around AD 1000. Subsequently, many archaeobotanical samples of sweet potato have been radiocarbon dated to precontact contexts in New Zealand and Hawai'i. Given the evidence for rapid Polynesian expansion throughout southeastern Polynesia between about AD 800 and 1000, it is entirely plausible that at least one voyaging canoe reached South America to establish contact and return with sweet potato tubers, which then entered the Polynesian horticultural complex. Indeed, the adoption of sweet potato (as opposed to other American crops such as maize or beans) is culturally plausible, given that the plant is both morphologically and ecologically similar to the *Dioscorea* yams with which the Polynesians were already familiar. The Proto Eastern Polynesian name for sweet potato, *\*kuumara*, is almost certainly a borrowing from a South American dialect where the term for the crop is *kumar* or similar variants (Yen 1974, appendix; Green 2005).

A second possible botanical transfer into Polynesia is the bottle gourd (*Lagenaria siceraria*), a useful plant known to have been present in the Americas by at least 9900 BP. Archaeobotanical remains of bottle gourd (gourd fragments and seeds) have been recovered in precontact contexts in Hawai'i and elsewhere in Eastern Polynesia. A recent effort to test the hypothesis of a pre-Columbian American origin for the Polynesian bottle gourd using molecular evidence (Clarke et al. 2006) proved inconclusive, owing to the likelihood of postcontact hybridization with Asian cultivars. Nonetheless, *Lagenaria* remains a likely candidate for Polynesian transfer from South America.

If Polynesians made contact with coastal peoples in the Americas, the question arises whether this resulted in the flow of ideas, organisms, or even genes into the New World. One recent claim for such a Polynesia-to-America transfer concerns the jungle fowl (*Gallus gallus*), a species carried from Southeast Asia throughout the Pacific during the Austronesian expansion. Whether chickens were present in South America in pre-Columbian times has been debated, but Storey et al. (2007) report an AMS-dated chicken bone from the El Arenal site in south-central Chile, which, they argue, is evidence for Polynesian contact and introduction of *G. gallus*. The reported date, calibrated to AD 1321–1407, would fall toward the end of the period of extensive Eastern Polynesia voyaging, but certainly predates Spanish occupation (Pizarro reached Peru in 1532). This claim has provoked strong debate (Gongora et al. 2008, Storey et al. 2008), and more evidence from El Arenal or other sites will be required before a pre-Columbian transfer of chickens from Polynesia to South America can be firmly accepted.

A second case for Polynesian cultural influence in the New World has been made by Jones & Klar (2005), who argue that the sewn plank canoes of the Channel Islands region of California resulted from Polynesian contacts. They adduce both archaeological and linguistic evidence in support of their argument, which has again resulted in vigorous debate (Anderson 2006, Arnold 2007).

In short, some contact between Eastern Polynesians and indigenous American populations seems incontrovertible based on the evidence of the sweet potato. But much more research will be necessary to refine our understanding of such contact, and whether the Polynesians made any significant contributions to New World culture history.

## CONCLUSION

The founders of an integrated, holistic approach to anthropology, including Sapir (1916), were confident that deep time problems of human history would be amenable to coordinated investigation by the discipline's several subfields. A century later, methodological advancements in archaeology, historical linguistics, and bioanthropology have made that vision a reality. The enduring problem of the peopling of the Pacific demonstrates the strength of building and testing models based on multiple lines of independent evidence. Moreover, claims that the genetic, linguistic, and cultural complexity of Oceania is so great (a "tangled bank") that no signals of homologous history may be detected has been shown to be false. While cultural contact, borrowings, and gene flow are indeed important parts of the history of Oceanic peoples, phylogenetic relationships can nonetheless be determined. In many ways, the Pacific serves as a model region for historical anthropology.

## DISCLOSURE STATEMENT

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**Errata**

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