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SOUTHEAST SOLOMON ISLANDS IN REGIONAL PERSPECTIVE: SETTLEMENT HISTORY, INTERACTION SPHERES, POLYNESIAN OUTLIERS AND EASTWARD DISPERSALS

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ABSTRACT: This paper reviews the prehistory of the greater southeast Solomons region in the light of the 46 years of research which has been conducted since Green and Yen published the preliminary results of their Southeast Solomons Culture History Project in 1976. Green saw the region as key to investigating some of the major questions relating to Oceanic culture history, and as subsequent archaeological, linguistic and genetic research has shown, this has proven to be the case. The evidence is reviewed for initial Lapita and subsequent settlement, the development of a Marginal East Melanesia–Central Micronesia Interaction Zone, early proto-Polynesian settlement of the Polynesian Outliers and the probable role of the region in the settlement of East Polynesia.

Keywords: Marginal East Melanesia–Central Micronesia (MEMCM) Interaction Zone, southeast Solomons, Melanesia, Polynesia, Micronesia, Remote Oceania settlement, culture history, Pacific archaeology, DNA, Oceanic linguistics

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In 1970 Roger Green and Douglas Yen began the Southeast Solomons Culture History Project (Green 1972; Green and Cresswell 1976; Green and Yen 2009). This project was designed to fill a gap in archaeological knowledge and address a number of broader archaeological questions concerning the settlement and culture history of the western Pacific. These questions reflected both Green's interest in the archaeology of West Polynesia, arising from his earlier project in Sāmoa (Green 1969), and Yen's ongoing research into Pacific agricultural systems (Yen 1971, 2009). Green (1976a) listed five major "important" questions concerning relationships between West Polynesia and Island Melanesia which required a better understanding of Island Melanesia. The focus of their National Science Foundation research grant was clearly to understand Polynesian prehistory, while at the same time acknowledging the possibility of a more complex prehistory of Island Melanesia than was currently known or imagined. The questions in brief were:

1. What is the nature of the earlier cultural assemblages from Island Melanesia which may be ancestral to those already known from Western Polynesia?

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2. Are there early cultural complexes in Island Melanesia that reflect a people lacking horticulture, or with different horticultural systems or patterns of agricultural intensification from those found today in both Island Melanesia and West Polynesia?
3. …. [A]re the non-Austronesian-speaking peoples of Island Melanesia survivors of populations who occupied a much greater area before the arrival of Austronesian speakers? …
4. Are the Polynesian-speaking peoples on the outlying islands of Melanesia remnants of populations left behind on these small islands as the Polynesians moved out into the Pacific, or are they … the result of drift settlements from the western area of Polynesia … after settlement of Polynesia and the development of its culture?
5. Does the agricultural complex of West Polynesia really derive from Western Melanesia as most theories maintain, despite a diversity of opinions on Polynesian origins (Buck 1938; Heyerdahl 1952; Emory 1959; Suggs 1962; Yen 1971)? (Green 1976a: 10)

The southeast Solomons research area, as they defined it, included islands of the easternmost main Solomons (Makira (San Cristobal), Ulawa, Uki, Santa Ana) which formed a linguistic sub-group of Southeast Solomonic and those of the Temotu province of the Solomon Islands in Remote Oceania (Green 1991), over 360 km west of Santa Ana. Temotu includes the Reef/Santa Cruz Group, Vanikoro, Utupua and the Polynesian Outliers of Taumako, Pileni, Tikopia and Anuta (Fig. 1). Green noted the cultural, genetic and linguistic variability of the region, which included, at that time, people speaking Polynesian (Samoic), other poorly understood probable Austronesian languages (Utupua, Vanikoro) and what were believed to be non-Austronesian (Santa Cruz and Main Reefs) (hereafter NAN) languages. That almost unique diversity along with the geographical, biological and geological diversity reflected within the region and the contrast seen across the Near Remote Oceania boundary would, he believed, potentially help investigate "the sources of the region's cultural complexes, linguistic groupings, and agricultural practices in relation to those of West Polynesia, Eastern Melanesia, and Micronesia" (Green 1976a: 13).

Since Green wrote those words in the introduction to his 1976 report with the subtitle "A Preliminary Survey", much has been learned from the outcomes of that early fieldwork which have continued for many decades (Green and Yen 2009) and from more recent work in linguistics and genetics. The implications of some of these more recent works might have surprised Roger, as they have many of us; however, at the same time as new answers have arisen to the questions of 1976, so have new questions and puzzles. In

Figure 1. Map of the western Pacific showing population movements.

the following I will revisit Green and Yen's southeast Solomons examining both what we have learnt about that area and its relation to greater issues, including in turn the initial settlement of Remote Oceania and the settlement of the Polynesian Outliers, central Micronesia and East Polynesia, as the southeast Solomons would seem to have played a central role in the dynamics of Pacific prehistory.

LEAPING INTO REMOTE OCEANIA

When Green wrote in 1976, it is probable that he believed that the Lapita archaeological culture had settled in West Polynesia with Austronesian-speaking people who were the ancestors of Polynesians, and also that it was to be expected that this involved a movement through the main Solomons and ultimately as far east as Tonga and Sāmoa. Certainly in 1979 he hypothesised that Lapita would be found in the many major lagoon systems of the main Solomons (Green 1979: fig 2.12). A complication in this was the apparent presence of speakers of NAN languages in the Reef/Santa Cruz and of course the "Melanesian" biology and to some extent "Papuan" culture amongst the Austronesian speakers of southern Island Melanesia. Was this the result of subsequent movements of "Papuan" influence, or was the story of West Polynesian origins more complicated through genetic bottlenecking or a founder effect amongst a possibly genetically and linguistically diverse Lapita population?

Lapita in the Solomon Islands

Over the years since 1979 pieces of this puzzle gradually began to fall into place or in some cases became more puzzling as research developed. In the mid to late 1990s Richard Walter and I began research in the Western Province of the Solomon Islands to investigate findings of ceramics which appeared to have Lapita affinities (Reeve 1989), some of which I had been shown while touring the Western Province in 1989. Subsequent research has shown that these ceramics are found in very many (37+) intertidal sites in the Solomon Islands located west of Malaita/Guadalcanal and the eastern Solomons, and the oldest includes a small amount of dentate stamping and carinated pot forms, making it very Late Lapita, dating at the very earliest ca. 700–600 BC (Carter *et al*. 2012; Felgate 2003; Felgate and Dickinson 2001; Radclyffe 2020; Sheppard 2019; Sheppard *et al*. 1999; Sheppard and Walter 2006, 2009; Thomas *et al*. 2020). This formed a long ceramic sequence in an area that maintained a ceramic tradition into the historic period. In the eastern Solomons, despite employing the same survey methodology as used in the Reef/Santa Cruz where he discovered numerous ceramic sites, Green found no ceramics other than a handful of small, very friable plain sherds from cave sites in Santa Ana. This material was first noted by the anthropologist

William Davenport (1972) following his emptying of a number of caves and shelters on Santa Ana of significant amounts of deposit, as I observed at the Feru rock shelter in 2009. Modern dating of samples recovered by Green in association with ceramics from cave deposits on Santa Ana have provided date ranges of 831–767 (2δ) cal BC (Sheppard 2011: 833; Walter and Sheppard 2017: 61). Santa Ana is the very small island at the eastern tip of the main Solomon Islands (Fig. 1) located 360 km due west of Santa Cruz. It is famous in Santa Cruz oral tradition for receiving drift voyages from Santa Cruz. Failure to reach Santa Ana meant drifting into the "Seas Without Return" (Davenport 1964: 138). Despite Green's broad survey and excavations on four of the easternmost islands, which did produce Spanish ceramics from a failed AD 1595 settlement or marooned group at Pamua on Makira (San Cristobal) (Allen 1976), Green found no ceramics from any other period, nor is there any historic ceramic tradition in the region. No other subsequent survey or excavation in the eastern Solomons has produced ceramics from any period despite deposits dating back through the Lapita time period (Blake *et al*. 2015; Miller 1979; Miller and Roe 1982; Moser 2018; Roe 1993).

In 2006 we proposed a revised culture history for the Solomon Islands arguing for an Early Lapita leapfrog movement from the Bismarck Archipelago directly out into the sites of Remote Oceania in Temotu, which bypassed the main Solomons. This dismissed the previously assumed wave-of-advance model (Sheppard and Walter 2006). This was based not simply on our experience in the western Solomons, as has been suggested (Spriggs and Reich 2019: 632), but included consideration of the Lapita archaeology of Temotu as well as available linguistic and genetic evidence, all of which pointed to the high probability of our hypothesis being correct.

Leapfrog into Remote Oceania

The primary archaeological evidence was first the very large quantity of Bismarck obsidian in these early Reef/Santa Cruz sites, over 2,000 km from the sources, with no evidence of re-use or economising, followed by the almost complete loss of such material in sites further south and east (Reepmeyer 2009; Sand and Sheppard 2000; Sheppard 1993; Specht 2002). The presence of chert from Malaita/Ulawa (Sheppard 1996) clearly indicated at least resource exploitation from the main Solomons; contacts to the south were also indicated by material from the Banks Islands as part of a large Early Lapita–period interaction sphere centred on Temotu (Green and Kirch 1997). The other indicator was the speed of Lapita dispersal, occurring within a few generations, east through Near Oceania and out into Vanuatu, New Caledonia, Fiji and Tonga. It seemed very unlikely that a wave of advance through the large islands of the main Solomons, pushed by some form of demographic driver, could happen in such a compressed time, even if one considered some kind of high-grading or ideal free distribution model (Kennett *et al*. 2006) of settlement.

The evidence from linguistics was also compelling. For Green (1976b) the possible presence of NAN speakers in Temotu was perplexing, as it did not easily fit with the Lapita (Proto-Oceanic Austronesian) to Polynesian origins model (Shutler and Marck 1975), although it did fit with the model of two waves settlement of southern Island Melanesia with a second wave of "Papuan" influence seen in the post-Lapita Mangassi or incised ceramics of Vanuatu (Garanger 1971; 1972: 122; Spriggs 1997: 158; 2000) or possibly with a pre- or post-Lapita settlement of NAN speakers (Green 1988; Spriggs 1984). Another, perhaps even more fundamental, complication was the fact that the Austronesian languages of Temotu did not appear to be closely related to members of what Pawley defined as Eastern Oceanic (Pawley 1972), including their Southeast Solomonic neighbours immediately to the east. A number of hypotheses were proposed to explain this complicated situation.

Wurm (1969, 1970) had proposed that

> the ancestors of the present-day SC [Santa Cruz] speakers were Papuan speakers who, probably under Austronesian cultural impact enabling them to build seaworthy craft, migrated eastwards from the Papuan homeland in the New Guinea area. They seem to have been subjected to a strong influence by speakers of an Austronesian language type which was different from the Eastern Oceanic one which appears to have established itself first in the greater part of Melanesia, and which made itself felt quite strongly in the New Britain and New Caledonia areas. (Wurm 1970: 548)

Wurm hypothesised that the non–Eastern Oceanic Austronesian component of the Reef/Santa Cruz languages was the result of a migration of "aberrant Oceanic Austronesian" speakers from the Proto-Oceanic–Papuan contact zone in northeast New Guinea and the New Britain region "largely by-passing the other areas in Melanesia which at that time may already have been occupied by Austronesian speakers of Eastern Oceanic" (Wurm 1970: 549).

Green argued in turn that it seemed more likely that the Austronesian influence on the NAN languages of the Reef/Santa Cruz occurred in Temotu, and that the archaeological evidence indicated that there was a 3,000-year-old cultural complex (Lapita) in the region that had persisted for 700 years, "which I believe is not ancestral to the later prehistoric cultural complex of its present non-Austronesian SC-speaking populations" (1976b: 53). Green then postulated that although Lapita was associated with Austronesian in Polynesia, this was not necessarily the case everywhere, and particularly in the Reef/Santa Cruz. To assume such an association in the Reef/Santa Cruz "would require that in the last several thousand years its present non-Austronesian speakers have displaced a previous Austronesian-speaking population associated with Lapita pottery" (1976b: 53). This was apparently too complicated a scenario for Green. He summarised his linguistic arguments for Temotu history as follows (Green 1976b: 60):

(i) a very early (4,000–5,000 years ago) settlement of Island Melanesia by Oceanic-speaking people with languages like those of Utupua or Vanikolo in Temotu,
(ii) emergence of an Oceanic language (Eastern Oceanic) about 4,000 years ago out of the southeast Solomons or Vanuatu that spreads and differentiates over the entire southeast Solomons and northern and central Vanuatu but fails to establish a surviving colony in the Santa Cruz region,
(iii) immigration about 3,000 years ago of a small group of Reef/Santa Cruz speakers, who *if* Austronesian (following suggestions from Peter Lincoln (Mühlhäusler *et al*. 1996)) had borrowed extensively from their neighbours, who were Oceanic and not Eastern Oceanic speakers, and subsequently displaced resident Oceanic-speaking populations in Temotu, and
(iv) immigration in the last 2,000 years or less of Outlier populations from at least two sources who occupied smaller islands, replacing or absorbing earlier founder populations.

The models of both Wurm and Green, explaining the linguistic complexity of Temotu, along with subsequent work by Ross on the history of Proto-Oceanic and the languages of western Melanesia (Ross 1988), did not support, in 2006, a simple Lapita wave-of-advance model out of the main Solomons into Temotu, with Wurm explicitly calling for a direct movement from the Bismarcks into Temotu.

The final line of evidence available in 2006 was from genetics. Friedlaender and colleagues (Friedlaender *et al*. 2002; Friedlaender, Gentz *et al*. 2005; Friedlaender, Schurr *et al*. 2005) had published a number of papers which included modern mitochondrial DNA data from Santa Cruz, the main Solomons and the Bismarcks. This indicated the presence in Santa Cruz of the genetic signatures of the introduction of two distinct populations at different times. One was their haplogroup I which included the "Polynesian motif" looking most like Remote Oceania; the others (II–V) were most closely matched with samples from the Bismarck Archipelago and particularly East New Britain, and not with samples from the main Solomons. In their paper published in 2002 they provided a "cautionary tale on ancient migration detection", discussing how hard it was to tell which population came into Santa Cruz first or where mutations had occurred. Ultimately this related in part to the debate over "fast train" versus "slow boat" models (Bellwood 2001) of Austronesian settlement of Oceania. Did Lapita people, who were generally assumed to be Austronesian speakers, move rapidly through Near Oceania with little genetic admixture, or was Lapita genetically mixed with indigenous “Papuan” speakers while developing in Near Oceania? The Santa Cruz data seemed to indicate a more recent “Polynesian” expansion and genetic introduction into Santa Cruz on top of an older “non-Austronesian” population.

> The narrowly defined mtDNA haplotypes present on the Santa Cruz Islands show more conclusively that severe bottlenecks and loss of diversity within the population carrying this haplogroup [I] had occurred prior to Austronesian arrival in the Santa Cruz Islands, not later. That these haplotypes form the only star-shaped cluster in the Bandelt median network suggests an independent population expansion from the rest of the Santa Cruz sample, which is consistent with a separate settlement by haplogroup-I-bearing individuals (either prior to, or subsequent to, the introduction of others). Because the pairwise mismatch distribution suggests that the timing of this expansion is relatively recent, one might guess that the Austronesians were an overlay on a more diverse and ancient non-Austronesian population base. (Friedlaender *et al*. 2002: 468)

This represented a conundrum for Friedlaender *et al*. (2002) as this appeared to be contrary to the accepted archaeological model which would “suggest the reverse order of population movements”. Friedlaender *et al*. (2002) had introduced their paper with a discussion on migration models, describing wave-of-advance and leapfrog models. They concluded their discussion by stating: “Studies of agricultural migrants in the Philippines and Southeast Asia suggest that leapfrogging is a recurrent pattern in the expansion of pioneer farming communities in particular” (Friedlaender *et al*. 2002: 455). They did not return to this in their conclusion, but clearly their Santa Cruz data indicated a leapfrog movement from the Bismarck Archipelago.

Research in the southeast Solomons has made significant progress since 2006. Systematic study of the languages of Temotu has shown that they are in fact Austronesian and form a first-order division (Temotu) of Oceanic, one of nine high-first-order groups and with a shared ancestry perhaps found in the languages of the St Matthias Group (Mussau and Tench) (Ross and Naess 2007: 471), although, as pointed out by Ross (Sheppard 2011: 834), that does not necessarily derive them directly from Mussau; and more recently Mussau–Tench has been proposed as a separate group along with Temotu and seven other groups in a rake-like structure directly under Proto-Oceanic (Ross *et al*. 2008; 2016: 14). Their arrival in Temotu was, however, separate from the arrivals of Southeast or Northwest Solomonic in their respective areas (Naess and Boerger 2008; Naess and Hovdhaugen 2007; Ross and Naess 2007: 467) and potentially earlier. Support for this status as a distinct higher-order division of Oceanic is also found in the phylogenetic linguistic analysis of Gray *et al*. (2009).

Genetic research conducted since 2006, both on modern and ancient DNA, has confirmed the leapfrog hypothesis. In 2016 (Skoglund *et al*. 2016) the first genome-wide ancient DNA was recovered from skeletal material (all female) from the Early Lapita Teouma site on Efate, Vanuatu, and the Late Lapita Talasiu site on Tongatapu, Tonga. The three samples from Teouma and the single sample from Talasiu presented very similar DNA which in a summary principal component analysis (PCA) (Skoglund *et al*. 2016: fig. 1) formed a tight grouping and was unlike modern DNA from the Bismarck Archipelago, Solomon Islands or Polynesia and closest to samples from East Asia and especially the Philippines, although they did not sit within any modern grouping. Mitochondrial DNA was recovered from the three Vanuatu samples and were all haplogroup B4a1a1a, the classic "Polynesian motif" (subsequent research on the Teouma cemetery found that haplogroup and subclades in all 24 individuals studied (Lipson *et al*. 2018: S1)). These samples did not contain any detectable evidence of "Papuan" ancestry, unlike the modern samples from Near and Remote Oceania, which all have greater than 25 percent "Papuan" ancestry. Dating of the Tongan individual at 910–390 (2δ) cal BC indicated that the introduction of "Papuan" ancestry into Remote Oceania occurred after that time. The results of this research strongly supported the model of rapid movement of Lapita people through Near Oceania with little admixture with earlier established "Papuan" populations.

"Papuan" Movement into Remote Oceania

The success of this genetic research encouraged attempts to extract DNA from many other archaeological samples of Pacific human remains (Spriggs and Reich 2019) and also to create a large sample of modern DNA from Vanuatu, which was unavailable in 2016. This resulted in two papers published in 2018 (Lipson *et al*. 2018; Posth *et al*. 2018) and another in 2020 (Lipson *et al*. 2020). Another paper by Pugach *et al*. (2018) has surveyed, more specifically, genome-wide data with a focus on the Solomon Islands. All of these papers conclude that the "Papuan" component of DNA in Remote Oceania is most closely related to modern samples from the Bismarck Archipelago and not the Solomon Islands and explicitly support the leapfrog model of settlement from the Bismarcks into Remote Oceania (Delfin *et al*. 2012; Lipson *et al*. 2020: 4854; Pugach *et al*. 2018: 883; Ricaut *et al*. 2010; Sheppard 2019). It should be noted, though, that there does not appear to be enough "Papuan" DNA in the Early Lapita individuals to identify any point of origin in the Bismarcks or anywhere in Near Oceania, other than from some distinctive population with closest modern affinities in East Asia, possibly the Philippines.

Modern DNA from Santa Cruz is like that from Vanuatu, particularly northern Vanuatu (Lipson *et al*. 2018; Lipson *et al*. 2020; Pugach *et al*. 2018), and is most similar across all studies to that from East New Britain, plotting closest, in PCA plots, to modern Tolai (Lipson *et al*. 2018: fig. S2) or Baining (Posth *et al*. 2018: 734), all currently resident in the Gazelle Peninsula of East New Britain, an area susceptible to volcanic activity and population displacement. The Tolai migrated to the region from New Ireland and the Duke of York Islands, displacing the Baining on the rich volcanic soils around Rabaul, possibly after an eruption in the eighth century AD (Johnson 2013: 346); however, Ross (1988: 261) argues that these languages are descended ultimately from languages of the Willaumez Peninsula area, whose speakers migrated east along New Britain and across to New Ireland, with the eruption of the Rabaul volcano severing linguistic relationships with New Ireland. Within the southeast Solomons, samples from Makira have some similarity to those from Santa Cruz (Pugach *et al*. 2018: 874); however, traditions of drift voyages directly west from Santa Cruz to Santa Ana and Makira might account for this admixture (Davenport 1964).

Timing of the settlement in Temotu of this distinctive population would appear, following the dated individuals in Vanuatu, to be at the earliest ca. 500 BC (Posth *et al*. 2018) or near the time of the end of the Lapita ceramic tradition in Temotu. This population would appear, given the very distinctive nature of Santa Cruz DNA, to have almost completely replaced the earlier Lapita population in what has been described as a "massive demographic change", albeit occurring in an incremental fashion with multiple migrations creating variation in the outcome in Remote Oceania (Posth *et al*. 2018: 736; Spriggs and Reich 2019). This variety may be seen, perhaps, in the different post-Lapita ceramic traditions seen in Remote Oceania. In Temotu we see the gradual simplification of ceramics with loss of decoration ca. 700–600 BC (Doherty 2009: 193), creating a plainware which Green (1985) called Eastern Melanesian Plainware, to distinguish it from what had been called Polynesian Plainware in West Polynesia, and ultimately the complete loss of ceramic production ca. 100 BC (McCoy and Cleghorn 1988). The initial secondary expansion into Temotu in the Late Lapita period would appear to have occurred at approximately the same time as expansion of people making an incised ceramic tradition out of New Ireland into the northern and western Solomon Islands ca. 700–600 BC (Sheppard and Walter 2009; see also Felgate 2003; Garling 2007). This tradition is easily derived from Lapita incised decorative traditions but is similar to some post-Lapita developments in Vanuatu (e.g., incised and applied relief tradition) (Bedford and Clark 2001).

The nature of the cultural tradition expressed by the first Lapita settlers in Temotu can be constructed from our general knowledge of Lapita society (Kirch 1997) and the specifics of sites in the Reef/Santa Cruz (Green and Pawley 1999; Sheppard 1993; Sheppard and Green 1991). They shared a well-defined elaborate ceramic tradition, suggesting an important and common ideology, and were highly mobile with a well-developed voyaging technology, which allowed them to maintain contact with a homeland in the Bismarck Archipelago, as seen from the continuous transport of obsidian over some centuries, and the procurement of a variety of resources from an extensive interaction sphere extending throughout Temotu and to neighbouring islands (Green and Kirch 1997). They carried an economy based on domesticates with a probable important arboriculture component, which allowed them to maintain settlements once initial virgin natural resources became depleted. The evidence for a long period of ongoing interaction with the homeland (Sheppard 1993) is especially significant as it would suggest ongoing connections with New Britain (predominantly Willaumez Peninsula, but also Admiralties sources) for obsidian and, we can assume, with the "Papuan" populations living there. Populations followed either with them or in their footsteps, ultimately replacing them in the genetic sense, as there is little Lapita or First Oceanic Founder (Lipson *et al*. 2018) DNA signature in the modern Santa Cruz population, possibly represented in the average of 5 percent Polynesian component reported (Pugach *et al*. 2018: 874). However, as suggested by Friedlaender *et al.* (2002), this may be the result of more recent introductions from Polynesian sources, although Pugach *et al*. (2018: 879) see no evidence of late Polynesian gene flow into Santa Cruz.

The construction of a cultural profile for the Reef/Santa Cruz and a genetically "Papuan" population post-Lapita is difficult given the limited data, although Moira Doherty (2007, 2009) has produced a PhD thesis on the topic. Historically the people of Santa Cruz have many distinctive cultural features, many of which are shared with their near neighbours, which distinguish them from both the main Solomons and the cultures of Vanuatu to the south. These include an important arboriculture subsistence base, the construction of round houses, the use of the backstrap loom, the use of an elaborate red-feather exchange valuable, the construction of stone-faced dance circles, and most emblematic, the use of *tepukei*, a style of sailing outrigger canoe (Haddon and Hornell 1997, vol. 2: 40). A series of other distinctive items of material culture (e.g., *Mitra* shell adzes, sling stones) appear within the post-Lapita archaeological sequence. The linguistic evidence indicates they followed the Lapita leapfrog path bypassing the already-settled main Solomons.

Doherty was investigating the extent to which she could see a significant disjuncture in the archaeological or cultural sequence of Santa Cruz which might be associated with a change from a Lapita, presumably Austronesian, culture to what was considered at the time to be a NAN or "Papuan" influenced culture. After carefully examining the archaeological record, which extended from Lapita up to the historic period, she concluded that there was no major disruption apparent in any aspect of the record; instead, Santa Cruz appeared to be the recipient of many cultural influences over the span of the record.

Doherty (2007: 473) concludes:

> The archaeological evidence overall suggests continuity, with additional inputs over time from diverse sources, not cultural replacement. It can be noted that Santa Cruz and the Main Reefs Islands are geographically situated to receive castaways as well as purposeful visitors from east and west. At different times, different influences washed through here (e.g., from Micronesia and Polynesia)—probably more than we know of from the archaeology—but not at a rate or scale that is incongruous in the wider regional context. Networks of interaction of varying geographical scales can be recognised at different time periods. To this extent, history in the islands is reticulate. (Doherty 2007: 473)

This conclusion would support the genetic argument of Lipson *et al.* (2020) of a long-term gradual stream of influence (Anthony 1990) from the Bismarck Archipelago following the Lapita navigational path into a resource-rich new environment free of malaria (Sheppard 2011). Archaeologically the only strong signal is the loss of the Lapita design system ca. 700–600 cal BC and perhaps a change in settlement organisation which created new forms of deposition in the form of habitation and midden mounds (Doherty 2007: 163–67, 183; Walter and Sheppard 2017: 122), unseen in the Lapita period. House and midden-mound formation appears to begin in the Plainware period and continue on through the sequence. Ceramics within these sites are very fragmented (Doherty 2007: 357), indicating a different formation and depositional process compared to the earlier Lapita sites. Evidence for such kinds of archaeological deposits is not common in the main Solomons, although their appearance on Makira (Green 1976c; Miller 1979), Santa Ana (Swadling 1976) and Uki (Green 1976d) in the eastern Solomons might be significant given some evidence of a limited (Pugach *et al.* 2018) genetic relationship with Santa Cruz.

THE ORIGINS OF SOUTHEAST SOLOMONIC

Given what we now know about Lapita expansion in the Solomon Islands, the origins of the languages of the Eastern Solomons–Southeast Solomonic are enigmatic. For Green (1976b: 49) the assumption was an association with the Austronesian spread by Lapita forming part of a proposed Eastern Oceanic language group along with the languages of Remote Oceania. However, if they were not created through a Lapita/Austronesian settlement, how did they originate? Were they formed by non-Lapita Austronesian speakers? The major cultural, linguistic and genetic boundary in the main Solomon Islands is marked by the Tryon–Hackman (Ross 1988) line (Fig. 1) which runs north–south across the easternmost end of Santa Isabel, dividing the main Solomons into eastern and western areas. To the west are the Austronesian languages of Northwest Solomonic which extend up through

Bougainville and Buka to Nissan, and to the east the Austronesian languages of Southeast Solomonic. The linguistic difference across this boundary is significant. Languages within these areas are closely related and people often speak or understand a number of neighbouring languages; however, across this boundary people say they cannot "hear" languages, and Ross (1989) considers the "sharpness" of this boundary to be like that between French and German. The Northwest Solomonic area also includes the greatest number of NAN or "Papuan" languages found in Island Melanesia (Wurm 1975), a very interesting fact in itself, although the easternmost NAN language is found in the Southeast Solomonic area on Savo, which lies just off the northwest coast of Guadalcanal. Ross (1988: 262; 2010: 250) locates the origins of the speakers of Proto-Northwest Solomonic in southern New Ireland.

Ross suggests Northwest Solomonic split from its Meso-Melanesian parent sometime after the initial breakdown of Proto-Oceanic (POc) with a movement into the western Solomons; if we assume the movement of Temotu as a first-order division of POc dates to 1000 BC, then the time represented by the formation of Proto-Northwest Solomonic would fall after that (Ross 2010). Ross proposes, however, in an effort to explain the presence of the Tryon–Hackman line, a two-wave model of expansion into the northwestern Solomons, first a movement of Old Oceanic speakers ca. 1100 BC as part of an Early Lapita expansion throughout the Solomons, including the eastern Solomons and into Remote Oceania, followed by the movement of Northwest Solomonic speakers in the Late Lapita period, following an argument by Felgate (2007). Ross (2010: 25) explains: "For socioeconomic reasons which perhaps entailed symbiotic relationships with Papuan speakers (cf. Dutton 1994), the NWS southeastward expansion stopped roughly at the furthest point of much earlier Papuan expansion. At some date after this, NWS speakers came into contact with SES speakers and the Tryon–Hackman line came into being." Ross sees limited but suggestive linguistic evidence from loans for an earlier Old Oceanic substratum in the western Solomons, although there are no current languages descended from Old Oceanic in that region, which makes the proposal problematic for Pawley (2009: 536) unless the earlier colonists were very small in number. There is also no archaeological evidence of an Early Lapita presence, and we now know that the leapfrog hypothesis of Early Lapita bypassing the Solomons is firmly supported.

We now have over 37 Late/post-Lapita sites found throughout the western Solomons as the result of research by a number of different research teams working since 1996 covering most islands in the region (Sheppard 2019). During the same period ongoing research in the eastern Solomons has repeated the success of the Southeast Solomons Culture History Project (Green and Cresswell 1976) and found no Lapita ceramic (or any ceramic) sites in that region. It is clear that with the marked difference in languages there is also a distinctive culture history which in the eastern Solomons has not included a ceramic tradition. This is also supported by the probable[1] absence in Southeast Solomonic of linguistic reconstructions for clay or cooking pots which are found in POc (Ross 1996) and present in Western Oceanic, including Northwest Solomonic, while POc terms for wooden bowls to mash nuts or other wooden containers are found in Southeast Solomonic.

The movement of Proto-Northwest Solomonic into the western Solomons would appear to be correlated with a very Late Lapita tradition, evidenced by a few dentate stamped sherds and carinated pot forms dating ca. 700–600 BC as part of a much larger incised and appliqué design tradition which lasted for some unknown time, but likely until at least AD 0 and persisting in some areas as a plainware tradition into the historic period (Sheppard 2011; Sheppard and Walter 2009). The incised and appliqué tradition has clear affinities with Late/post-Lapita ceramic assemblages from New Britain (Watom), southern New Ireland and Tanga (Garling 2003, 2007), which is the source region for speakers of Northwest Solomonic. This movement correlates in time with the movement of people with "Papuan" genes into Remote Oceania as discussed above and is possibly part of the same period of expansion which saw the appearance of a mid to Late Lapita–derived ceramic tradition on the south coast of New Guinea in the Port Moresby area (Sheppard *et al*. 2015).

Whence Southeast Solomonic?

What then explains the position and history of Southeast Solomonic? It is significantly different to its neighbours to the east and west, although like all Austronesian languages in Near and Remote Oceania it finds its ultimate origin in Proto-Oceanic spoken in the Bismarck Archipelago region (Ross *et al*. 2016) over 3,000 years ago, although Pawley finds "no decisive evidence to subgroup SE Solomonic with any other branch of Nuclear Oceanic" (Pawley 2009: 537) (i.e., all non-Admiralties Oceanic). Both Ross (1988, 2010) and Pawley (2009) attribute much of the distinctive nature of Northwest Solomonic to ongoing interaction and borrowing from NAN-speaking "Papuan" neighbours (Dunn *et al*. 2005; Sheppard *et al*. 2010), which has created considerable diversity compared to the very conservative languages of Southeast Solomonic which show very little borrowing (Pawley 2006). Only two "Papuan" languages currently exist within the southeast Solomons: Savosavo on a small island (Savo) within sight of Honiara off Guadalcanal, and Lavukaleve, spoken in the Russell Islands 40 km west of the western end of Guadalcanal. In the northwestern Solomons today we find six "Papuan" languages spoken by considerable numbers of people on Bougainville, Vella Lavella and Rendova (Sheppard *et al*. 2010; Wurm 1975: 791). The lack of "Papuan" borrowing in Southeast Solomonic would attest to its separate history from Northwest Solomonic and absence of the same sort of "Papuan" interaction indicating little shared history.

In 2006 we suggested (Sheppard and Walter 2006) that speakers of Proto-Southeast Solomonic must have come from a location without a ceramic tradition, and the closest suspect might be to the east in Temotu after it became aceramic ca. 200 BC. Pawley (2009: 536) reviewed our argument and concluded that Southeast Solomonic, as a well-defined subgroup of Oceanic, must have separated from the ancestors of Fijian and Polynesian no later than 1000 BC and, using glottochronology, that it has been present in the eastern Solomons for at least 2,500 and probably 3,000 years. Pawley does not, however, offer any place of origin for Southeast Solomonic. This would leave it surrounded by ceramic-making communities to the east and west. The alternative hypotheses left would then be a movement of pre-Lapita aceramic Austronesian speakers into the Solomons or a pre-Northwest Solomonic movement, as suggested by Ross, throughout the main Solomons who were or became aceramic very quickly.

Genes and Southeast Solomonic

Is there evidence in the available DNA results to support any of the proposed hypotheses concerning the origins of Southeast Solomonic? First, there is clear evidence to support a different genetic history for populations in the eastern Solomons versus those from the west with samples forming distinct, well-separated distributions on plots of PCA or cluster analysis results (Lipson *et al*. 2020; Pugach *et al*. 2018). Lipson *et al*. (2020: fig. 2) report the most comprehensive analysis of Solomon Island data. This includes one ancient DNA sample from Malaita which plots in with modern Malaitan samples. Modern samples from Makira, the easternmost island of the main Solomons, are considerably variable and plot along a gradient which take them down into the modern Vanuatu distribution and close to ancient samples from Eretok (Retoka Island, Efate, Vanuatu). The Malaitan ancient sample dates to cal AD 1310–1370 (2δ) (Posth *et al*. 2018: table 1), while the Erotok samples from the Roi Mata burials (Garanger 1982) date to ca. AD 1600 (2δ) (Lipson *et al*. 2020: table 1), and are reported as having a high proportion of FRO (First Remote Oceanic) ancestry (i.e., Lapita). Pugach *et al*. (2018) in their earlier study reported:

> The western SI [Solomon Island] populations share more with Tonga than with the PO [Polynesian Outliers]. In contrast, populations from the eastern SI (Russell, Gela, Savo, Malaita, and Makira) show more Papuan-related ancestry than the western SI and also exhibit more sharing with the BA [Bismarck Archipelago] than with Bougainville or the western SI (except Isabel…). They also do not show any particular recent links to Santa Cruz. In addition, like many other islands across the SI chain, Makira and Savo show a recent genetic relationship with the Tolai from New Britain. (Pugach *et al*. 2018: 879)

As I have noted elsewhere (Sheppard 2019), care needs to be exercised in interpreting modern DNA from the Solomons as there is and has been considerable admixture from various recent historic events. This includes introduction of Polynesian Outlier DNA from Ontong Java (Luangiua) into western Santa Isabel as the result of drift voyages and nineteenth-century capture, and the effects of the Methodist missions' introduction of Polynesian missionaries, often Sāmoans, Tongans and Fijians, by Reverend George Brown, who established a mission to East New Britain, the Duke of York Islands and neighbouring New Ireland in 1875 and to the western Solomons in 1902 (Brown 1908; Reeson 2013: 89). The descendants of some of these missionaries can be found in the western Solomons today. Some of the earliest Polynesian mission teachers in the Tolai area were from Lau in Fiji and very likely were genetically Tongan, given the settlement of Lau by Tongans in late prehistory.

If, as Pawley (2009) argues, the breakup of Southeast Solomonic occurred prior to 1000 BC then the genetic evidence would suggest a movement of aceramic Austronesian speakers prior to the development of the Lapita ceramic tradition ca. 1520–1060 (2δ) cal BC based on evidence from Mussau (Cochrane *et al*. 2021: 7) or within the period 1750–1450 BC (Kirch 2021: 162), perhaps lightly occupying the eastern Solomons in an area of limited occupation by "Papuan" hunter-gatherers, as suggested by the low rate of loans from "Papuan". Alternatively, or in addition, the Makira data suggests a linkage to the south with Temotu and northern Vanuatu following the arrival of genetic "Papuans" in the area ca. 500 BC. This might explain the small amount of late plainware recovered from Santa Ana in the very late to post-Lapita period and be the result of drift voyages or sporadic connections to areas directly east in Temotu. We do know from the distribution of chert to Lapita sites in Temotu from Malaita/Ulawa that the eastern Solomons were within the Temotu interaction sphere during the Lapita period. This southeast Solomons interaction sphere would appear to have been active at different scales from the earliest settlement of Remote Oceania.

MARGINAL EAST MELANESIA–CENTRAL MICRONESIA INTERACTION ZONE

As Pawley (2009: 537) notes, amongst the variety of areas showing some linguistic evidence suggesting periods of shared history with Southeast Solomonic is Micronesia. The origins of Nuclear Micronesian appear to be almost as obscure as those of Southeast Solomonic. Following Pawley (2017, 2018) all languages of Micronesia except Palauan, Chamorro, Yapese and those of the Polynesian Outliers of Nukuoro and Kapingamarangi are considered to fall within the Oceanic Austronesian family and are grouped into Nuclear Micronesian. Pawley (2018: 325) locates Proto-Nuclear

Micronesian as spoken on one or more high islands (e.g., Pohnpei, Kosrae) in central Micronesia with innovations indicating a considerable period of separation from all non-Micronesian languages. Blust (1984, 2010) is to my knowledge the only linguist to publish arguments relating languages of Southeast Solomonic to Micronesian. In 1984 he described a series of cognate forms which he argued were shared exclusively by Nuclear Micronesian and Cristobal–Malaitan, now called Longgu/Malaita/Makira languages (LLM), one of two major subgroups of Southeast Solomonic, the other being Guadalcanal–Nggelic (the languages of Bughotu on the eastern tip of Santa Isabel and those of Nggela (Florida Group) and Guadalcanal) (Lichtenberk 2010). Blust called the language to which these innovations were attributed "Proto-Malaitan-Micronesian" (PMMc). In replying to a critique of his proposal by Lichtenberk (1988, 2010) Blust states that Lichtenberk's objection "deflects attention from a potentially valuable set of comparisons that suggest that LLM and Nuclear Micronesian (NMc) languages experienced a period of exclusively shared history apart from other Oceanic languages that was subsequently overlaid by the coevolution of all languages in the southeast Solomons" (Blust 2010: 560). Where this short period of shared history might have occurred is not suggested; however, the chronology and potentially the geography might be informed by the archaeology and timing of Micronesian settlement (Davidson 1988). Earlier studies have proposed relationships with northern Vanuatu/Temotu (Grace 1964; Pawley 1972; Song 2009) and the Admiralty Islands (Smythe 1970) and/or Mussau (Kirch 2001: 51; Ross 1988: 326).

The earliest sites in the islands of eastern and central Micronesia are coastal and submerged. Dating suggests to Athens (2018) settlement in a brief pulse of extensive region-wide activity in a narrow window between 0 and 200 AD. Submerged sites with small amounts of ceramic have been found on the high islands of Pohnpei, Kosrae and Chuuk. This pottery is generally calcareous sand tempered with very limited rim notching and small amounts of punctation on Pohnpei and plain elsewhere. Temper analysis indicates they are all locally made (Dickinson 2006: 30). Athens relates the ceramic assemblages to Late Lapita Plainware. It seems probable that these earliest submerged sites were stilt villages like those known from Lapita sites in the Bismarck Archipelago and the western Solomons (Athens 2018; Nagaoka and Sheppard 2021).

Micronesian Interaction with the Solomon Islands

In 1909 the German ethnologist Fritz Graebner[2] commented, based on his study of Santa Cruz and Melanesian material culture, that "[o]ne of the most interesting phenomena of South Seas ethnology is the zone of Micronesian cultural influence, which extends along the northeast edge of the Melanesian archipelago and terminates in Santa Cruz" (Graebner and Schütze 1909: 193 [175]). There is considerable evidence in both ethnographic and archaeological material culture of a long history of interaction within a zone stretching from northern Vanuatu through Temotu, along the scattered chain of islands which run north off the eastern coast of the Solomon Islands up to Mussau, which is the northeasternmost point of Island Melanesia, and on north into central and eastern Micronesia (Fig. 2) (Intoh 1999, 2002, 2017). This Marginal East Melanesia–Central Micronesia (MEMCM) Interaction Zone provides a safe voyaging field which for the most part could have been within sight of land (Irwin 2008). Seasonal winds would have provided favourable crosswind voyages from Micronesia to the south during the summer northwest trade winds season and north with the winter southeast trades (Woodford 1916: 30). Computer voyaging simulation demonstrates considerable success for voyages into Micronesia originating in the Temotu region (Irwin 1992: 119–20) or the Solomons (Montenegro *et al.* 2016:

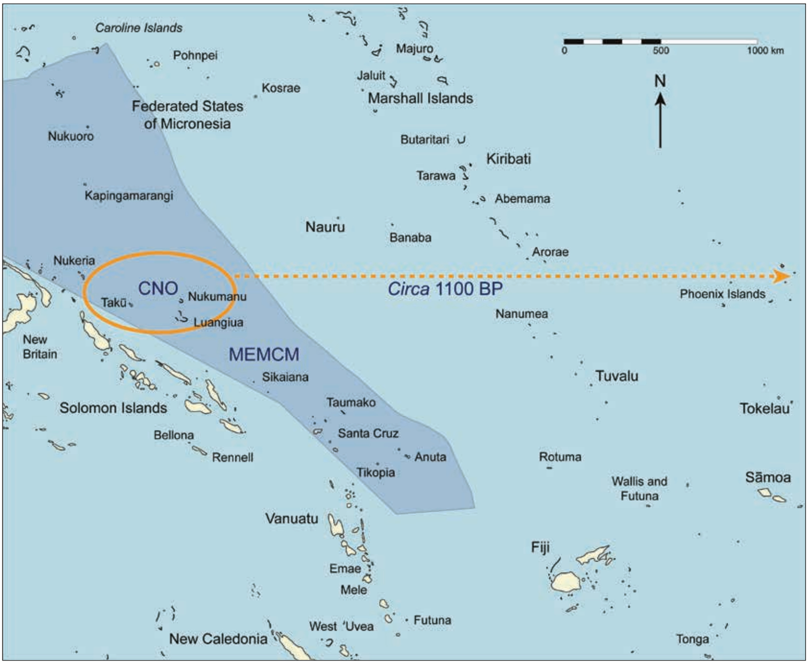

Figure 2. Marginal East Melanesia–Central Micronesia (MEMCM) Interaction Zone and location of the Central Northern Outliers (CNO).

12690) and drift voyages from Kiribati to Taumako (Leach and Davidson 2008: 477). Oral tradition on Nukuria reports voyaging associated with immigration from Nukuoro to the north, Nukumanu and Sikaiana to the south and Tarawa (Kiribati) and Nukufetau (Tuvalu) 2,600 km to the east (Parkinson *et al*. 1986: 8–9; Parkinson 1999: 227). Oral tradition also records seasonal travel between Ontong Java and Tikopia (1,200 km) in large sailing canoes to obtain ritually important turmeric which was traded along the chain north to neighbouring Polynesian Outliers (Bayliss-Smith 1978). Folklore in Takū (Moyle 2007: 22, 26) describes the chain of Outliers stretching south along the Solomons to Tikopia as *te atu lou*, a chain connected by culture and direct contact through seasonal voyaging, ending at Tikopia, the ancestral source of turmeric. To the south oral tradition and historical records report irregular but common travel between Anuta and Tikopia (Feinberg 2003).

Voyaging in Marginal East Melanesia

There is considerable evidence of voyaging in large ocean-going sailing canoes between the Polynesian Outliers within this interaction zone. In Ontong Java oral tradition records an 18 m long canoe with a small house carrying 20 men travelling on a return voyage to Tikopia 800 km southeast, probably in the early nineteenth century, and in 1910 an early ethnographer (Parkinson *et al*. 1986: 21, 29) reported several plank-built 10–14 m long canoes (*vaka fai laa*) rotting on the beach at Takū, located 300 km northwest of Ontong Java (Bayliss-Smith 1978; Moyle 2018). At Taumako in 1606, during the visit of the Spanish explorer Quirós, large double canoes capable of holding 60 people and 60 feet long were described (Barwick and Stevens 2016: 15, 17; Leach and Davidson 2008: 16; Markham 1967: 230, 360), and a captive from Sikaiana (250 km northwest of Taumako) named Pedro, captured at Taumako, was taken to Mexico where he described a visit to Sikaiana of a similar double canoe holding 110 people (Markham 1967: 494). Canoes of that size were not seen by visitors in the nineteenth century, and it is probable that there was a very long history of large canoes drifting or travelling from Sāmoa/Tonga arriving on these Outlier islands, as described in oral tradition (Firth 1961; Hogbin 1940; Moyle 2007; Woodford 1916). To the east-northeast of these Outliers, 1,200 km, lies the western edge of the Micronesian islands of Kiribati, which span the equator and form the first islands east of the northern Outliers and northeastern Melanesia. Their oral tradition (Grimble 1989: 289, 322) describes earliest settlement from the west, but like many of the Polynesian Outliers they have oral traditions of connections with Sāmoa with a major “invasion” from Sāmoa from whom modern people descend and which Grimble (1989: 332) dates to AD 1250–1275. Large voyaging canoes (*baurua*) as much as 23 m long were observed in the early nineteenth century in Kiribati (Haddon and Hornell 1997: vol. 1: 359).

The common sailing outrigger canoe seen in Temotu is tepukei (Fig. 3a,b), famously used in the complex interisland trading system which linked the entire region (Davenport 1962; Sheppard 2020). There were no large outrigger sailing canoes used historically in the main Solomon Islands, where large dugouts and beautiful plank-built canoes dominated and were used in trade and raiding (Sheppard 2021), although small, paddled outriggers are known throughout the region (Haddon and Hornell 1997: vol. 3: 81). Sailing outrigger canoes of the size of tepukei appear only on reaching the Bismarck Archipelago, where outrigger canoes were most commonly used; however, the *mon* type of plank-built canoe like that seen in the northwestern Solomons is found in southern New Ireland, from which it appears to have originated (Sheppard 2021).

Haddon and Hornell describe tepukei as follows:

> The Santa Cruz craft are unlike any others. The hulls are simple dugouts without washstrakes or endpieces, and in these respects are similar to canoes from many other places, but the narrowness of the opening is peculiar and finds its nearest analogue in northern New Ireland [including New Hanover, Emirau and Mussau]. In the large sailing canoes the hull is little more than a float to support the large transversely extending platforms. The whitening of the canoes with lime is also a feature of many New Ireland canoes and occurs also at Wuvulu [west of Manus].
>
> The connectives of the two booms are essentially similar to those found in the southern New Hebrides and Fiji. For a closer analogy of the outrigger apparatus, one must turn to Micronesia [Marshall Islands, Kapingamarangi, Kiribati (Nonouti)] though not for the structure of the body of the canoe. (Haddon and Hornell 1997: vol. 2: 50)

Graebner also comments on the similarities of tepukei to canoes of Micronesia and notes other similarities in material culture in his detailed theory of Santa Cruz culture history (Graebner and Schütze 1909: 161–213).

> The outrigger type of boat resembles neither the Melanesian nor actual Polynesian forms, but rather its closest relatives are found on Ponape and the Marshall Islands. Both have the curved transverse pieces extending from the outrigger bridge to the outrigger beam, which on Ponape are combined with the vertical connecting rod. The system of walls protecting each house individually—not the bastion-like constructions outside the villages—and the island fortifications mentioned by Quiros resemble the well-known, still enigmatic constructions on Ponape and Kusaie. The use of Curcuma [turmeric] to color the body and the mats. For example, the ornamentation whose second chief element—besides that of the totem culture—is closely connected with the style characterized by designs of triangles, rhomboids, and fish, from Uluthi, Truk-Mortlock, Ponape, and the Gilbert Islands, the

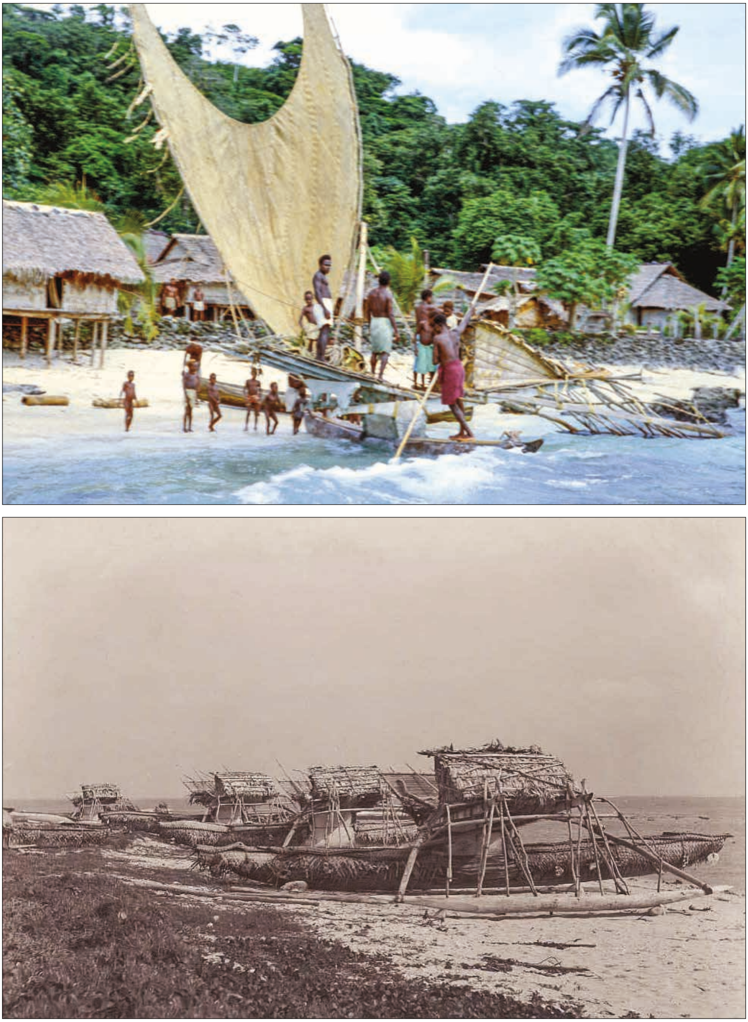

Figure 3. (a) *Top*: Temotu tepukei. Photo by William Davenport with permission of the University of Pennsylvania Museum.
(b) *Lower*: Sailing canoes on the beach, Pileni, Reef Islands, Swallow Group, Solomon Islands, 1906. Photo by J. Beattie, courtesy of the National Library of Australia, PIC/7580/210 LOC Album 461. https://nla.gov.au:443/tarkine/nla.obj-141059262

> sandals, and especially the ear ornaments, which are quite similar to those used on Truk-Mortlock, constitute further points of contact. The ear plug, too, is found on the central Carolines. Since the analogies mentioned overlap in part into eastern Micronesia, the following may be mentioned as special points of contact with this part of the area: the sounding rods known on the Marshall Islands, the square club of the Gilbert Islands, and the small stick for catching flying fish, which is likewise verified for the Gilbert Islands, but also for the region west of the Palau group. (Graebner and Schütze 1909: 193)

Material Culture Evidence of Interaction with Micronesia

Graebner had also commented on the presence of the weaving loom (Fig. 4) in Santa Cruz, which he traces from Micronesia, arguing that it represents a primitive form appearing in Santa Cruz before it diversified in design in Micronesia (Graebner and Schütze 1909: 189). This backstrap loom, used to weave banana fibre, is found throughout Indonesia, from where Riesenberg and Gayton (1952) argue it was introduced into the Caroline Islands of eastern Micronesia, and subsequently along the Polynesian Outliers from Nukuoro and Kapingamarangi south to Nukuria, Takū, Nukumanu (Parkinson 1999: 238–41), Ontong Java, Sikaiana, Taumako and Tikopia and in Temotu on Matema in the Reefs, Santa Cruz, Gaua in the Banks Islands, at Santo in Vanuatu, within the Bismarck Archipelago in the St Matthias group (Mussau, Emirau, Tench) (Parkinson 1999: 148) and in the Takar-Saar coasts of West Papua (the Jobi region, Sarmi and the islands of Kumamba, Wakde and Jamna). It is not found elsewhere in Oceania. This introduction would have occurred post AD 0 in Micronesia and early in its history into the marginal islands of eastern Melanesia and south to Temotu where it appears in an early form (Riesenberg and Gayton 1952). Most recently Buckley and Boudot (2017) have conducted a phylogenetic analysis of Asian looms that links those of Santa Cruz with those of Micronesia, in a group that includes looms from the Philippines. Its near ubiquitous distribution in the northern and central Polynesian Outliers would appear to link it with the development of Polynesian tradition in those islands; however, its absence in East Polynesia would date its introduction to after settlement of that region ca. AD 900 (Sear *et al*. 2020). On Taumako impressions of loom-woven cloth are found on excavated shell ornaments from the Namu period and would appear to be older than AD 1500 (Leach and Davidson 2008: 190).

Kite fishing is another practice and technology which has a very similar distribution to that of the loom. Anell (1955: map 4, 39) describes the distribution of this form of fishing for garfish (*Zenarchopterus*), using a kite dragging a bait of spider web or shark skin over the surface of the water. Kite fishing is found from Indonesia east into the eastern and central Caroline Islands of Micronesia; elsewhere in Micronesia kites were known and flown but not used in fishing. In Island Melanesia kite fishing was known

Figure 4. Temotu backstrap loom. Photo by William Davenport, with permission of the University of Pennsylvania Museum.

among the Jabim (Huon Peninsula) and the nearby Tami Islands and to the immediate west of New Britain on Umboi (Siassi). To the south it was very common in the many islands of the Massim region in the Solomon Sea off the southeastern coast of New Guinea. In the Bismarcks it was known in the Admiralties but not in New Britain, the Duke of Yorks or New Ireland; however, it was found in the northeastern peripheral islands of the St Matthias Group, Mussau, Tench and Emirau. It would appear to be found in a continuous distribution from Buka (Parkinson 1999: 222) south through the main Solomons, although Anell did not have evidence from Choiseul or Makira. In Temotu it is found in Santa Cruz, the Reefs and Vanikoro and south to the Banks Islands and Ambae and Malekula in Vanuatu. While the fishing kite is not known from areas south or east into Polynesia (Anell 1955: 35), the kite flown as a ritual object or for entertainment was known throughout East Polynesia, although apparently not in Fiji or West Polynesia (Anell 1955: 35; Chadwick 1931) prior to the historic period. The term MANU.1C [NP] Kite is reconstructed for Nuclear Polynesian and reported in Pollex (Greenhill and Clark 2011) from East Polynesia and the Polynesian Outliers of Sikaiana, Tikopia and Nukuoro in Micronesia.

Kite flying as entertainment or as part of ritual, such as in East Polynesia where it is associated with gods and chiefs (Chadwick 1931), is found from

Indonesia through Micronesia and Melanesia, with the exception of New Caledonia (Anell 1955: 35), and through the Polynesian Outliers and East Polynesia. This distribution indicates it was not a Lapita or Proto-Oceanic introduction. It seems likely it was introduced through Micronesia after the settlement of central Micronesia, post AD 0, and was subsequently distributed east from the Outliers into East Polynesia. The fishing kite, which is absent in East Polynesia, would appear to have been developed after that settlement and be a late development which Anell (1955: 40) places in the outer island zone of the Bismarck Islands (Admiralties to St Matthias Group) or the Massim region in northeastern Melanesia from whence it was distributed north into Micronesia and south through the Solomons into Temotu.

The distribution of fish-hook forms in Oceania is also indicative of relationships spanning the southeast Solomons. Anell (1955: 91, 96) reports, following Te Rangi Hiroa (1930: 294) and Burrows (1938: 12), that the simple or one-piece fish-hook used in angling was not found historically in West Polynesia and possibly not in Fiji. It was found throughout Island Melanesia, although possibly not on Santa Cruz (Graebner and Schütze 1909: 187), but was very important in Micronesia, the Polynesian Outliers and East Polynesia. In Island Melanesia and Micronesia turtle shell is often used in their manufacture. The absence in West Polynesia would suggest in the first instance that the fish-hook was not a Lapita introduction or was of secondary importance, although linguistic evidence indicates terms for angling and hooks from Proto-Oceanic (Walter 1989). Single-piece fish-hooks are, however, known from Lapita sites throughout their distribution (Ono *et al*. 2019), although not common, and archaeologically they are rare in any period in West Polynesia or in Vanuatu (Garanger 1972: 108), whereas shell hooks are very common in East Polynesia. Small but significant finds of shell single-piece fish-hooks in West Polynesia are from Ofu and Olosega in the Manuʻa Group of eastern Sāmoa with 28 small *Turbo* shell single-piece hooks found associated with Polynesian Plainware at <835–656 cal BC (Petchey and Kirch 2019) at the Toʻaga site (Kirch and Hunt 1993) and 54 fragments and similar whole hooks from two additional sites in similar plainware contexts reported by Quintus and Clark (2020). Another small sample (four) of small *Turbo* shell hooks comes from Niuatoputapu in late Plainware contexts (Kirch 1988: 204), while Tongan Lapita sites have produced a small number (seven) of *Turbo* and pearl-shell single-piece hooks (Burley and Shutler 2007) scattered through Lapita and Plainware sites, and Lapita contexts in New Caledonia have produced a similar number (five) of *Turbo* hooks (Sand 2010). It would seem possible that Lapita fishing was more focused on mass-capture techniques such as netting, spearing and poisoning in reef-lagoon settings than on angling in more open ocean settings (Kirch 1997: 200; Kirch and Dye 1979; Ono *et al*. 2019). The small number of shell fish-hooks in Lapita and West Polynesian contexts is highlighted by their abundance in early ceramic contexts in the Polynesian Outliers of Anuta (Kirch and Rosendahl 1973: 62) and Tikopia, where in early Plainware ceramic contexts, similar to that of Niuatoputapu, close to 300 pieces of fishing gear, including *Turbo* hooks of similar form, are reported by Kirch (1982, 1988), highlighting the contrast. The pattern is repeated in Taumako where over 40 hooks and blanks made from *Trochus* (*Rochia nilotica*) and *Turbo* shell of a variety of forms were recovered from the early Tavatava rock shelter site, in a Late Lapita or Plainware context (Leach and Davidson 2008: 108, 309). No fish-hooks are reported from the early Reef/Santa Cruz Lapita sites; however, one-piece fish-hooks of pearl-shell were recovered from Plainware contexts on Santa Cruz at Mdailu and at the Növlaö rock shelter.

Davidson describes one-piece hooks from the Outlier Nukuoro in eastern Micronesia:

> Some confusion arises from the lack of published examples of Type V hooks attributed to Nukuoro (the only one is an incomplete example figured by Finsch), the use of the name *maimoni* for Type I hooks by Kubary and Eilers and their failure to record the name *buledango*. There is no doubt, however, of the importance of the Type V hook in Nukuoro pre-history, for its popularity at Nu-1 was reflected at other excavated sites. Nor is it absent entirely from the ethnographic record, for it is the most numerous in the kits of hooks attributed to the Society Islands (Edge-Partington 1895, pls. 20, 21; Beasley 1928, pl. LX) which can now clearly be seen to be of Nukuoro origin, as Emory and Sinoto suggested (Emory & Sinoto 1965, p.88). (Davidson 1971: 41)

Trolling Lures as Evidence of Interaction

The trolling lure, used generally in the capture of pelagic skipjack bonito (*Katsuwonus pelamis*) and other tuna (Bell *et al*. 1986: 55) that can be found at the surface in large schools in the tropical Pacific, is found in Lapita sites in small numbers made of *Trochus* shell (Kirch 1997: 201) throughout the Lapita distribution (Burley and Shutler 2007; Leach and Davidson 2008: 309; Szabo 2007; Szabó 2010), although the incidence of bonito or other pelagic fish is uncommon in Lapita sites (Ono *et al*. 2019). The Early Lapita prototype (Fig. 5) may have been like that from the Talepakemalai site in Mussau, which is a simple one-piece *Trochus* hook with grooved notches at the proximal end for a line attachment and grooves at the base for possible attachment of hackles (Kirch 1997: 200–201). A very similar trolling hook was found in the eponymous Early Lapita site (WKO013A) in New Caledonia, with Sand indicating a similar form from the St Maurice–Vatcha Lapita site on Île des Pins (Sand 2010: 191). Most, and perhaps all, of the Late Lapita/Early Plainware lures are single-piece trolling hooks.

The largest and most complete sample is from the TK-4 excavation in Tikopia, where three lure shanks in *Trochus* were recovered from the Kiki Late Lapita/Lapitoid phase (Kirch and Yen 1982: 244) which date to the Late Lapita/Plainware transition period (TK-4 UCIAMS-13474 2625 ± 15 BP; TK-36 UCIAMS-13477 2590 ± 15—both on *Rattus exulans*) (Kirch and Swift 2017). These lure shanks are missing their points through breakage; however, the proximal ends of two show distinctive projecting upright line-attachment features or snoods, which, although ethnographically unique, might be most closely matched in examples from the eastern Solomons, where protuberances are used as line attachments (Cummings 1973: fig. 2). The Tikopia line attachment forms are also found on a lure from a probable Late Lapita context in Watom, New Britain (SAB Vunaburigai, Trench SAB/I layer 22, Jim Specht, pers. comm., 2021), and six virtually identical forms were excavated from a Plainware context at the Mdailu site (SE-SZ-33) on Santa Cruz, while a similar form was recovered from Te Ana Tavata on Taumako in an early Plainware context (Doherty 2007: 244; Leach and Davidson 2008: 110, 308; McCoy and Cleghorn 1988: 110).

Each of the TK-4 shanks have perforations drilled through the base of the shank at the distal end which Kirch and Yen suggest may have been used to attach hackles, as is common in ethnographic examples of composite hooks. Identical perforations are found on the distal point base of *Trochus* shanks recovered from the Lapita site of Bourewa in Fiji (Szabo 2007: fig. 15.16) and from Vaipuna in Tonga in Late Lapita/Plainware (CAM 41531 2620 ± 50 BP) transition contexts (Burley and Shutler 2007: fig. 10.13). Kirch and Yen (1982) argued that this single trolling hook form may have been part of a widespread "Lapitoid" form, although Kirch and Green (2001: 132, 140) find there is limited archaeological evidence for it as part of an early Ancestral Polynesian fishing kit; however, they make a linguistic argument for the presence of a single-piece *Trochus* trolling hook. Both Szabo and Burley and Shutler argue that their examples are the point portion of composite hooks. An additional example of a composite bi-perforated hook point made of pearl-shell was excavated from TK-20 (Tuakamali Phase post 1400 AD) on Tikopia (Kirch and Yen 1982: fig. 95n) in a late prehistoric context and is reported to be identical to modern examples held by Tikopians as ancestral heirlooms (e.g., Beasley 1980: plate XCVII).

Anell (1955: 145) reports that two-piece trolling lures or spinners are found historically in only a few areas on the northeast coast of New Guinea and with only a few reports from the Bismarck Archipelago including on northeastern New Ireland and offshore islands, and on Nissan. The area of intensive use and variety is to be found throughout the Solomon Islands with distinct differences reported for the north and western Solomons compared to those in the southeast (Bell *et al*. 1986; Cummings 1973). The trolling

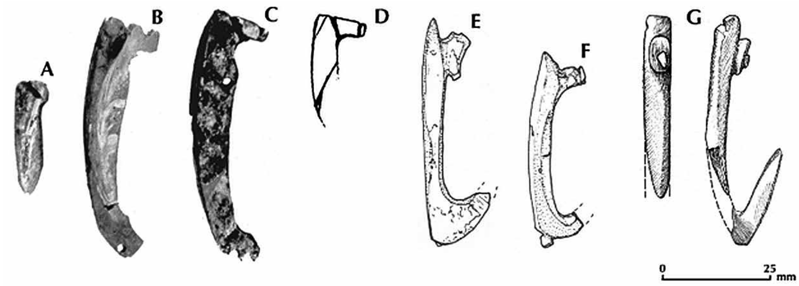

Figure 5. Comparison of *Trochus* lures. A, B, C: Tikopia site TK-4, courtesy of Pat Kirch. D: SAB Vunaburigai, Watom, courtesy of Jim Specht. E, F: SE-SZ-33 Mdailu on Santa Cruz, courtesy of Pat McCoy. G: 78.249 and 78.257 Te Ana Tavatava Layer 4, Taumako. Figure 8.5 from Leach and Davidson (2008); image courtesy of Foss Leach.

lure is not reported historically from Santa Cruz (Anell 1955; Graebner and Schütze 1909). One lure is reported from the Reef Islands, likely from the Pileni Polynesian Outlier (Anell 1955: 163). To the south trolling lures were not found historically in Vanuatu or New Caledonia, and in archaeological contexts pelagic fish (Scombridae) are rare (Davidson *et al*. 2002: 156; Garanger 1972), with a complete absence of pelagic fish from deposits in Vanuatu (Bedford 2000: 231; Bouffandeau *et al*. 2018). It would seem that the Lapita tradition of exploitation of lagoon and reef fish, primarily by other means than angling, continued in this region throughout prehistory.

Contrasting with the situation in southern Melanesia, the chase of pelagic fish using trolling lures was common historically in Micronesia, West (including Fiji) and East Polynesia and the Polynesian Outliers with considerable elaboration in the design of lures (Anell 1955: 159–93). A major distinction is made between those in the Solomon Islands and eastern Micronesia (Ponape, Kosrae, Marianas, Marshalls, Kiribati, Nauru) which have a line attachment only at the top (proximal end) of the lure, with a point base fastened separately, which Anell (1955: 188) considers to be an early or "primitive" form, and those of Polynesia and areas of West Micronesia which have the line drawn down from the top attachment along the shank to the point base for a secondary attachment. Within this latter group an additional regional variation is found in the design of the point base and how it is attached to the lure body or shank. Lures with a point base which has been projected towards the proximal or head end of the lure, in such a fashion to allow additional perforations used for lashing, are characteristic of West Polynesia (Sāmoa, Tuvalu, Tokelau, Pukapuka and ʻUvea) and the Polynesian Outliers (Anell 1955: plate V)—with the exception of Rennell (Chikamori 1986) and Bellona, where trolling lures were not used—and the western Carolines as far west as Yap in Micronesia (Anell 1955: 156, 164). The Outlier forms typically have two perforations in the point base, which is made of turtle shell (Anell 1955: 162). Trolling lures in East Polynesia are characterised ethnographically as having a distal point projection extending towards the distal or bottom end of the lure allowing binding behind the point (Anell 1955: 174; Te Rangi Hiroa 1932: fig. 104). This distal form of point base is also found as a separate attachment in East Micronesia, where point forms and attachments are highly variable, and in the Solomon Islands, where a simple or distal attachment is standard (Anell 1955: 147, 151). Those of the Outliers were closest in form to those from Sāmoa, and Anell (1955: 164, map 112) describes the "Samoan" form as also prevailing in the central and western Carolines. Trolling lures were known in Tonga but apparently abandoned early in the historic period. Trolling lures are found throughout East Polynesia with the exception of the southern Cooks, Rapa, Mangareva and Rapa Nui (Easter Island), in southerly zones where skipjack may not have been common (Allen 2017). In Aotearoa New Zealand trolling lures were used to catch kahawai (*Arripis trutta*), which, like bonito, school and feed on the surface. Anell (1955: 174–78) distinguishes three basic varieties of lure in tropical East Polynesia using variation in the point form and attachment. The Tahitian form have one hole in the point with attachment from a short protuberance at the back of the hook while the Marquesan form has two holes in a distal base projection (Anell 1955: fig. 18). The Hawaiian form differs from most Polynesian forms in having "in most of the specimens" (Anell 1955: 177) no point base projection.

Although Anell describes both the Solomon Island and eastern Micronesian "spinners" as primitive forms, he nominates eastern Micronesia as "in all likelihood" the source region for the development of these hooks (Anell 1955: 189), which then influenced developments in Melanesia. This hypothesis was perhaps influenced by the availability in 1955 of archaeological samples of lures from Ponape and Kosrae. A pearl-shell trolling hook with a very similar line attachment to the Taumako sample described above is reportedly excavated from Kosrae or Ponape and illustrated by Anell (1955: 151; Intoh 1999: 416). Beasley (1980: figs 147, 197) describes them as three pearl-shell lures excavated from within the ruins of Nan Madol in 1895 by F. Christian. An additional excavated example from Nan Madol is dated to cal AD "894–1025" by Athens (2018: 286). Trolling lures of pearl-shell have been recovered from a number of other archaeological contexts in Micronesia including Nukuoro post AD 689–949 (2δ) (Davidson 1971, 1992), Palau (Masse 1986), Fais (AD 800–1400) (Ono and Intoh 2011) and the Marshall Islands (Ebon Atoll, Majuro AD 700) (Intoh 1999: 416; Rosendahl 1987: 95–98), with two additional specimens from burials on Majuro Atoll reported by Weisler (2000). The Marshall Island examples have distinctive head attachments (e.g., Rosendahl 1987: figs 1.49, 1.50) identical to those from Fais and Palau in western Micronesia, and Rosendahl, Intoh and Weisler compare them most closely to those from the Solomon Islands, with Weisler matching them to a lure from Star Harbour on Makira in the eastern Solomons recovered in a surface context by Green (1976d: fig. 40) and a lure excavated on Uki Island just off Makira (Green 1976d: 191; Kaschko 1976). The distinctive head attachment with flared projections on the head to secure the line attachment found in early Micronesian contexts predominates in the eastern Solomons (Bell *et al*. 1986; Cummings 1973: fig. 1, map 1). In his review Anell makes repeated observations linking lures from what he calls his southern Solomon Islands (Santa Isabel, Nggela, Malaita, Ulawa, Makira, Santa Ana) type with those of eastern Micronesia (Anell 1955: 148, 155, 186, 189) and describes the Solomons as a centre of excellence in lure production.

In his study of Solomon Island compound fishing lures Cummings (1973: 20) describes the eastern Solomons as the area of greatest diversity in form and distributional overlap, indicating considerable interaction within the area. In an update of that analysis Bell *et al.* (1986: 52) more narrowly define the area of greatest diversity as being in Malaita–Ulawa–Makira–Santa Ana–Santa Catalina and note its correlation with Pawley's (1972) Cristobal–Malaitan (Makira–Malaitan (Pawley 2009)) linguistic sub-group. It is in this area that bonito fishing has been significantly incorporated into ritual and cultural expression, creating a bonito cult shared across the region. This includes elaborate initiation/coming-of-age rituals for boys involving the use of special plank-built lightweight bonito canoes (Neich 2001) from which the initiate caught their first bonito upon the opening of the bonito fishing season (Mead 1973). Mead (1973: 82) reports that "[t]he bonito cult with its associated complex of frigate birds and sharks was central to the religious system, the value system and to the technological and artistic system of Santa Ana". This cult and its associated artistic forms were found throughout the eastern Solomons and in the easternmost islands (Santa Ana, Makira, Ulawa and South Malaita) involved significant interaction and cultural exchange. Carvings of bonito, frigatebirds and sharks figure prominently in the production of a distinctive art style often reproduced in bowl form (Davenport 1968). Intoh and Eda (2008) note that bowls in frigatebird form, like those of the eastern Solomons, were used in the central Caroline and Mortlock Islands.

Given available archaeological and ethnographic data the following hypotheses may be advanced as to the history of Oceanic fishing lures:

(i) In the Lapita period a limited range of simple one-piece trolling hooks and lures were used in pelagic fishing, which formed a small component of a fishing strategy which generally focused on reef and lagoon fishing employing other technologies.
(ii) In post-Lapita Plainware contexts this tradition continued.
(iii) In the Solomon Islands archipelago, where bonito were common and easily accessed, composite lures with single-head line attachments were developed out of a Late Lapita context and diversified in the eastern Solomons.
(iv) Lures of this form were distributed into eastern Micronesia during early settlement.
(v) Lures with a double line attachment were developed in the Sāmoan region from the Lapita form and distributed throughout the Polynesian Outliers.
(vi) Lures of a West Polynesian form but influenced by an eastern Micronesian design of distal point attachment are introduced with the settlement of East Polynesia.

Evidence from Shell Adzes

Terebra and *Mitra* shell adzes (Fig. 6) also provide archaeological evidence of contacts between Micronesia and Melanesia. Distinctive adzes made from these shells are not found in Polynesia, and they have not been found in the Philippines or Indonesia, nor in Anuta, Tikopia or New Caledonia. Davidson (1971) recovered large samples of this form from her excavations on Nukuoro and provides a comprehensive report on their distribution (see also Intoh 1999: table 1):

> *Terebra* (or *Mitra*) shell tools with the cutting edge at the aperture end are wide-spread in Micronesia and parts of Melanesia, being reported from archaeological contexts in the Marianas (Thompson 1932, p.55; Spoehr 1957, p.154), Yap (Gifford & Gifford 1959, pp.187–188), Palau (Osborne 1966, pp.451–452) and the New Hebrides where specimens from Fila are dated to 9th and 17th centuries (Shutler 1970, p.136; Shutler & Shutler n.d. plate 6B; Garanger 1966, pl. IV) and ethnographically from a wide area including the Western Carolines (Eilers 1936, p.237), Central Carolines (Damm 1938, p.320), Mortlocks (Krämer 1935, pl.9), Kusaie (Finsch 1893, p.470), Nukumanu (Sarfert & Damm 1929, p.153), the Admiralty Islands (Nevermann 1934, p.222), St Matthias group (Nevermann 1933, p.53), New Britain and New Ireland (Finsch 1893, pp.21, 54) and the Banks and Northern New Hebrides (Edge-Partington 1890, p.146). I recorded or collected examples on Ponape and neighbouring atolls, while the Auckland Museum collections

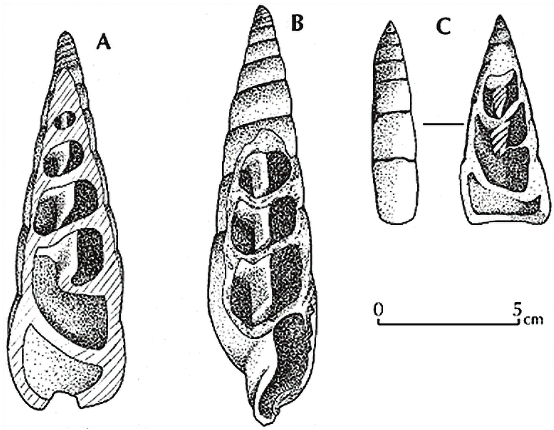

Figure 6. *Terebra* and *Mitra* adzes from Kahula. A: A306. B: A269. C: A110. Figure 7.5 from Leach and Davidson (2008); image courtesy of Foss Leach.

> contain examples from the Gilbert Islands and some of the Solomon Islands. The use of *Mitra* shells [as opposed to *Terebra*] seems to be relatively rare. They are particularly documented for Kusaie. (Davidson 1971: 54)

The earliest excavated levels on Nukuoro date to AD 680–949 (Davidson 1992) and do not contain any *Terebra/Mitra* adzes, which appear in levels dating post AD 1600 (Davidson 1971: 20). On Chuuk (Truk) this form is common in contexts reported to be younger than AD "1465 ± 95" although unknown ethnographically (Takayama and Intoh 1978: 54). In Micronesia the form is common and Intoh (1999: 413, table 1) dates it appearing ca. AD 1000–1200 (see also Takayama and Intoh 1978: 38–41).

The earliest examples appear to come from the EHK site on Eloaua Island (Mussau) ca. AD 460–620 (Kirch 2000: 117), and ethnographically Parkinson (1999: 145) reported them as the only adze form on Mussau. In Temotu they are found in archaeological sites on Santa Cruz, Vanikoro and Taumako. In the Reef/Santa Cruz 27 *Terebra/Mitra* adzes were recovered from Sie Village (SE-RF-3) dating to AD 1440–1850 and are also reported in the Mateone Dance Circle (SE-SZ-26 layers IV/V/VI) dating to AD 1200–1485 and in Dai Village (SE-SZ-11, layer V and surface) dating to < 240 BP (Doherty 2007: 51, 239; McCoy and Cleghorn 1988: 110). On Taumako a large number of *Terebra* adzes were excavated from the Kahula site dating within the period AD 1335–1410 (Leach and Davidson 2008:

259–61). In Vanikoro this adze form is only reported from late prehistoric to early historic contexts. It would appear it was dropped in the late prehistoric/ early historic period of Temotu.

In Vanuatu *Terebra/Mitra* adzes are reported ethnographically by Speiser (1990: plate 32) from Santo and Malekula, and Bedford (2000: 193) reports archaeological examples from throughout the islands dating post AD 1400. They are not reported from the southern Outliers of Tikopia and Anuta (Kirch and Rosendahl 1973: 102). Further to the south in New Caledonia *Terebra* adzes polished on their proximal section are not reported from archaeological contexts, although Sand (2001: 86, fig. 89) reports *Terebra* gouges polished on their apex appearing for the first time around AD 1000.

Intoh (1999: 413–14) suggests that *Terebra* adzes appear about the same time in Melanesia and Micronesia ca. AD 1000–1200 and are distributed by way of the Polynesian Outliers, and certainly we do find them in the northernmost Outliers and in Taumako ca. AD 1300, although not in the southern Outliers. The early date on Mussau might suggest development of the innovation in the marginal islands of northeast Papua New Guinea and dispersal during a late period of interaction across the marginal islands of East Melanesia extending north into Micronesia and south into Temotu and Vanuatu.

Breadfruit and Arboriculture in the Marginal East Melanesia–Central Micronesia (MEMCM) Interaction Zone

In the Solomon Islands Santa Cruz is famous for its distinctive dried breadfruit (*Artocarpus altilis*) called *nabo*, which is today prepared much in the same way as copra with the segments from roasted fruit dried over a fire. The dried nabo can then be stored for two years or more. In AD 1595 a dried "biscuit" of probable nabo was presented to the Spanish visiting Santa Cruz (Yen 1973b). This form of preparation is found in the greater region of Temotu on the southern islands of the Banks group, Mota and Mota Lava (Codrington 1891: 7), but not elsewhere in Island Melanesia or Polynesia. In Micronesia drying of oven-cooked breadfruit flour is found on Kapingamarangi, in the Marshall Islands, where fermented breadfruit is pressed and dried (Yen 1975: 151), and on Guam, where breadfruit is preserved by drying. Safford (1905: 145) reports for Guam:

> As the breadfruit is in season only during certain months of the year, some of the natives lay in a store of it for the rest of the year by slicing it and drying or toasting it in ovens, making a kind of biscuit of it which they call "biscocho de lemae." If kept dry this will last indefinitely and may be eaten either without further preparation or cooked in various ways. It is fine food for taking on a journey, as it is light and conveniently carried.

The scattered distribution of the use of breadfruit drying into Micronesia suggests a possible introduction from Santa Cruz, and the description of it as a useful food for long distance voyaging is intriguing. Breadfruit is also stored for long periods in pits, as fermented partially ripened fruits called *masi*, a form common in Oceania where breadfruit is consumed, including in the Reef/Santa Cruz both on Santa Cruz and the Polynesian settlements of the Reef Islands (Doherty 2007: 169).

Breadfruit is not an important component of subsistence in the main Solomon Islands (Guppy 1887: 84). However, in Temotu, where arboriculture is of major importance, breadfruit provides an abundant year-round crop with trees very common around settlements. Yen describes it as one of the major starch sources of the high islands of Micronesia and Polynesia, where it is a major staple in the Marquesas, and on the atolls of the Marshall and Caroline Islands (Yen 1974), where it was also an important source of wood for canoe construction (Lawrence 1964). In Papua New Guinea both the flesh and seed are consumed in the islands off the north coast, in the Bismarck Archipelago and Milne Bay Province (Bourke and Allen 2009: 215). Temotu stands out from the rest of Oceania for the intensity of arboriculture, cultivating many of the species collected in Melanesia and using more species than elsewhere in Polynesia and Micronesia.

As Yen notes, breadfruit is not an important component of diet in the Solomons west of Temotu, although a number of species of *Canarium* almond are very important within the main Solomons (Hviding and Bayliss-Smith 2000). The most important species on Santa Cruz, *Canarium harveyi*, is endemic to Temotu and was possibly domesticated there (Yen 2009) and is distributed eastward to Tikopia, Anuta, Fiji, Sāmoa, Tonga and Niue (Yen 1996). In the Bismarcks arboriculture and breadfruit are reported as important in Mussau and the adjacent islands (New Ireland, New Hanover) (Kirch 1989; 2021: 32, 258; Lepofsky 1992) extending into southeast New Britain (Panoff 2018). To the south breadfruit is an important crop in the southern Polynesian Outliers of Tikopia and Anuta (Yen 1973a: 117), where it is known in the fermented form as *masi* and forms part of an important system of arboriculture like that found in Temotu (Quintus *et al*. 2019). Fermentation is also recorded from the southernmost Outliers of Futuna, Aniwa, Malo and Aneityum (Labouisse 2016). In the central and northern Outliers breadfruit is an important crop in Kapingamarangi, where processes of fermentation include methods found both in Melanesia and Polynesia (Atchley and Cox 1985). On Takū breadfruit was formerly common and used as an important source of food, timber and fibre until cut down for development of copra plantations (Moir 1989: 113). Moyle also reports (Richard Moyle, pers. comm., 2021) the variety of breadfruit names in Takū suggests its former importance. Immediately south in the atolls of Ontong Java, Bayliss-Smith

(1973: 304, 361) recorded its presence on only three of 79 islets surveyed and did not record it as a component of diet. In Vanuatu breadfruit is present, although generally of lesser importance than other nut groups, except in the Banks and Torres Islands where it ranks first in tree crops (Labouisse 2016). Codrington (1891: 304) counted 60 varieties of breadfruit on Mota, a small island of the Banks Group. In New Caledonia the climate is only suitable for its growth in the northeast of the main island (Barrau 1957).

Breadfruit occurs in both seeded and seedless forms created through hybridisation of cultivars. Seeded forms are most common in New Guinea and Island Melanesia, with seedless forms becoming progressively more common eastward into Polynesia and north into Micronesia and almost all cultivars becoming seedless in East Polynesia (Zerega *et al*. 2004). Genetic analysis indicates that the closest ancestors of *Artocarpus altilis* are wild populations of *A. camansi* recorded from primary forests in New Guinea and *A. mariannensis* native in its wild form to the Mariana Islands and Palau. Zerega *et al*. (2004) propose two stages in the origins of cultivated breadfruit: (i) vegetative propagation of *A. camansi* and human selection in Melanesia and Polynesia with direct transport to the high islands of Micronesia, and (ii) introgressive hybridisation between *A. camansi*–derived breadfruit and *A. mariannensis* in Micronesia with subsequent reintroduction to Melanesia and Polynesia, where seedless varieties of this hybrid are also found. Breadfruit cultivars without *A. mariannensis* traits do not grow well in harsh atoll conditions (Ragone 1997). However, with those traits and on atolls with more than 200 mm of rainfall annually, breadfruit is common (Barrau 1961: 51). Once established this hybrid could then support development on Micronesian atolls (Petersen 2006). The early origins of cultivated breadfruit are argued on genetic grounds to be in the vicinity of Temotu: "Indeed, it is in the Eastern Solomon Islands and Vanuatu where few-seeded cultivars begin to appear and in Western Polynesia where few-seeded and seedless cultivars emerge" (Ragone 1997, cited in Zerega *et al*. 2004: 764), then dispersing into Micronesia via reciprocal long-distance voyages into East Melanesia.

The use of breadfruit would appear to date to at least the Lapita period. A Proto-Oceanic term is reconstructed POc **kuluR* 'breadfruit' (*Artocarpus altilis*) (Ross 1988: 149; Ross *et al*. 2008: 127, 158), while a term relating to its processing would appear to be POc **masi(t*) 'smell bad; bad smell; sour, acid, fermented'. Kirch and Green (2001: 160) suggest PPN **masi* refers to fermented breadfruit. Reflexes of **kuluR* have variants **kunuR* and **baReko*. Pawley (2017: 302) notes that reflexes of **baReko* are found in New Ireland, northwest Solomons, southeast Solomons, Temotu, and north-central Vanuatu and southern Vanuatu, and suggests this reflects a second introduction during the Late Lapita period. While the linguistic evidence is inconclusive as to the source of breadfruit as a cultigen, it does confirm interaction between Micronesia and eastern Melanesia.

> The simplest historical view of this situation is that Santa Cruz was the arboricultural center from which the tree as cultigen and the associated development of preparation method was diffused; but there is nothing in the evidence to negate the alternative hypotheses. They are that breadfruit, or at least the preparation method, was (i) a "feed-back" contribution from Polynesia with the settlement of the so-called 'Outliers' in Melanesia, or (ii) an addition from Micronesia to the "Melanesian" agricultural system. (Yen 1974: 283)

Direct Lapita evidence for breadfruit is limited as the fruit would not preserve well in archaeological deposits, although breadfruit starch and charcoal have been recovered in the Marquesas (Allen and Ussher 2013; Huebert and Allen 2020) and carbonised skin from a prehistoric site in the Society Islands (Kahn and Ragone 2013). It is not found in the very large macro-botanical assemblage recovered from the Early Lapita sites in Mussau (Kirch 1989). However, there is evidence, in the archaeological material culture, of scrapers in a form used ethnographically to scrape or peel breadfruit. At Mussau a large number (102) of dorsal caps of the large cowrie shell *Cypraea tigris* with either a ground curved edge or exhibiting much use wear were recovered and described as "used to scrape the rounded surfaces of tubers such as taro or yam, or of breadfruit" (Kirch 2021: 421). These were predominantly from the Early Lapita period excavation at the ECA site dating in the range 3750–2950 cal BP (Kirch 2021: 162). The illustrated examples from Mussau (Kirch 2021: fig. 13.30) look very much like ethnographic examples of breadfruit scrapers from Micronesia.

In Micronesia shell peelers made of cowrie would appear to be found most commonly in eastern Micronesia (Chuuk, Pohnpei and Marshalls) (Davidson 1988; Dye 1987: 358; Ishikawa 1987; Parker and King 1981; Rosendahl 1987: 127). Dating the appearance of these forms is difficult; however, Parker and King (1981: 18–19) note on Chuuk that few if any breadfruit processing tools were associated with the early ceramic deposits but that abundant material culture associated with breadfruit processing was found in the later aceramic deposits, which they date to (TKMO-1) AD 1305–1420, and report similar material culture from the Mortlocks at AD 1000–1100. A very similar date range for cowrie breadfruit scrapers like modern examples is reported from Chuuk by Takayama and Intoh (1978).

Cowrie-shell peelers are found in archaeological deposits on the southern and central Polynesian Outliers of Taumako, Tikopia and Anuta. On Taumako *Cypraea tigris* scrapers of a distinctive form (Leach and Davidson 2008: fig. 4.28), and like those recovered from Early Lapita context on Mussau, were recovered in the Lakao period from the Te Ana Tavata site, with dates of 1782 ± 61 (NZ4643) and 1161 ± 59 (NZ4645) (Leach and Davidson 2008: 115, 314) that calibrate to AD 128–1025 (2δ). A very similar form of scraper was recovered on Anuta (Kirch and Rosendahl 1973: 88) in an early Plainware ceramic context dated within the first half of the 1st millennium BC

(Kirch 1982; Kirch and Rosendahl 1973: 96). Similar forms of cowrie scraper were also found in the Kiki Phase (TK-36) on Tikopia (Kirch and Yen 1982: 252), with a conventional radiocarbon age of 2590 ± 15 (UCIAMS-163477; Kirch and Swift 2017: Table 2) that calibrates to 800–640 (2δ) cal BC.

Stone pounders used in the processing of breadfruit are common in Micronesia and East Polynesia but not West Polynesia. On Santa Cruz there is no evidence of the distinctive Micronesian forms in the archaeological record, but Doherty (2007: 319) reports one elongated pestle with flattened ends from the SE-RF-19 site, a pestle from the Mdailu site in a plainware context and a similar form from the Lapita SE-RF-2 site interpreted as a nut cracker. Stone and shell pestles used in the cracking of nuts are found in the Bismarck Archipelago and south into Buka and Bougainville, while wooden food pounders are found on the Polynesian Outlier Nukuria (Parkinson 1999: 217, 236). In eastern Micronesia food pounders very similar in form to those of central and marginal Polynesia were documented by Burrows from Kiribati, Kosrae, Pohnpei, Ngatik, Pingelap, Nukuoro, Palau and Yap (Burrows 1938: 133), although Ishikawa (1987) would revise that list slightly.

Additional evidence for breadfruit consumption is found in the archaeological presence of large pits interpreted as masi or breadfruit fermentation and storage pits. In the Lapita period oval pits interpreted as food storage pits were found at Nenumbo (SE-RF-2) in the Reef Islands (Green and Pawley 1999: 78), although there is nothing to identify them as specifically breadfruit fermentation pits. On Niuatoputapu (NT-93) in the plainware Pome'e phase dating to 500 BC–AD 800 Kirch (1988: 109) reports pits with distinctive features supporting their identification as ensilage pits like those known historically, those being near-vertical sides, flat bottoms and no evidence of fire or trash disposal.

Summary of the Marginal East Melanesia–Central Micronesia Interaction Zone
The archaeological and cultural evidence reviewed above argues for the presence of a zone (Fig. 2) of interaction among the small islands which form a dispersed chain along the eastern coast of Island Melanesia and north into central and eastern Micronesia. In Melanesia these include the Polynesian Outliers but also the small islands of Temotu in the Solomon Islands and the small islands of the St Matthias Group in the easternmost Bismarck Archipelago (Mussau, Tench, Emirau, Tulun). To the northeast of the St Matthias Group ca. 500 km lies the northernmost of the Polynesian Outliers, Kapingamarangi and Nukuoro, which in turn are 200 km south of the southernmost of the Caroline Islands (Satawan). The water gap from northeastern Melanesia to the southernmost islands of Micronesia, while the largest distance within this chain, was regularly sailed since the Lapita period when canoes sailed east into Temotu from the end of the main Solomons. The

people of this chain of small islands share, for the most part, a strong maritime tradition and ability based on both the need to derive much subsistence from the sea and the need to share and source resources from neighbouring islands at some distance, especially during times of food stress. This interaction would have included the neighbouring large high islands to the west.

THE SOUTHEAST SOLOMONS AND THE ORIGINS OF EAST POLYNESIANS

The fourth goal of Green and Yen's research programme in the southeast Solomons was to evaluate: "Are the Polynesian-speaking peoples on the outlying islands of Melanesia remnants of populations left behind on these small islands as the Polynesians moved out into the Pacific, or are they, as the majority of scholars now hold, the result of drift settlements from the western area of Polynesia and able only to have established themselves as distinctive linguistic and cultural entities after the settlement of Polynesia and development of its culture?" (Green 1976a: 10). Within the southeast Solomons research area were the Outlier islands and cultures of Tikopia, Anuta and Pileni (the latter whose language is spoken within the Reef Islands and Taumako). Green (1976b: 51) also argued for a distinction between the southern Outlier languages of Tikopia and Anuta and that of Pileni, which was suggested to group with those to the north (e.g., Sikaiana, Luangiua (Ontong Java) and Takū). Based on estimated times of breakup of Nuclear Polynesian he argued the Polynesian settlement of these Outliers was within the last 2,000 years, possibly after earlier "Proto-Polynesian, pre-Polynesian or other Oceanic or non-Austronesian" languages were "totally submerged" (Green 1976b: 51).

Settlement of the Polynesian Outliers

We now know that most of the larger southern Outliers where archaeological research has been conducted were first settled in the very Late Lapita period during the transition to a plainware ceramic tradition which extended out to Sāmoa and Tonga. Linguistic research has described the Outlier languages as Samoic and ultimately derived from the greater Sāmoa region. The timing of this back movement from greater Sāmoa is uncertain, but I would argue that it could well have occurred at the time of first permanent settlement of the Outliers and have been part of a southern east–west interaction zone established in the many hundreds of years following Lapita settlement of West Polynesia. Canoes which were able to settle that region were presumably equally capable of frequent return voyages.

It seems generally assumed that the southern Outliers were first settled by a Lapita population, or a later one related to those in neighbouring Melanesian islands like those developed in the early post-Lapita period. Archaeologists have then sought to find in the record a replacement or influx of genetically and linguistically Polynesian people from the east. This has proved to be difficult (Davidson 2012). In Taumako Leach and Davidson (2008: 6) set out to explicitly find such a signal in a "transition from non-Polynesian to Polynesian occupation … from the evidence of the material culture". After considerable fieldwork and detailed analysis of material culture and human remains, they were unable to find, to their satisfaction, such a signal in a record which extends from the very Late/post Lapita ceramic period (900–400 cal BC 2δ) through to the historic period.

> It seems to us that influences from the central Pacific could have been arriving on Taumako at irregular intervals since the time of first settlement of the two areas. On present evidence there is little or no gap between the date of first settlement of Taumako and that of Samoa, Tonga, and Fiji. Given that periodic landings on Taumako of large sailing craft from these central Pacific islands are quite plausible, we would not expect some dramatic change in material culture at a particular time in the past. In any event, we cannot claim that a distinctive Polynesian material culture emerged at any time on Taumako. To be sure, stone adzes from a quarry on Tutuila arrived on Taumako during the *Namu Period*, but the identity of the people who imported them is unknown. They left no other identifiable impact on Taumako society. It is certainly true that the material culture of Taumako from the earliest to the latest times has its closest affinity with the Santa Cruz area. (Leach and Davidson 2008: 322–33)

They conclude, after study of the skeletal material and material culture, that just about the only thing that hints of Polynesian about the historic population is the language, which is most closely related to the other Outliers that have a Samoic ancestry.

Tikopia is the other southern Outlier with a well-studied archaeological record (Kirch and Yen 1982; Kirch and Swift 2017). This sequence again extends from a very late "Lapitoid" plainware Kiki Phase dating settlement within the range 917–733 (2δ) cal BC, comparable to settlement dates on both Taumako and Anuta with similar plainware ceramic traditions (Kirch and Swift 2017: table 5, 332). Kirch identifies the Tuakamali Phase, beginning cal AD 1158–1212 (2δ) (Kirch and Swift 2017: 333), with the appearance of Polynesian culture traits such as basalt adzes and trolling lures of West Polynesian (Kirch and Yen 1982: 236–37, 244, 333) forms. These basalt adzes, although different from earlier Kiki Phase adzes made of a variety of exotic materials, some of which are similar to early West Polynesian forms, are all ethnographic samples (Kirch and Yen 1982: 236) and not excavated, although their presence is attested by adze flakes of basalt in the Tuakamali context derived from oceanic basalts from east of the Andesite line and are of West Polynesian (Sāmoa, 'Uvea, Futuna, Tonga) derivation. Three *Trochus* shell trolling lures recovered from early Kiki Phase deposits are forms similar to those from Late Lapita Plainware contexts in Santa Cruz, Watom, Fiji and Tonga (as discussed above). A pearl-shell trolling lure point, like those kept as heirlooms, is similar to "typical West Polynesian" forms (Kirch and Yen 1982: 244) and recovered from a Tuakamali context.

That there is interaction with West Polynesia in this later period is well supported by oral history in Tikopia and other Outliers. However, it also seems probable that this is not the first contact from the east and does not obviate the possibility of earlier or initial settlement from the east by Proto-Polynesians. In Tikopia there is a long oral history of movement from the east and neighbouring islands extending back to the earliest lineages who are said to be autochthonous or *te afukere* 'earth-sprung' (Firth 1961: 70, 86). Kirch and Yen (1982: 337–38) propose three hypotheses for origins of initial settlement: (i) settlement from the west, presumably as part of a Late Lapita expansion, (ii) settlement from nearby islands, e.g., Temotu region, and (iii) settlement from the east, "in an early Outlier pattern of westerly voyaging or drift from the Fiji and West Polynesia area". They note the Kiki Phase ceramics are of a Lapitoid Plainware tradition found from Watom through Temotu to Fiji and West Polynesia, which does not rule out any of the hypotheses, while small amounts (12 flakes) of Admiralty obsidian (McCoy *et al*. 2020) and fine-grained chert support a link to the west at least into Temotu. However, motifs on a few of the Late Lapita dentate sherds link more closely to Fiji and West Polynesia than to Temotu.

> Thus we may have to leave open the possibility that the initial settlement of Tikopia was indeed from the east, but that soon after colonization, contacts were established with neighbouring communities in the Reefs and the Santa Cruz group, from which the exotic materials of western provenience were obtained. Such a possibility was earlier suggested by Kirch and Rosendahl (1976: 241–42) for the Anuta case, and has been further supported by the tentative sourcing of early Anuta chert to Futuna Island (Kirch 1981a). (Kirch and Yen 1982: 338)

While Kirch and Yen concluded that they could not choose among the three hypotheses for initial settlement given the available data, they did strongly support the Tuakamali Phase as representing a Polynesian immigration ca. AD 1200, with nothing in the archaeological record refuting Tikopian oral tradition and genealogies describing arrival from and linkages to West Polynesia (Firth 1961: 85). Most recently geochemical analysis of the volcanic glass from Tikopia has assigned three samples in the Tuakamali Phase to an unknown Tongan source (McCoy *et al*. 2020).

Anuta is the final southern Outlier with a record of initial settlement through to the historic period (Kirch 1982; Kirch and Rosendahl 1973; Yen and Gordon 1973). Oral tradition claimed two periods of settlement, an initial autochthonous settlement by *te apukere* ‘earth-sprung’ people, who were replaced around 12 generations ago by immigrants from “Uea” (presumably ‘Uvea, or Wallis Island) (Kirch 1982). Excavation indicated a possible hiatus in occupation between these two periods. The initial settlement was in the Plainware very Late Lapita or Lapitoid period with a cultural assemblage from site SE-AN-6 like that found on Tikopia and Taumako and dating 1210– 831 (2δ) cal BC (I-6275 2830 ± 90 on wood and coconut shell).

Kirch noted that the large array of one-piece fish-hooks, found in the early period, “appeared as though they might be candidates for a fishing gear technology ancestral to the more developed hook arrays of Triangle Polynesia, and especially of Eastern Polynesia” (Kirch 1982: 245). However, “the discovery of several *Turbo*-shell hooks (with line-attachment styles identical to those from Anuta and Tikopia) in Lapita sites on the northern Tongan island of Niuatoputapu (Kirch and Dye 1979)” complicated the picture; “[i]n short, it is still difficult to assess the relative probabilities that Anuta was initially settled from one of the nearby islands of the Santa Cruz group or northern New Hebrides (Banks and Torres Islands), or from Western Polynesia, as an early ‘outlier’ ” (Kirch 1982: 253). The association of West Polynesia with one-piece fish-hooks such as those described by Kirch is made problematic by their very limited appearance both archaeologically and historically in the region; however, more recently a significant assemblage of similar forms has been recovered from the Plainware period at the To‘aga site and related site in Manu‘a, eastern Sāmoa (Kirch and Hunt 1993; Quintus and Clarke 2020) (as discussed above), strengthening its association with West Polynesian Proto-Polynesian culture. As noted above, similar forms from the same period are found on Taumako, Tikopia and Santa Cruz.

Taken together there is some basis for suggesting an early-Plainware-period Proto-Polynesian culture relationship between West Polynesia and the southern Outliers; although there is no smoking gun, it should be considered very possible that the Polynesian “back movement” which is attested by oral tradition and some archaeological material from late prehistory had a much earlier genesis in a period of interaction resulting in the initial settlement of the small Outliers offshore from Island Melanesia by Lapita descendants with a Polynesian linguistic and genetic heritage.

Linguistic Evidence

It has long been argued that East Polynesia was initially settled directly from West Polynesia, despite early anthropological arguments based on the study of material culture differences finding it hard to derive one from the other (Buck 1985; Burrows 1938; Kirch 1986). As noted by Kirch (1986) archaeologists also found the conventional model originally proposed by Emory and Sinoto (1965) and supported by Green's (1966) linguistic sub-grouping problematic. Both Bellwood (1970) and Davidson (1976, 1981) argued that a Proto-East Polynesian homeland linking West and East Polynesia was not yet apparent.

> The earliest sites in the Marquesas and Society Islands, Hawaii, Easter Island, and New Zealand reveal a material culture which already has traits differentiating it from that of West Polynesia. Hence, for East Polynesia we have a polythetic assemblage whose immediate origins are not apparent in West Polynesia, although its slightly more distant origins are. (Bellwood 1970: 96)
>
> If we are to accept that Eastern Polynesia was colonised from Western Polynesia, there must have been a point at which a pioneering Eastern Polynesian culture was indistinguishable from the Western Polynesian culture of at least one island group, but that point has not yet been documented archaeologically. The differences between early Eastern Polynesian cultures defined by archaeologists and any Western Polynesian cultures are still greater than any differences we can confidently identify within Western Polynesia. (Davidson 1981: 108)

Kirch (1986) also drew attention to the implications of a shorter chronology for the orthodox model which posited the Marquesas as the East Polynesian homeland within which characteristic innovations developed:

> Since all Eastern Polynesian languages share certain lexical and phonological innovations in common, this implies that a unified Proto-East Polynesian speech community existed long enough before the primary split between Tahitic and Marquesic branches for such innovations to develop. The same can be said for other aspects of culture as well, for it is clear that Eastern Polynesian societies share many features which must have been developed in an ancestral community before dispersal to the various East Polynesian islands and archipelagos. These include, for example, the typical Eastern Polynesian *marae* concept of court, elevated *ahu*, and upright representations of deities or ancestral figures. It is questionable whether the Emory-Sinoto model, with the rather late settlement of the Marquesas (A.D. 300) and fairly rapid dispersal to Easter Island and the Societies, would allow sufficient time for such linguistic and cultural innovations to have developed in the ancestral East Polynesian community. (Kirch 1986: 19)

Since 1986 considerable effort has gone into investigating the chronology of the East Polynesian sequence, and rather than increase the available time for innovations to develop in an East Polynesian homeland, which was the expectation in 1986, the chronology has been considerably shortened and the speed of settlement across the East Polynesian triangle increased. Wilmshurst *et al*. (2011a: 1815), after reviewing available radiocarbon dates, concluded that settlement was "earliest in the Society Islands A.D. ~1025–1120, four centuries later than previously assumed; then after 70–265 y, dispersal continued in one major pulse to all remaining islands A.D. ~1190–1290". Critical review of this analysis (Mulrooney *et al*. 2011; Wilmshurst *et al*. 2011b) did not significantly increase the time depth of colonisation or reduce the speed of settlement. Most recently Sear *et al.* (2020), using multiple human-impact proxies from sediment cores in the southern Cooks and high-resolution dating methods, have identified initial limited human impact ca. 900 AD prior to archaeological evidence, with colonisation by ca. AD 1000 and with expansion throughout the rest of East Polynesia in the period AD 1150–1300. Their data indicates the initial pulse occurred during a period of prolonged regional drought. Most recently dates from the Marquesas (Allen *et al.* 2022) suggest settlement there is penecontemporaneous with settlement of the Society Islands ca. AD 1100–1200. Although the Sear *et al*. (2020) data pushes initial movement into East Polynesia somewhat earlier, it does not significantly increase the time for development of a unified Proto-East Polynesian language (Wilson 2018: 395) and culture distinct from that of West Polynesia in an as yet unspecified location within East Polynesia. Where is the mystery island or region?

In a series of papers, the linguist William Wilson (2012, 2018, 2021), expanding on earlier research (Wilson 1985), presented linguistic evidence for an East Polynesian settlement from Polynesian Outliers lying east of the Solomon Islands.

> The PNO-EPn [Proto-Northern Outliers–East Polynesian] hypothesis suggests that settlement of East Polynesia was from the north. A likely scenario progresses from the Central Northern Outliers [Takū and Ontong Java] through the Phoenix and Line islands to the Marquesas. This scenario differs from the most likely settlement pathway within the context of the standard theory, that is, a southern entry from Samoa to the Southern Cook and Society islands, possibly initially through the Northern Cooks. (Wilson 2012: 290)

The ultimate origins of the Outlier languages and East Polynesian remains as Samoic, at some earlier period, but now East Polynesian is a direct descendant of the sub-grouping Central Northern Outlier–East Polynesian (Wilson 2012) rather than a direct descendant of Nuclear Polynesian or Samoic languages. In 2018 Wilson expanded his hypothesis to include the Southeastern Solomons Outliers (SSO) of Vaeakau-Taumako (Vae, Pileni), Tikopia, Rennell and Anuta (Wilson 2018: fig. 2), which are located higher on the tree, indicating an earlier ancestor-descendant relationship with all other Outlier (Outlier languages south of Tikopia/Anuta not placed) and East Polynesian languages. This would push the origin of the Northern Outliers and East Polynesian back into the southeast Solomons.

Wilson states his research "will also provide evidence for a Southeast Solomons Outlier source for the settlement of the Northern Outliers and the establishment of a related new proto-language stage. That new proto-language is the basis for describing movement from the Southeast Solomons through the Northern Outliers and then from the Central Northern Outliers on to East Polynesia" (Wilson 2018: 394). In a subsequent paper he has concluded:

> Rather than descending directly from a language spoken in the Samoa area, or one spoken in Tokelau, Pukapuka or Tuvalu, PEPN [Proto-East Polynesian] descends from PCNO-EPN [Proto-Central Northern Outlier–East Polynesian], whose homeland was in the Central Northern Outliers of Luanguia, Nukumanu, Takū, and Nukeria. PEPN was the result of a movement eastward from those atolls into a PEPN homeland that included the Phoenix, Line, and Marquesas Islands. Many of the innovations of EPN languages trace to PCNO-EPN and have cognates in the Outliers. (Wilson 2021: 67)

The linguistic scenario proposed by Wilson would have the following steps or periods: (i) early movement from the high islands of Sāmoa or a Samoic-speaking region (Futuna, 'Uvea) into the southeast Solomon Outliers, (ii) movement into the northern Outliers in what I have called the Marginal East Melanesia–Central Micronesia Interaction Zone, and (iii) movement into the Proto-East Polynesian homeland of the Phoenix, Line and Marquesas Islands east of the northern Outliers. Archaeologically this may align with (i) Polynesian Plainware period settlement ca. 600 BC–??, (ii) occurring prior to the settlement of East Micronesia out of the East Solomons–Micronesian Interaction Zone ca. AD 0, and (iii) movement east from the northern Outliers into the Proto-East Polynesian homeland ca. AD 900.

Archaeological and Ethnographic Evidence

Wilson (2018) lists a number of items of ethnographic material culture which are characteristic of East Polynesia and found in the Outliers but are absent or very rare in West Polynesia. These include "stone or wooden food pounders, large anthropomorphic carved god figures, *Ruvettus* hooks and upturned canoe ends (Parkinson 1999: 229, 234–37)". He also notes a whalebone hand-club called *paraamoa* (chicken feather/wing) in Nukumanu (Parkinson *et al*. 1986; Parkinson 1999: 237) and Takū similar in form to East Polynesian hand-clubs which in Māori when made of whalebone are called *paraaoa* (Wilson 2018: 415). Many of these historic cultural differences are among those which distinguish West from East Polynesia as originally identified by Burrows (1938) and confirmed by Kirch and Green (2001: table 3.1).

Archaeological evidence of a distinctive MEMCM Interaction Zone–East Polynesian relationship is found in the development of one-piece fish-hook technology which departs from the Lapita pattern in the early Plainware period and spreads throughout the region. The development of a form of composite trolling lure with a line attachment like that of West Polynesia and West Micronesia and a form of distal point base extension and attachment like that found in the Solomon Islands and eastern Micronesia can also be proposed. Bonito is uniquely important in early East Polynesian sites of the Marquesas (Allen 2017; Davidson *et al*. 1999; Leach *et al*. 1997) and Society Islands (Davidson *et al*. 1998) and in sites in central-East Micronesia (Leach and Davidson 1988; Ono and Intoh 2011), where it can predominate in fishbone assemblages, subsequently declining in importance. Some of the earliest descriptions of the early East Polynesian trolling composite lure form are those excavated and described by Robert Suggs from Nuka Hiva in the Marquesas. He describes a series of shanks and hooks with proximal and "incipient proximal" extensions which are found in and characteristic of early deposits and notes they are like Anell's West Polynesian forms (Suggs 1961: 82–83, 88–89). At the Hane site in the Marquesas Sinoto (1970: fig. 1, 113) recovered a series of lure shanks and finished point bases which he argued are evidence of a transition from a West Polynesian type of proximal point base in the early levels ca. 1000 AD (Allen *et al*. 2021; Conte and Molle 2014) to an East Polynesian distal point base in later levels. Similarly the early forms recovered at Vaito'otia in Huahine, Society Islands (Sinoto and McCoy 1975), and Maupiti (Emory and Sinoto 1964) may be components of a "Sāmoan" lure form like that commonly found in the Outliers and Micronesia with a proximal base extension and not the distal extension characteristic of historic East Polynesia. These trolling lures, along with the deep-water *Ruvettus* hooks (Parkinson 1999: 234) and the diverse assemblages of one-piece angling hooks, represent a technological complex and fishing tradition characteristic of both the MEMCM Interaction Zone and East Polynesia.

Another subsistence tradition which is characteristic of this region is the breadfruit complex (Ishikawa 1987). As discussed above, the domestication and early distribution of breadfruit appears to be an important component of the development of the MEMCM Interaction Zone. It is also important in tropical East Polynesia, where the pounded paste is stored in ensilage pits (Barrau 1957), and especially so in central East Polynesia and in the distinctive arboriculture (Huebert and Allen 2020; Quintus *et al*. 2019) of the Marquesas. Its presence in early sites is suggested by distinctive cowrie-shell scrapers and stone pounders which are not found in West Polynesia but are common in Micronesia. Suggs describes both in his early work on Nuka Hiva, although he argues that breadfruit importance grew over time (Suggs 1961: figs 29–30, 99–103). He notes some stylistic similarities with Micronesian stone pounder forms although cautions they may have been made by a nineteenth-century Gilbertese community (Suggs 1961: 101). Ethnographic examples of such forms, however, are common in East Polynesia (Burrows 1938: 133; Ishikawa 1987). Recent research by Huebert and Allen (2020) reports breadfruit along with candlenut charcoal from early settlement contexts on Nuka Hiva and also argue for an intensification of breadfruit cultivation over time in the developing arboriculture of the island. Quintus *et al*. (2019) draw East Polynesian comparisons with the arboriculture of the Polynesian Outliers, to which of course should be added that of Santa Cruz. Allen and Ussher (2013: fig. 4) describe from archaeological contexts on Nuka Hiva cowrie (Cypraeidae) shell peelers (Figure 7) of the distinctive form found in Micronesia and the MEMCM Interaction Zone as discussed above, although neither example produced breadfruit starch, indicating they were used at least occasionally to process other plants.

Variation in adze forms have been routinely used to investigate culture history in the Pacific. The East–West Polynesia distinction is summarised as tanged stone adzes in East Polynesia of variable cross-section and untanged stone adzes of trapezoidal cross-section in West Polynesia (Emory 1968; Green 1971; Reepmeyer *et al*. 2021). Both Emory and Green, based on the untanged early forms in the Marquesas and Society Islands, saw the development of East Polynesian stone adzes from those of Sāmoa. In the early settlement period of the southern Outliers a small number of stone adzes of diverse forms and raw materials have been reported from Tikopia (Kirch and Yen 1982: 236) and would appear to be made of stone exotic to Tikopia and sourced to Vanuatu or the Solomon Islands, while a series of ethnographic adzes are made of oceanic basalt which, based on typology and petrography, are sourced to West Polynesia and probably Sāmoa (Best *et al*. 1992) and related to the Late Aceramic Tuakamali period (Kirch and Yen 1982: 236). A similar picture is found on Taumako, where nine adzes were examined (including one from Makira and two from Nupani in the Reef Islands) with two excavated from the Late Kahula Phase. All were made of oceanic olivine biotite-rich basalt sourced, based on petrography (Leach and Davidson 2008: 431) and geochemistry (Best *et al*. 1992), to Sāmoa, very possibly the Tatagamatau source on Tutuila. This dispersal of adze materials and forms from Sāmoa would appear to date to the time of movement into East Polynesia with such adzes associated with early-settlement-period sites in the southern Cook Islands (McAlister *et al*. 2013; Walter and Sheppard 1996; Weisler *et al*. 2016) at a time when there is geochemical evidence of widespread interaction within East Polynesia (Weisler and Walter 2017) and within West Polynesia and areas west.

Throughout the MEMCM Interaction Zone the standard adze is made from shell as there is no suitable stone on these small atolls (Craib 1977; Davidson 1971; Moir 1989; Radclyffe 2021; Rosendahl 1987) or it is geologically limited to high islands such as those of Temotu (Doherty 2007: 231), Tikopia, Anuta or

Figure 7. Marquesan Cypraeidae (cowrie) shell peeler. Figure 4 from Allen and Ussher (2013), courtesy of Melinda Allen. Photo by Tim Mackrell.

Mussau (Kirch 2021: 44). The majority of shell adzes are made from *Tridacna* and have a triangular plan form. As discussed above, a distinctive type of adze made from *Terebra* or *Mitra* shell links Micronesia and eastern Melanesia south to Vanuatu and was reported as the only adze form used historically on Mussau, where it dates back to ca. AD 841–1288 cal (Kirch 2021: 134). It would appear that this form was known at the time of East Polynesian settlement and would potentially provide a link into the MEMCM Zone.

In East Polynesia the high volcanic islands all provide stone for the manufacture of stone adzes, and although occasional shell adzes can be found, they are only common on the atolls such as the Tuamotus (Emory 1975) and northern Cook Islands (Te Rangi Hiroa 1932; Cramb 2020), where there is not suitable stone. However, Emory (1975: 109) notes that the Tuamotu adzes are distinct from those of Micronesia, differing in manufacture technique and in what appears to be efforts to replicate the form of basalt adzes with tangs and quadrangular sections. In the early settlement sites, some shell tools are found, commonly including (Sinoto 1970; 1979: 9; Sinoto and McCoy 1975: 159) chisels made of *Terebra* shells where the proximal or tip end of the shell has been ground flat to form a chisel edge. This form of chisel is not found in the MEMCM Interaction Zone except on Nukuoro, where it occurs along with *Terebra* adzes in a late context (Davidson 1971: 54). There is thus no obvious linkage seen in shell or stone adzes from the MEMCM Interaction Zone into East Polynesia, where stone adzes dominate and where East Polynesian forms appear to have quickly developed out of generic West Polynesian forms in the settlement period. This would involve the development of new forms of hafting and accommodation to high levels of variability in stone quality influencing form (Sheppard *et al*. 2001).

One area where there would appear to be reasonable direct evidence of connections between the MEMCM Interaction Zone and East Polynesia is in styles of ornaments. Leach and Davidson (2008: 313, fig. 8.6) recovered distinctive ivory reels (Fig. 8) from the Namu Period burials on Taumako (AD 1000–1800), known ethnographically from Tikopia and the Marquesas, Fiji and Tonga. Archaeological examples are known from Vanuatu in the Roi Mata burials dating to ca. AD 1600, and from early East Polynesian assemblages in the Marquesas, the Society Islands, Aotearoa New Zealand (Walter 1996) and the Australs (Leach and Davidson 2008: 313). The only similar archaeological form in West Polynesia is a "barrel-shaped" polished bone bead from Sāmoa in a possible early first millennium AD context (Hunt and Kirch 1988: 175). Walter considered this form to be a "Polynesian or Central Pacific innovation which spread to Outlier communities and Vanuatu" (Walter 1996: 521). Suggs (1961: 133) also proposed that the notched-edge bi-perforated pearl-shell disks found in early contexts in Nuka Hiva were early examples of the Marquesan *uhikana*, which was a forehead ornament over which a turtle-shell filigree was attached like that of a *kapkap* of Island Melanesia. Reichard (1933: 90, 97, 114) in her comprehensive study of the kapkap form describes it as found from the Admiralties south through Island Melanesia with a centre of excellence in New Ireland and neighbouring islands, south through the Solomon Islands (Burt *et al*. 2009) to another centre of excellence in Santa Cruz (*tema*). Outside of that zone it is only found in the Marquesas. The combination of elaborate finely carved turtle-shell overlay on a polished shell disk led Suggs (1961: 134) to argue that the number of elements and their interrelationship with the whole made it difficult to accept independent invention as an explanation for the similarity between kapkap and the uhikana. The use of pearl-shell in the Marquesas for the shell disk is, however, unique, as kapkap disks are usually made of *Tridacna*.

Reichard does not describe kapkap from the St Matthias group, although Were (2001) indicates their presence there and in the small islands off the east coast of New Ireland and New Hanover (Parkinson 1999: fig. 46, 130–31). Reichard (1933: 117) does describe the elaborate carving of chains of rings in turtle shell used as ear ornaments on St Matthias, which she argues show strong design relationships with similar forms in the Carolines. This would appear to be another example of interaction in the MEMCM Zone.

One area where there is clear evidence of east–west connection in early East Polynesia, beyond the adze geochemistry data discussed above, is the presence of small numbers of ceramic sherds in East Polynesia. Suggs (1961: 95) surprisingly found six pottery sherds in his early work on Nuka Hiva and felt that at least some of them must be exotic to the Marquesas. Additional material was subsequently found, and today we have 14 sherds in total from the Marquesas and four from the southern Cooks (Allen *et al*. 2021). Physical and petrographic examination of these sherds by Dickinson identified that at least three from the Marquesas were definitely from west of the Andesite Line, having "abundant monomineralic quartz grains and subordinate granitic rock fragments", which Dickinson matched with tempers from the Rewa Delta of Fiji (Allen *et al*. 2012: 91). Three other groups of sand tempers were potentially derived from oceanic basalts and were initially presumed to be local (Dickinson *et al*. 1998). However, more recently it has been proposed that at least some of these tempers, and perhaps all, are derived from West Polynesia: "the Marquesan placer sand tempers are consistent with post-arc sands from areas of Fiji other than the Rewa Delta, having similarities with pyroxene-rich Fijian post-arc tempers from the north coast of Viti Levu and the northwest coast of Vanua Levu", while three of the Cook Island sherds contain tempers most like those from Tonga (Allen *et al*. 2012: 99).

Ceramics from Fiji appear to be moving within West Polynesia and to the north of Fiji during the period of early East Polynesian settlement. Dickinson has identified four sherds from Navatu on the north coast of Viti Levu 1,000 km north in the deepest levels of the Temei site on Vaitupu, Tuvalu, associated with a "corrected radiocarbon date of AD 1080 ± 70 (on shell)" (Dickinson *et al*. 1990). Two other sherds from Vaitupu and six from other atolls in Tuvalu are sourced to the north coast of Viti Levu or Vanua Levu (Dickinson 2006: 117), while Best (1988: 113) has identified three probable Fijian (Dickinson 2006: 117) sherds on Atafu in Tokelau, 1,500 km north, dating possibly as early as AD 1299–1400 (2δ) (Petchey *et al*. 2010).

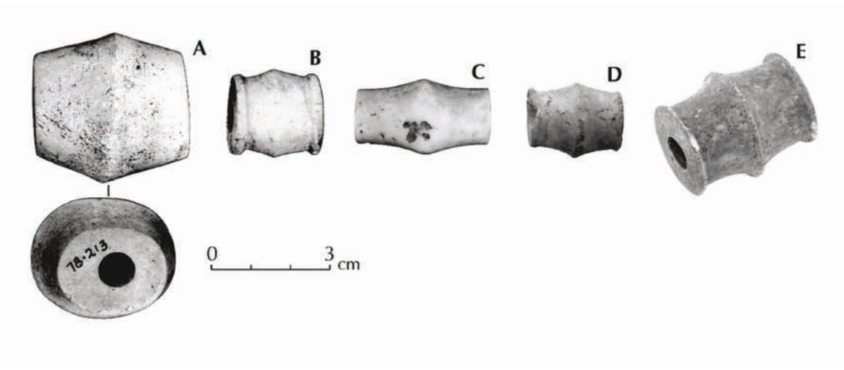

Figure 8. Ivory reels. A: 78.213 Burial 174 Namu. B: 78.178 Burial 158 Namu. C: E59460 Tikopia Neg. CN1276-35A courtesy Australian Museum. D: Atiahara Tubuai courtesy Lawrence Miller. E: ME006315 Wairau Bar Burial I courtesy Museum of New Zealand Te Papa Tongarewa and Rangitāne o Wairau. Figure 8.6 from Leach and Davidson (2008), courtesy of Foss Leach.

Genetic Evidence

There is little genetic research which would shed light on relationships among the Polynesian Outliers, West and East Polynesia and Micronesia. Hudjashov *et al*. (2018) have conducted a study of modern DNA including the Outliers (Ontong Java, Tikopia, Rennell, Bellona), Bismarcks, Solomon Islands, West Polynesia (Sāmoa, Tonga, Futuna, Fiji, Niue, Tuvalu) and East Polynesia (Hawai‘i, Aotearoa/NZ, Cook Islands) with a new modern dataset from the Leeward Society Islands. Their study of mitochondrial DNA concludes: "A PCA plot based on frequencies of mtDNA B4a1a lineages (Supplementary Fig. S8) places the Leeward Society Islands closest to Ontong Java (central northern Polynesian outlier, Fig. 1a) with the major West Polynesian populations of Tonga and Samoa among the most distant from eastern Polynesians" (Hudjashov *et al*. 2018: 5). Their Figure S8 also shows the other Outliers distant from Sāmoa and Tonga, with Tikopia and Bellona as extreme Outliers, from other samples.

The most recent study which incorporates some data from the Outliers and Sāmoa with a detailed study of modern populations from the Marquesas and Society islands is that of Tätte *et al*. (2022). Their overall study is conducted at a very large scale, including data from mainland East Asia, looking at broad-scale patterns of Austronesian dispersal, and would benefit from a more detailed study of patterning in Remote Oceania and Micronesia. Plots of multi-dimensional scaling of genetic distance of Y-STR haplotypes data in their Supplementary Figure 7 place two Outliers in the study (Ontong Java, Rennell) closest to their Marquesas and Society Islands samples, while Tikopia lies as an outlier from the main dataset. Median network analysis was employed to further investigate the relationships between East Polynesia, Sāmoa and the Outliers. They concluded that the peripheral location of Sāmoa and the Outliers in the network was "more compatible with migrations of the C2a-M208 Y chromosome lineage from East Polynesia rather than from Samoa West Polynesia or Ontong Java to East Polynesia" (Tätte *et al*. 2022: 15), resulting in the authors suggesting significant migration west from East Polynesia. Median network analysis as used in genetics has been critiqued (Kong *et al*. 2016) as not representing evolution or history given the absence of rooting used in cladistic trees. Tätte *et al*. (2022: 15) estimated the age of samples and concluded: "Congruent with the topology of the Network, the age estimations indicate that the C2a-M208 lineage is not older in Ontong compared to East Polynesia, not providing support for a west to east gene flow from the former." However, they qualify their results noting the estimation of ages has considerable inbuilt uncertainty.

Recently Gosling *et al*. (2021) have examined samples of ancient (21 samples) and modern (159 samples) DNA from Tokelau and four ancient samples from Kosrae using complete mitochondrial genome sequencing.

Comparison was made with data from West Polynesia (Tuvalu, Niue, Tonga and Sāmoa), East Polynesia (Cook Islands, Leeward Society Islands and Aotearoa/NZ), northern Polynesian Outliers (Ontong Java, Bellona, Rennell and Tikopia) and Micronesia (Kiribati, Nauru, Kapingamarangi and Majuro). Their results show the presence of a number of rare mitochondrial DNA haplogroups in the early Tokelau ancient DNA which provide links to their ancient samples from Kosrae, Micronesia (B4b1a2i). This haplogroup is found most commonly in modern Micronesian samples. Rare haplogroups found in the modern DNA include B4a1a1ab, which is only found at similar frequencies in reported samples from Ontong Java, and B4a1a1x, which is only reported from Tuvalu and Majuro and Kapingamarangi in Micronesia (Gosling *et al*. 2021: 10).

Together these studies would support the evidence from oral tradition and material culture of a history of linkages into Micronesia and the Polynesian Outliers along the chain of islands stretching from the Outliers east to East Polynesia. Genetics does of course link the Outliers to Sāmoa, as seen in a recent study (Harris *et al*. 2020) which unfortunately does not include data from East Polynesia. A fine-grained analysis of such data is needed to follow the genetic trail. It may be significant that Harris *et al.* (2020: 9461) propose, after studying the population structure of their Sāmoan data, a second significant migration into Sāmoa ca. 900–1,050 y ago and cite Addison and Matisoo-Smith's (2010) proposed West Polynesian settlement through the low islands of the Carolines, Kiribati and Tuvalu.

Whence East Polynesia? Summary and Critique

The idea that East Polynesia was settled as part of a separate movement east across the chain of islands north of Sāmoa is of course an old one. Parkinson (1999) in 1907, based on his detailed research in the Bismarck Archipelago including New Ireland, St Matthias and the then German Polynesian Outliers of Nukumanu, Nukuria and Takū, suggested two potential routes of migration: a southern route through New Guinea and the Solomon Islands into Island Melanesia and west into "Central Polynesia", and a northern route "via the Pelau Islands or the Marianas to the Carolines, the Marshall and the Gilbert Islands and on from there" (Parkinson 1999: 240). Parkinson did not view the southern route as plausible given the absence of Melanesian items of material culture in Polynesia (e.g., pottery, bows and arrows), and the Polynesian influence in Island Melanesia he attributed to back movement of Polynesians both through accidental and purposeful voyaging. He argued Polynesian migration occurred in two waves: an early initial movement "much further back in time than one usually believes"; and following this initial settlement of "Central Polynesia", "a second, much later, great stream of migration from the west poured over the equatorial islands, the Carolines, the Gilbert Islands, and so on" (Parkinson 1999: 243), mixing with the earlier migrants and with one stream settling the Polynesian Outliers. Parkinson's theory was based primarily on his observation of abundant evidence of Micronesian material culture and what he saw as biological similarities in his study area of northeastern Melanesia. Parkinson did not explicitly settle East Polynesia in this second migration but noted it might have occurred at the same time as people of the initial settlement moved east as far as Aotearoa New Zealand.

Buck (1985: 47) in 1938 followed Parkinson's theory for much the same reasons and considered the settlement of the Polynesian Outliers to be a combined movement from Micronesia in the north and West Polynesia in the east. Polynesia itself was settled out of eastern Micronesia in a number of migrations into both West and East Polynesia with East Polynesia being settled by a movement east through the chain north of Sāmoa (Buck 1985: 63–65). Food plants such as fine taro were considered to require volcanic soils and therefore not to have come via the atoll route but along a southern route through Melanesia into Fiji from where they were distributed east (Buck 1985: 315–16). Burrows also noted the Micronesian linkages in Polynesian culture and the possibility of a migration theory to explain differences between East and West Polynesia; however, he was sceptical of such an explanation and opted instead for an approach which combined diffusion with processes of culture change, retention, abandonment and local innovation. "Any of the traits mentioned may be old Polynesian, retained in central-marginal Polynesia but abandoned in the west. Again, any of them may have developed in central Polynesia and spread from there to Micronesia, instead of the other way" (Burrows 1938: 163).

Critique of the route east from the northern Outliers includes the difficulty of settling such a large area as East Polynesia from such small islands in an apparently short period of time, and the linguistic argument that the settlers of East Polynesia had a language indicating an origin in high islands. Pawley and Green (1971: 17) in an early reconstruction of Proto-Polynesian vocabulary argued that the speakers of Proto-Polynesian "occupied or lived near an environment where, for example, mountains, cliffs, rivers, lakes, landslides and, probably, volcanic rock were found. That is, the community lived on or near a high island or large land mass, rather than a remote atoll." Reconstruction indicated the homeland was some high Indo-Pacific Island with native fauna unlike that of East Polynesia and explicitly ruled out the homeland as being in "marginal regions of West Polynesia" (Pawley and Green 1971: 23). Geraghty (2009), using the same approach, looked at plant names in East Polynesia and concluded that some plants widespread in East Polynesia (*kalaka (*Planchonella*), *kawa (*Piper methysticum*), and *koka (*Bischofia javanica*)) are not found in the northern Outlier atolls proposed as a homeland by Wilson, and neither are other semantic domains such as freshwater fish or many high-island topographic features common in East Polynesia. However, he notes that it is possible that the Polynesian Outliers were familiar with neighbouring high islands. Linguistic evidence of the distribution of the cognates of *kaute*, the East Polynesian hibiscus, have also been used to argue for ongoing east–west interaction back into the northern Outliers from East Polynesia following the latter's settlement (Thomson *et al*. 2020), again demonstrating, like the adze sourcing data, the widespread mobility apparent in that period. I would suggest that the oral traditions of the Outliers, the presence of large sailing canoes and shared material culture indicate familiarity with large islands on the western and southern margins of the MEMCM Zone, and of course their ultimate origins, as I have argued above, were in the high islands of greater Sāmoa.

Although we have no archaeology for the northern Outliers of Ontong Java, Sikaiana, Nukumanu and Takū it seems probable that the entire MEMCM Zone was settled once atolls became habitable following drawdown from the mid-Holocene highstand. Dickinson suggests atolls in this zone may have experienced a highstand until 200 BC with an estimated cross-over date of AD 1000–1200 when the islands were above estimated high tide (Dickinson 2003: 497). This model has been challenged, however, with both archaeological examples in the Marshall Islands showing atoll development significantly prior to the highstand fall (Weisler *et al*. 2012) and revised geomorphological models of atoll evolution which indicate dynamic response of atolls to sea-level variation allowing growth in response to sea-level rise (Kench *et al*. 2005). In general atolls west of 180 degrees longitude, including the MEMCM Zone, appear to have been settled potentially well before their cross-over dates (Nunn 2016: fig. 3), which would provide a window for the development of populations from which East Polynesia might have been settled.

The potential prehistoric population of the northern Outliers might have approximated the 5,135 estimated for historic Ontong Java, Sikaiana and Takū by Bayliss-Smith (1975: table 7.2) assuming a diet of 25 percent taro. Population growth rates on Tokelau after historic depopulation are recorded as 4 percent or higher (see also Bayliss-Smith 1975: 331 for Ontong Java), and Green and Green propose, given the Tokelau data, that "immigrant founding populations of ca. sixty (two double-hulled or outrigger oceangoing canoe loads) can establish settlements that endure 100, 200, and even more years" (V. Green and R. Green 2007: 252). Oral tradition on the Outliers speaks of significant amounts of voyaging and movement of large canoes with sizeable numbers of people both arriving and leaving (Bayliss-Smith 1978; Grimble 1989; Moyle 2007, 2018; Parkinson 1999: 226). Accounts are full of stories of invasion and population replacement and migration in response to food shortage after cyclones (Firth 1959; 1961: 151; Swift *et al*. 2021), droughts, tsunamis or warfare. Evidence of drought for several centuries in the East Polynesian expansion phase (Sear *et al*. 2020) might well have stimulated movement from small islands very susceptible to such effects. It would seem that Outlier populations on these small atolls with limited resources were dynamic and highly mobile, both for adventure and in response to stresses of many kinds (Firth 1961: 150). Such variation may have acted as a type of pump driving expansion out east into the ocean, while on larger islands or archipelagos similar movement may have been absorbed within or by neighbouring islands.

CONCLUSIONS

As discussed above many of what were mysteries of the southeast Solomons for Roger Green in 1976 have been explained or had considerable light shone upon them in the last four decades. The languages of Temotu have been shown to be Austronesian with origins not in the neighbouring eastern Solomons but in the Lapita heartland of the Bismarck Archipelago, as the result of a leapfrog movement across the Solomons also seen in the genetics. This also explains the surprising strength of Bismarck connections seen in the quantities of obsidian in Temotu while providing some understanding of the speed of Lapita movement into Remote Oceania. The subsequent movement of people with "Papuan" genes along this Lapita sea-path aligns with the two-wave model current in 1976 to explain the Melanesian character of Island Melanesia within Remote Oceania. This movement must have ultimately expanded east to Fiji, as argued by Burley (2013: 444), with paddle-impressed ceramics at ca. 150 BC having probable antecedents in New Caledonia at 700–0 BC in the time frame suggested for the arrival of "Papuan" genes in Vanuatu and presumably New Caledonia. As argued by Burley there is considerable evidence for two-way interaction across the water gap between Fiji and Island Melanesia (Cochrane 2008), and to this I would add Sāmoan expansion into greater Sāmoa (Futuna, 'Uvea) and west to the southern Outliers of the southeast Solomons in the early post-Lapita Plainware period. To answer Green's question, the Polynesian Outliers were not left behind as part of the Lapita expansion but, as indicated by oral tradition, small islands settled by Lapita Polynesian descendants returning from the east within an ongoing field of interaction which must have started soon after Lapita settlement and intensified over time as populations in West Polynesia grew. Oral tradition in the Outliers may simply be describing some of the more recent ends of an old process.

There is much evidence to indicate the voyaging corridor following seasonal winds off eastern Melanesia has an ancient history as an interaction sphere connecting the Outliers as well as the small marginal islands of the eastern Bismarck Archipelago, ultimately extending north into Micronesia by at least AD 0, although earlier connections with high Micronesian islands are not ruled out. How the Southeast Solomonic languages with Micronesian affinities fit into this is not clear unless the relationship dates from before expansion of an aceramic Austronesian-speaking population into the eastern Solomons from the Bismarck Archipelago prior to the Lapita expansion into Remote Oceania. It is the long history of activity and experience in this voyaging corridor that presumably provided the basis for the eventual extension into East Polynesia.

The prehistory of the southeast Solomons argues for the obvious importance of maritime technology, capable of long-distance return voyaging from the time of earliest Lapita settlement. As Dudley *et al*. (2021: 44) note, the Lapita-period canoe was capable of seasonal voyaging using the seasonal alternation of monsoonal and trade winds of the western Pacific; however, sailing upwind into East Polynesia required the development of the double canoe, the Oceanic spritsail and V-shaped hulls. It would seem this might have also facilitated the settlement of central Micronesia. Southeast Solomons prehistory also indicates the importance of opportunistic exploitation of newfound uninhabited lands, as seen in the leapfrog Lapita settlement of Temotu and the subsequent ongoing stream of similar leapfrog movement south in Late to post Lapita times. Once found, the chain of islands south from the Bismarck Archipelago provided a comparatively safe voyaging corridor for the inheritors of the Lapita voyaging tradition. Once the Lapita settlement of Remote Oceania was accomplished, growing populations in West Polynesia and easterly winds provided a stream of voyagers from the east who were able to safely settle small, possibly uninhabited, marginal islands of eastern Melanesia, including some of those in the southeast Solomons.

The role of the Solomon Outliers in arguments for the settlement of East Polynesia would perhaps surprise Roger Green; however, he was very supportive of research which has increasingly in the last 40 years used sourcing data from geochemistry and petrography to steadily expand our knowledge of extensive interaction spheres in Oceania. Evidence of long-distance interaction is no longer surprising, and so perhaps links from the Outliers into East Polynesia should not come as a surprise. Yet at the same time we should not discount the evidence from adze geochemistry of early links from southern East Polynesia such as the Cook Islands into West Polynesia, which is also supported by oral tradition (Walter and Sheppard 1996). The final story of East Polynesian settlement might be more complicated than a simple linear model of settlement: Roger would certainly agree with that.

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NOTES

1. Roger Green in 2006 also reported to us that he had searched but found no terms in Southeast Solomonic associated with pottery.
2. Fritz Graebner was an important early member of the German *Kulturkreis* school of culture history (Voget 1975). His study of Santa Cruz was based on his extensive experience in German museums and especially with the very large collection of Santa Cruz material culture and notes collected by the German collector and traveller Wilhelm Joest during a trip to Santa Cruz in 1897. Joest's collection formed the basis of the then newly founded Rautenstrauch-Joest Museum, which Graebner joined in 1906 (Lips 1935). The complex history of Santa Cruz proved an ideal dataset for the application of Graebner's method, with which he developed a detailed theory of Santa Cruz culture history, much of which might agree with modern results.

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