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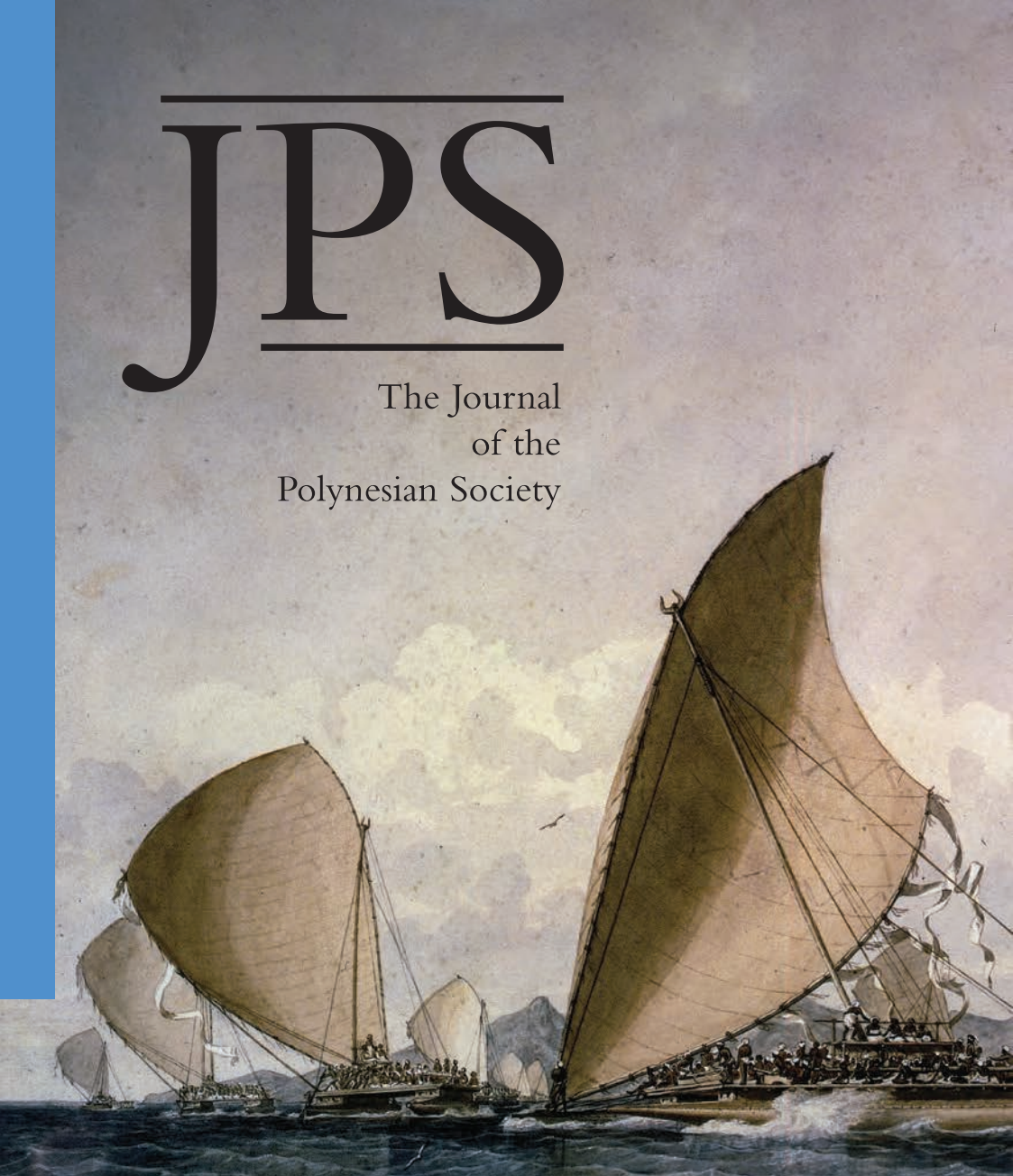

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Cover image: *Kalia*/*drua* of the combined Tongan and Fijian fleets shifting tack in rounding a reef to approach Ovalau, 1855. Painted by Glen Wilson. Permission courtesy of John Denham, London.

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Inquiries should be made to:

Hon. Secretary
af-jps@auckland.ac.nz.
The Polynesian Society
c/- Māori Studies
The University of Auckland
Private Bag 92019, Auckland

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Contributors to This Issue

Fergus Clunie, who worked for the Fiji Museum from 1969-87, is a Sydney-based research associate of the Sainsbury Research Unit, University of East Anglia, UK. He is particularly interested in Fijian material culture, and in tracing cultural, spiritual and historical linkages between Fiji and Western Polynesia. Besides conducting ongoing research into the history and consequences of Tu'i Tonga embroilment in Fiji and Samoa in the 16th century, he is currently investigating the artistic and scientific heritage of the voyage of HMS *Herald* to the southwest Pacific in the 1850s.

Anne Di Piazza is a research archaeologist affiliated to CNRS-CREDO, the French Centre for Pacific Studies at Marseilles, France. Her main research topics are voyaging and cultural seascape, reconstruction of ancient canoes, computer simulation of settlement processes, as well as canoe building.

Geoffrey Irwin is Emeritus Professor of Archaeology at the University of Auckland. He has carried out fieldwork in New Zealand, New Guinea, Indonesia, the Solomon Islands and Fiji. He has long-standing interests in wetland archaeology, settlement pattern archaeology, and in the prehistory of Pacific colonisation and inter-island voyaging. He grew up on Auckland's Waitemata Harbour and has sailed ever since. In the 1970s and 1980s he was fortunate to sail on the double *orou* canoes of the Mailu on the south coast of Papua New Guinea and on outrigger canoes in the Massim. He later took his own 11-metre yacht *Rhumbline* across the western Pacific, along routes first taken by Lapita sailors. These experiences have influenced his views about voyaging in prehistory.

Richard Flay is Professor of Mechanical Engineering and Director of the Yacht Research Unit at the University of Auckland with research interests in wind engineering and yacht aerodynamics. He has been responsible for many wind tunnel investigations of large buildings and high performance yachts and has been involved in several successful America's Cup campaigns. He has helped organise five High Performance Yacht Design Conferences and designed a large Boundary Layer Wind Tunnel recently constructed at the University of Auckland. His interest in the performance of Polynesian sailing vessels, and its impact on the settlement of the Pacific, is a natural complement to his work on the innovative modern high performance vessels which have been the traditional focus of the Yacht Research Unit.

A Life Member's Gift in Appreciation

On behalf of the Council of the Polynesian Society, the editors acknowledge the sizeable monetary contribution of Marianne Skanland, a long-standing Life Member, given in appreciation of the Society's work. The Society is most grateful for her support and is considering ways to use the gift as the initial donation for a programme supporting NZ graduate scholars' research in Oceania.

In years past the Society's President has asked Life Members for contributions to the Society's publication fund. These contributions made it possible for the Society to embark on a publishing programme that resulted in significant additions to the Memoirs in the past two decades as well as the new editions of the four volumes of *Ngā Mōteatea*. In the present academic environment, support of emerging scholars undertaking research in Oceania, the teachers and established researchers of the future, and authors of future journal articles and memoirs, seemed an important undertaking for the Society in light of its aims since its establishment 125 years ago.

TONGIAKI TO *KALIA*: THE MICRONESIAN-RIGGED VOYAGING CANOES OF FIJI AND WESTERN POLYNESIA AND THEIR TANGALOAN-RIGGED FOREBEARS

FERGUS CLUNIE
Sainsbury Research Unit, University of East Anglia

Since 1817, understanding of Fiji and Western Polynesia's voyaging-canoe heritage has been retarded by a theory advanced in John Martin's *Account of the Natives of the Tonga Islands*. According to his hypothesis, Tongan voyagers replaced their Tangaloan-rigged *tongiaki* double canoes with pre-existing Micronesian-rigged Fijian *drua* 'double canoes' (Tongan *kalia*) in the late 18th century. (Tangaloan, as I use it, refers to the culture, gods and people of a group of immigrants from island Southeast Asia who, led by Tangaloa, arrived in what are now Western Polynesia and eastern Fiji in AD 450-500.)[1]

I am arguing here that, while *drua/kalia* were indeed built in Fiji, Martin's hypothesis was ill-conceived. In doing so, I shall provide overwhelming evidence that Tongan navigators and Tongan-Samoan canoe-wrights drove a generationally staged development whereby *tongiaki* were crossed with a Micronesian-rigged Kiribati outrigger-canoe to produce twin-hulled transitional offspring that were then crossed with similarly hybridised Kiribati-rigged *hamatefua* 'outrigger-canoes' (Fijian *camakau*) to produce *kalia/drua*. To substantiate my thesis, I first examine Martin's *drua* vs *kalia* hypothesis and document how it survived after it had been authoritatively discredited. Then I explore how the canoes themselves reflect not just their own evolution but that of the societies which produced and used them.

To substantiate the foregoing, the article is broken into four key sections and corresponding subsections. The first assesses Martin's *drua vs kalia* hypothesis and documents how it survived after it had been authoritatively discredited. The second identifies who actually built voyaging canoes in the region and traces the canoes back to their ancestral roots by examining pre-Christian traditions which, combined with archaeology, trace the overlapping histories of godly and chiefly relationships in Fiji and Western Polynesia from the 5th century AD to 1616, when *tongiaki* were first encountered by Europeans. In the course of this composite narrative, the commencement of voyaging canoe construction in Fiji is linked to the arrival of the great founder gods of chiefly Fijian society, Degei and his immortal associates; Degei's relationship to primal Tongan and Samoan equivalents; and Tu'i Tonga activity in Fiji and Samoa in the 16th century. The third section documents how Fijian traditions concerning Degei were altered by missionisation in

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the 19th century to project him as an autochthonous Fijian deity and create the impression that concerted Tongan activity in Fiji was only enabled by the supposed Tongan adoption of the Fijian *drua* in the late 18th century, and demonstrates how these misconceptions enabled Martin's hypothesis to survive unchallenged until the 1980s. The final section examines the canoes themselves in order to assess their comparative performances, trace how, why and when one form morphed into another in the 18th century, establish that Tangaloan-rigged *tongiaki* and *hamatefua* were the hybrid descendants of early historical matings between autochthonous Melanesian and intrusive Tangaloan canoe technologies, and demonstrate how their Micronesian-rigged descendants of the 18th and 19th centuries reflect another extraordinary bout of intensive hybridisation and adaptation on the part of specialist Tongan navigators and Tongan-Samoan canoe-wrights eager to seize upon anything they could turn to voyaging advantage.

So: be prepared to digest a bewildering range of historical, geographical and cultural factors, hear as much about gods, kings and Methodists as canoes, and recourse as need be to the appended glossary.

MARTIN'S *DRUA* VS *KALIA* HYPOTHESIS

Pros and Cons of Martin's Hypothesis

Martin understood from William Mariner, who lived in Tonga from 1806 to 1810, that Tongan navigators had voyaged between Tonga, Fiji and Samoa since time immemorial. Drawing upon all available evidence, he reasoned that "although they have no tradition of such a circumstance":

> It is highly improbable that neither of them went out on a voyage of discovery, or if such an opinion be admitted, there is little doubt but that the people of Tonga first made the attempt, although the construction of their canoes were at that time far inferior. The grounds for this opinion are, first, their situation to windward, and secondly, their superior enterprising spirit, in affairs of navigation, which may be said to constitute a feature of their national character. Their superiority in this respect is so great, that no native of Fiji, as far as is known, ever ventured to Tonga but in a canoe manned with Tonga people, nor ever ventured back to his own islands, but under the same guidance and protection. (Martin 1818 [II]: 264)

Martin was further informed by voyaging literature that the since outmoded *tongiaki* had been extant in Tonga when Cook was there in the 1770s, but faced competition from a previously unrecorded Micronesian-rigged double canoe. This accorded with Mariner's information that whereas Micronesian-rigged *kalia* 'double canoes' had supplanted *tongiaki* in Tonga, they still clung on in Samoa, where: "The canoes [*va'atele* 'great canoe'] are similar

to those which were formerly in use at Tonga, but the natives of those islands never venture to the latter place but in canoes manned with Tonga people" (Martin 1818 [II]: 265).

So far, so good: Martin cannot fairly be faulted for underestimating the antiquity and scope of Tongan navigational enterprise, and his findings have otherwise weathered the test of time. Unfortunately, however, although Martin was well informed about Tonga, he had little to draw upon for Fiji beyond newspaper gleanings, observations and hearsay recorded in Tonga by late 18th-century visitors and missionaries, who were only just coming to grips with the language, and what Mariner had heard in Tonga. For firsthand Fiji information he only had Mariner—who during "sundry" trips ashore while the *Favourite* lay at Bua, Vanualevu "for five or six days" in 1810, verified much of what he had been told; and Mariner's tragically taciturn former shipmate Jeremiah Higgins—who spent 13 weeks at Vanualevu with the *Hope* in 1809–1810 (Martin 1818 [I]: vi-xiii, [II]: 64-8, 327, im Thurn and Wharton 1925: lxxxviixc, 140-48, 205). He can accordingly have known next to nothing of the circumstances governing voyaging canoe construction in Fiji. It is also evident Martin failed to notice that the Fiji-built "*calia"* [*sic*] of the early 1800s—each of which rode upon a long *katea* 'hull' and shorter, slighter *hama* 'outrigger-hull'—differed from the Micronesian-rigged double canoes Cook encountered in Tonga in the 1770s, which were adapted from their hulls upward to work the new rig, but were otherwise still *fakatoukatea* 'both *katea*', floating—like *tongiaki*—upon a matching pair of *katea* (Fijian *katā*) 'hulls'. He was thus in no position to decide for posterity that Tongan voyagers and canoe-wrights had "obtained a considerable share of information in the art of building and rigging canoes" from Fijians, let alone rule that Fijians must necessarily have been their voyaging canoe design and construction "instructors" because:

> The Fiji islanders make their canoes principally of a hard firm wood, called *fehi*, which is not liable to become worm-eaten; and as the Tonga islands do not produce this wood, the natives are not able to build canoes so large or so strong as their instructors: all their large canoes, therefore, are either purchased or taken by force from the natives of Fiji. (Martin 1818 [II]: 265)

Indeed, although *fehi* (Fijian *vesi*, Sāmoan *ifilele*; *Intsia bijuga*) certainly was the region's supreme hull building timber, the conclusions that he sprang to were unjustified. He failed to notice: (i) that *tongiaki* and *kalia* hulls were similarly formed, (ii) that they were also composed from *Calophyllum*, *Dysoxylum*, *Terminalia* and suchlike woods, and (iii) that large robust voyaging canoes were built in the Societies and Tuamotus in the absolute absence of *fehi*. The peculiar attraction of *fehi* timber actually owed more to

its spiritual than material qualities; this bloody-sapped tree was so spiritually charged its wood was used only for godly and chiefly purposes, most pertinently the construction of *vakatapu* (Fijian *waqatabu*) 'sacred canoes'.[2] His argument was, moreover, imperiled by his failure to consider some self-evident paradoxes—namely:

- The comparative unlikelihood of Fijians independently encountering Micronesian-rigged canoes—Kiribati was the closest source. Anderson's list of islands known to 1770s Tongans included *Talava* 'Tarawa', so although he obviously could not identify Tarawa with Gilbert's Matthew's Island, he might have noticed Cook had immediately correlated the new Tongan rig with that of the "flying proas" of the Marianas (see Anderson in Cook 1784 [I]: 369, Anson 1748.
- The fact that Kau Muala/Moala—a newly returned navigator cum canoe-building *matāpule* Mariner met in 1809—not only built a replacement when his own voyaging canoe was confiscated at Futuna, but sailed back to Fiji in it and eventually went home without trading it in for a *drua* (see Martin 1818 [I]: 307-36).[3]
- The paradox posed by the established character of Tongan voyaging to Fiji and recent replacement of Tangaloan-rigged *tongiaki* by Micronesian-rigged ones.

Early Rebuttal of Martin's Hypothesis

Given the limitations and prejudicial skewing of Martin's evidential base, it is hardly surprising that within a decade of his book's publication mariners began signalling that "Mariner" was mistaken and that, despite being built in Fiji, the great *kalia/drua* 'double canoes' and their phenomenally handy *hamatefua/camakau* outrigger auxiliaries were more Tongan than Fijian. Dumont d'Urville, for instance, volunteered that:

> Mariner thinks that the Tongans got most of their knowledge of the construction and rigging of canoes from the Fiji islanders. For myself, who has visited both peoples, I found the Tongans much more advanced in this respect. The canoes of Tonga-Tabou seemed to me to be infinitely superior to those of the Fiji islanders in proportions, style and workmanship. (Dumont d'Urville 1832: 265)

This should have attracted more notice than it did. D'Urville's people—among them Pâris, the leading Oceanic canoe authority of the 19th century—had been particularly interested in canoes. He did not belabour his point however, and it gained so little traction that neither Charles Wilkes, commander of the U.S. Exploring Expedition, nor Horatio Hale, his brilliant philologist, acknowledged it when visiting Tonga and Fiji in 1840. Indeed,

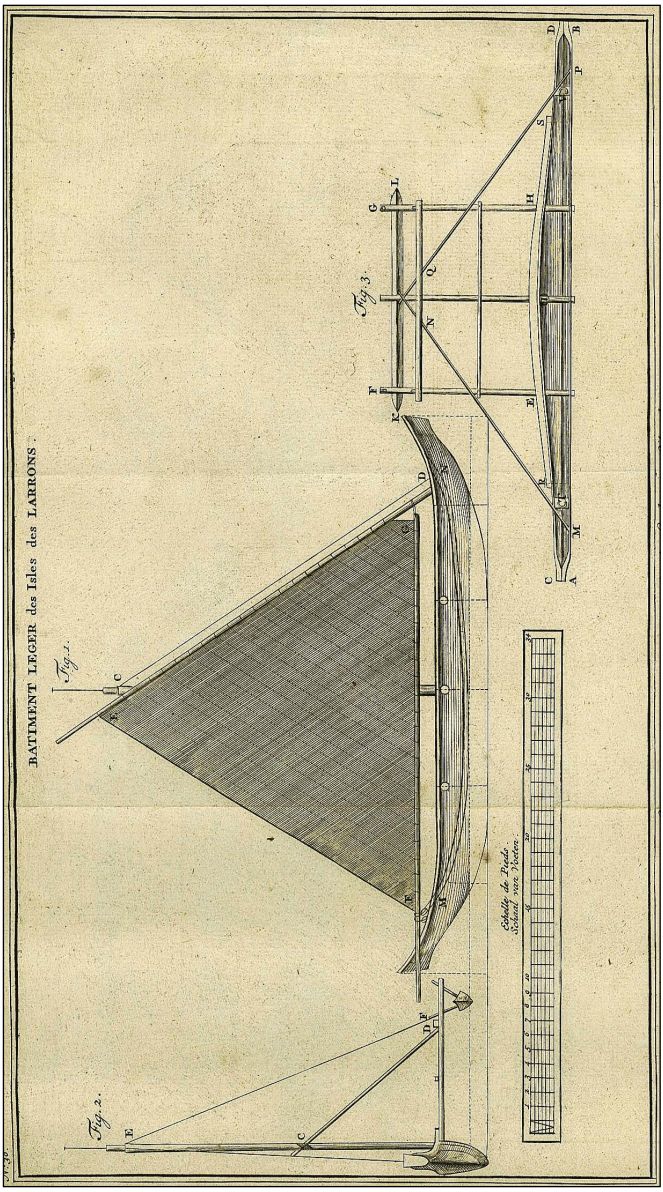

Figure 1. "Flying proa", Marianas, 1742 (Anson 1748).

although Wilkes first encountered *kalia* in Tonga he was so sure they were "of Feejee origin" that he deferred their description to the Fiji section of his *Narrative* (1845 [III]); and for all his acumen and interest in the slick tack-shifting Micronesian rig, Hale followed suit:

> The canoes of the Caroline islanders are made to sail with either end foremost, resembling in that respect, those which are in use at the Feejee Islands, and which the natives of Tonga have borrowed from there. Whether this model belongs properly to the black [Melanesian] race or the Micronesian is uncertain; but from its universality among the latter, we should be inclined to ascribe it to them. (Hale 1846: 74)

There is more to this than meets the eye, however, because although the Expedition's *bêche-de-mer* trader advisers insisted the canoes were fundamentally Tongan, neither Wilkes nor Hale mentioned that when conforming to the orthodox Martin doctrine, which was that promulgated by the Wesleyan missionary Cargill, to whom Hale's *Grammar and Vocabulary of the Vitian Language* was deeply obligated (Hale 1846: 92). Cargill was a linguist with an MA from Aberdeen University, so it seems that the Harvard-educated Hale may have accorded the benefit of collegial doubt to his fellow philologist's insistence that:

> The superiority of the Feejeean canoes is acknowledged by the inhabitants of the adjacent islands. The Tonguese have ceased to build canoes after the fashion of their own country, and imitate the structure of those built by the Feejeeans. The timber,—the shape of the canoe,—the manner of lashing it together,—the names of its different parts,—the mast, sail, and rigging, and furniture of the canoe are all Feejeean. This is creditable to the skill of Feejeean Mechanics. (Cargill in Schütz 1977: 61)

In terms of comparative qualification: besides living in Tonga in 1834-35, Cargill had been at Lakeba, the hub of Tongan activity in Fiji and chiefdom from which voyaging canoe construction in Lau was controlled, for nearly four years when he wrote that. Yet even his claim about the nomenclature of components—which conceivably swung the balance for Hale—is spurious. The terminology (as anyone morbid enough to sift the linguistic works listed in the accompanying bibliography will find) contains a mixture of intrusive Tangaloan and autochthonous Melanesian-derived terms which in Fiji sometimes combine to form a composite word. It is also evident that when not mistaking Samoan flange-lashing for Fijian, or failing to grasp that *drua* inherited their mast and sail from *tongiaki*, their rigging from Micronesia, Cargill parroted rather than corroborated Martin. The *bêche-de-mer* traders—Benjamin Vanderford, the Expedition's pilot and trading master, and Captain

John H. Eagleston of the *Leonidas*—however knew "Mariner" as well as Cargill did, and had the benefit of much wider Polynesian and Melanesian experience, including three decades worth of firsthand association with all of Fiji's major maritime chiefs and their canoe-wrights, as well as their resident Tongan relatives, Tupou Toutai and Lasikē. The latter were closely aligned with the Bauan *vūniivalu*, Tui Cakau, and Tui Nayau, and conducted their own canoe-building enterprises (see Eaglestone MS. 1830–33, Eagleston MS. 1833–36, Clunie 1984a). It is therefore fortunate that the traders were able to convince naturalist Charles Pickering—another ethnologically-informed member of the Expedition's scientific corps—that:

> The sea-going canoe, which is double, seems to be a genuine Tonga model; though the circumstance that these canoes are occasionally met with at the Feejee Islands has led to some confusion. It appears, indeed, from the observation of traders, that they are all built 'at the Feejee Islands; but by Tonga people alone, who make visits of several years' duration, for this special purpose. (Pickering 1851: 83)

The trader viewpoint failed to register, however, because Pickering unfortunately entombed it within his *Races of Man*, traduced by Oliver Wendell Holmes as "the oddest collection of fragments that was ever seen... amorphous as a fog, unstratified as a dumpling and heterogeneous as a low priced sausage" (Philbrick 2005: 343). Consequently, scholars also failed to notice when his "traders" were supported by this unorthodox compression of traditional *Fijian* opinion in *Jackson's Narrative*:

> The red [whale] teeth [*tābuadamu*]… they always told me were brought to the Feejees by the Tongans, from whom also they learned the art of building the large double canoes. They also said that, previous to the visits of the Tongans, the Feejeeans did not know the use of angona [*yaqona* 'kava'], although they called it by that name, and looked upon it as a useless weed. (Diaper 1853: 439)

Because Diaper was simply relaying the viewpoints of Fijian chiefs he consorted with in the early 1840s, none of whom were Christian, it is important to note that other Fijians substantiated the *tabua* comment, that the *yaqona* observation makes sense once you realise the chiefs were referring to the Tonga-derived *yaqona*-ring and discounting autochthonous *burau-yaqona* culture, and that the voyaging canoe information is corroborated by other contemporary Fijian authorities (see Clunie 2013a: 194-98). It is also notable that Captain Erskine of H.M.S. *Havannah*—who prevailed upon "Jackson" to write his *Narrative* and likewise "fancied" *kalia/drua* to be more Tongan than Fijian—understood, "One of the principal employments, which has now been entirely transferred from Tonga to Feejee, on account of the exhaustion

of the building materials in the one place and profusion in the other, is the construction of large double canoes" (Erskine 1853: 265).

So by 1849, when the *Havannah* was in Fiji, Martin's hypothesis had been extant for 32 years and, apart from being uncritically accepted by Wesleyan missionaries, had for the past 22 of those years been contradicted by informed foreign and Fijian witnesses who contended that although *kalia/drua* were built in Fiji, they were primarily Tongan. The shutters then came down, however, as Wesleyan missionaries entrenched themselves as the preferred Fijian authorities.

The Wesleyans Resurrect Martin

As a true son of the Enlightenment, Martin would hardly have been gratified that these evangelical enthusiasts insisted upon preaching rather than testing his hypothesis. Farmer, for instance, simply reiterated that "Tonga people were then, and are now, famous as navigators", but that "in the art of canoe-building they have been greatly aided by the Fiji Islanders" (1855: 63). And even this ostensibly authoritative statement by Thomas Williams is just as derivative:

> The well built and excellently designed canoes of the Fijians were for a long time superior to those of any other islanders in the Pacific. Their neighbours, the Friendly Islanders, are more finished carpenters and bolder sailors, and used to build large canoes, but not equal to those of Fiji. Though considering the Fijians as their inferiors, yet the Tongans have adopted their canoes, and imitate them even in the make of their sails. This change was in process when Captain Cook first visited Tonga in 1772 [1773]. The Fijians whom he saw were probably the companions of Tui Hala Fatai, who had returned, a short time before from Fiji in a canoe built by the people there, leaving in its place his own clumsy and hardly manageable *togiaki*. A glance at the new canoe convinced the shrewd Chiefs of Tonga that their own naval architecture was sadly at fault. Their *togiaki*, with its square [squat], upright mast, the spars for stays [shrouds], projecting like monster horns, the bevelled deck, the loose house, and its broad, flat ends, contrasted with the smart Fijian craft [*drua/kalia*] much as a coal barge with a clipper yacht. The *togiaki* was forthwith doomed to disuse, and is now seen no more among the fair isles of Tonga. Not the slightest change has been made in the model thus adopted, and which has now been used for more than a century by the best seamen in these regions; but the Tongans have the praise of executing the several parts with superior care and finish. (Williams 1858: 76)

The contrast between accounts based upon Williams' own canoe-sailing experiences and this plagiaristic pastiche could not be more marked. It seems to have been mostly composed by Rowe, the Missionary House editor and propagandist, but it appeared under Williams' authoritative name so—backed

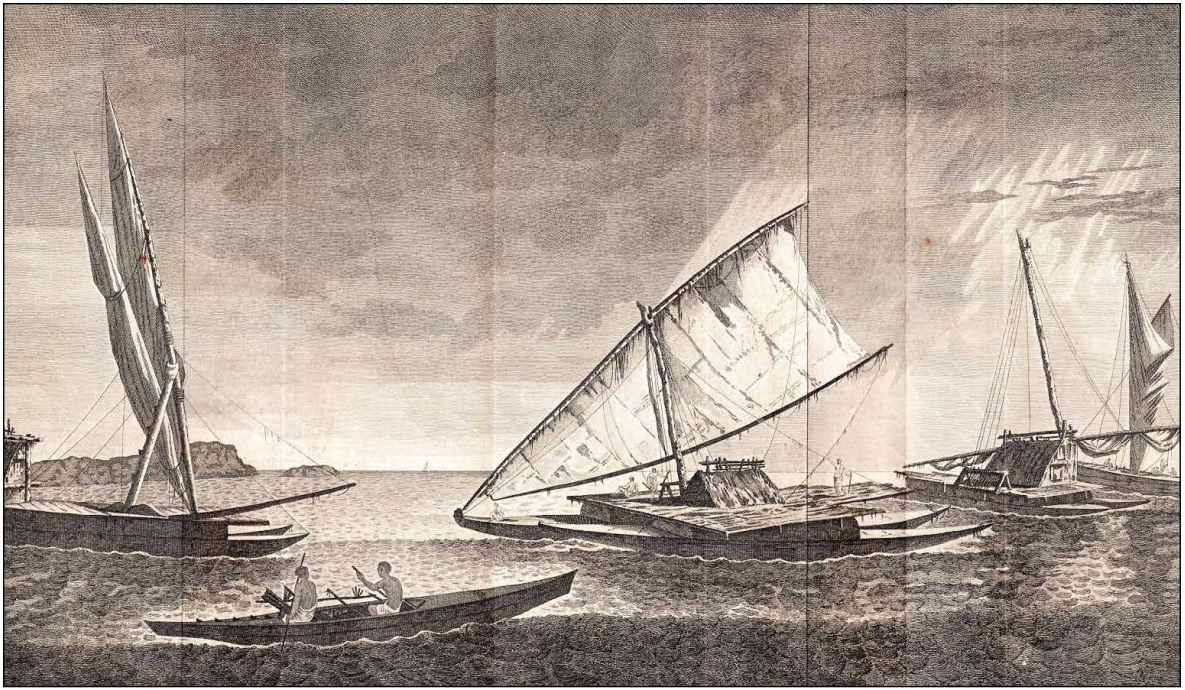

Figure 2. *Tongiaki* (left) and Micronesian-rigged *tongiaki*. The artistically introduced and engraver confused details are resolvable and even instructive, 1774 (Cook 1777 [2]).

by the usual train of supposedly corroborative but actually plagiaristic "authorities"—has been, and remains, highly influential. That being so, notice Williams repeats Cargill's old canard about the Fijian make of the *drua*'s sails, and that the passage is factually raddled by the claim that Fijians whom Cook met in the 1770s were "probably companions" of Tu'ihalafatai, who actually returned "from Fiji in a canoe built by the people there" in 1799, by which time *tongiaki* had long been sailing under the Micronesian rig. It is also remarkable that Williams' prejudicial inflation of the old *tongiaki*'s supposedly hopeless performance seeded ongoing denigration of that great canoe (see Thomson 1908: 294-95). And that "canoe built by the people there" skirts the issue of just who did actually build Tu'ihalafatai's *drua/kalia* in Fiji.

PRE-CHRISTIAN TRADITIONS AND VOYAGING CANOE HISTORY

Degei, Rokola and the Fijian Canoe-wrights

The preceding comment is more pertinent than paranoid because although Williams knew the roots of the *mātaisau* 'canoe-wrights' responsible for "Fijian" voyaging canoe construction, he did not expose them when elaborating that they comprised a "caste which bears in Fiji the sounding name of 'King's carpenters,' having Chiefs of their own, for whom and their work they show respect", or when outlining how, while "many natives" were engaged in canoe-building in Fiji by the 1850s:

> It seems that formerly none but persons of a certain tribe were permitted to do this work; but now many others [Wesleyan converts] are attempting it successfully.…The carpenters of the present day, however, are somewhat inferior to those who preceded them: neither is it difficult to account for this… for they are ill paid, and a vigorous competitor has entered the field, with whom the present race are too dispirited to cope. The Tongans crowd the path of the carpenter, and, as the Chiefs of Fiji like to employ them, seem likely to thrust the native mechanic [*mātai*], out of place and work. (Williams 1858: 71)

This contribution is rather more revealing than intended because in noticing that the *mātaisau* monopolised pre-Christian Fijian voyaging canoe construction, it jeopardises Martin's Fijian *drua* concept. To wit, that if *drua* preceded *kalia*, they must have been designed and produced by Williams' "King's carpenters", who thus must have been the "instructors" of the *mātaitoga* 'Tongan canoe-wrights' who then immediately became their masters. So the question becomes, who were these instructive yet degenerate *mātaisau*?

At bottom, Williams' interpretation of *mātaisau* is explained by his combining Samoan *mātai* 'skillfulness, dexterity, foremost' with Tongan *hau* 'governor/ruler'—*sau* in Fijian (see Tcherkézoff 2000). "King's carpenter", however, only applies if *ni* 'of' is interposed to distinguish a particular

chief's canoe-wrights: *mātainisau*. This is important because, although he was unaware that Fijian *mātaisau* echoes Samoan honorific *mātaisau* 'expert craftsman', Williams knew each *mātaisau* band in Fiji was headed by an hereditary *matāvule*, and that *matāpule* applied in Tonga to the hereditary leaders of the clans who monopolised voyaging canoe construction. (Martin 1818 [III]: 84-86).[4]

The foregoing indications that the *mātaisau* reached Fiji from Samoa via Tonga are corroborated by the wider regional reality that although most men practised carpentry to some extent, and religious sanctions did not apply to the building of simple dugout canoes (which were not technically *vaka*), the construction of voyaging canoes in Samoa, Tonga and Fiji was conducted under godly-chiefly authority, punctuated by equivalent sequences of divinely-ordained property and food presentations, and was *tapu* to all but the following exceptions.

- In Samoa: *tufugafauva'a* 'canoe-wrights' of *mātaisau* or *mātaitufuga* 'master carpenter' lineages, headed either by a chief or *tulāfale* 'chiefly spokesman', who not only answered to higher chiefly authority, but like their house-building and tattooing colleagues, collectively belonged to the *agaiotupu* 'kings' companions', who as *sātagaloa* reputedly descended from Tagaloa, primal founder-god of Polynesia (Krämer 1995: 98, 311, Hiroa 1930: 84-86).
- In Tonga, "Children of Tangaloa" or *tufunga fo'uvaka* 'specialist canoe-wrights', whose lineages likewise derived their calling from Tangaloa Tufunga 'god of artificers and the arts', whose priests [*matāpule*] were "all carpenters" (see Martin 1818 [II]: 109, Thomas MS., Gifford 1929: 145). Significantly, some if not all of these canoe-wrights had Samoan roots—Lehā, the Tu'i Tonga's principal house- and canoe-building *matāpule*, for instance, and Moala, *toutai* 'navigator' and canoe-wright of the Tu'i Kanokupolu (Gifford 1929: 67, 150, 254). Because *matāpule* corresponds to Sāmoan *tulāfale* and Fijian *mata*, it is likewise remarkable that *matāpule* (*mata* 'face', *pule* 'godly/chiefly authority'), like Fijian *matanivanua* 'face-of-the-chiefdom', were essentially hereditary companions, spokesmen, advisers and executive agents of the chief they served (Hocart 1913). Just as significantly, no matter how much Tongan blood *matāpule* had acquired over time, they were technically "outsiders" of Samoan, Fijian, Rotuman or *tokelau* ('northern', people from the atolls to the north) extraction, each being descended from and serving as the priest of a "foreign" deity. This meant *matāpule* could not only more effectively serve but also associate more freely with their chiefly patrons than others could, since they were not subject to many of the *tapu* that otherwise applied (Gifford 1929: 140-52).

- In Fiji: either locally entrenched, similarly hybrid clans of Fijian-speaking *mātaisau* 'canoe-wrights' whose primal god was Rokola, who arrived with the paramount *kalouvū* Degei; or bands of more recently settled or visiting *mātaitoga*. Regardless of whether they were *mātaisau* or *mātaitoga*, each such clan was headed by its own hereditary *matāpule*, *matāvule* or *tūnidau* who, as the priest and principal descendant of "Tongan" gods, was immune to *tabu* otherwise pertaining to the chief he served (see Hocart 1970: 108, Clunie 2013a: 180-81).

The *mātaisau* were not the only Tonga-derived canoe specialists in Fiji, however. Their position was comparable to that of expert sailing and turtle-fishing clans of similarly hybrid, Fijian-speaking *gonenitoga* 'Tongan children', *togaviti* 'Tonga-Fiji' or *kai loma* 'in-between people', each historically tied to a particular chief and headed by a *matāpule*, *matāvule* or *tūnidau* who doubled as its priest (Lyth MS.b, Calvert 1858: 4, Waterhouse 1866: 12, Toganivalu 1914: 3). The *gonedau* 'expert children' affiliated with the most powerful chiefs were crack canoe-men who—in competition with interloping Tongans and mostly sailing *camakau* or smaller *drua*—dominated interisland voyaging and canoe-fighting, and were, like the *mātaisau*, regarded as *vūlagi* 'sky-based strangers' or *kaitani* 'different people' by the autochthonous *kaivanua* or *lewenivanua* 'landed people', who resented their presence. As outsiders, they accordingly tended to dwell in compounds adjoining those of their chiefly patrons, or upon small offshore islands (see particularly Lyth MS.b, Toganivalu MS.: Ch. 14, Hocart MS.a 1970: 108).

Unlike the *mātaisau*, these *gonedau* had not arrived in a single group. Those whose forebears had drifted in, arrived as refugees or rebelled against Degei, principally venerated the primal Tongan sea-god Hemoana—Fijian Semoana alias Dakuwaqa—incarnate in a great shark or *dakulaci/dadakulaci* 'banded sea-krait' (Tongan *tukuhali*), and his sister Lupe (Fijian Rāluve, Rāmarama). Others, such as the Lasakau, Levuka, Butoni and Malake, who were more closely affiliated with Degei, primarily venerated Rakavono, who seemingly traces to the same godly root as Hemoana, but often manifested himself in human form and went by manifold names: Daucina, Rācinacina, Navosavakadua, Tūtūmatua (Tongan Tu'utu'umata), and so forth (Cross MS.a, Rabone 1845: 199, Hale 1846: 62, Lyth MS.b, Williams MS., Waterhouse 1866: 362-65, Heffernan MS. 1876–77, Fison 1904: 19-26, Hocart MS.a, 1929: 191, 1952a: 70, Witherow 1914, Collocott 1921a: 152, 237, Gifford 1929: 295-98, 340).

Because the chiefly patrons of these maritime outsiders derived their divinely ordained authority from Degei and his immigrant *kalouvū* followers, and were likewise classed as *kaitani* or *vūlagi* by the *kaivanua* (see Hocart MS.a, MS.b, Sahlins 1981, 1983, Hooper 1996), it follows that Degei brought not just the *mātaisau* but the crux of the Fijian chiefly system with

him. From 1835 onward, however, the great raft of so-called "Nakauvadra traditions" chronicling the activities of Degei and the *kalouvū* were infiltrated by Old Testament constructs, some of which became deeply embedded. Unfortunately, the confusion engendered by this initially quite spontaneous phenomenon and subsequent encouragement of it has since been more compounded than resolved by scholarship. It must therefore be stressed that, despite being overlooked by Peter France, bona fide pre-Christian Nakauvadra traditions were recorded by Osborn, Hale and others, and that their historical undercurrent is so collectively consistent, they must now be sifted to determine who Degei and his godly cohort historically were, and when and where they came from (see Osborn MS. 1833–36, Hale 1846, France 1966, 1969).

The tradition Osborn recorded at Bau in 1834 is remarkable for its arrival details, whereby, at a time associated with phenomenal flooding, "Old Thingee, family & about 200 followers", including his son "Woomberackee" (Uabaravi = Rokoua), approached Fiji in a gigantic double canoe and, upon sighting Kadavu, turned northwards towards Ovalau, making for Verata on the east coast of Vitilevu, where Degei subsequently ensconced himself in a cave and assumed the form of an earthquake-inducing serpent. While passing through Lōmaiviti, however, his canoe ran into a storm, during which its cargo was jettisoned and its "fire pan"(*tongiaki* characteristically carried a *tālafu* 'canoe-hearth' on deck) was washed overboard to form Naigani Island (see Figs 5, 8 and 9, also Clunie 1984b).[5] It is also notable that, consistent with Tangaloan descent from the Lagi 'Sky', the direction Degei's canoe came from is not mentioned in this, the Hale traditions or those Barker (1924, 1925a, 1925b, 1927a, 1927b) collected in Rā in the 1870s.

Hale's sources were more diverse, but the underlying consistency of the traditions he collected and way they meshed with linguistic and wider cultural evidence convinced him that (i) "many" Fijian "religious observances" and much "Vitian mythology" was "of Tongan derivation", (ii) the Tu'i Tonga had once resided in Fiji long enough to seek "the alliance of his dusky neighbours", impact heavily upon them and be impacted in return, and (iii) "the mythological history of *Ndengei*… appears to refer to events in the early history of the two races" (Hale 1846: 51-56, 181-86).

Before proceeding further, it is important to understand:

- That in acknowledging how "according to one account, the natives held that Ndengei created the first man and woman", Hale purposefully isolated an aberrant account provided by a recent Wesleyan convert, this being "directly opposed to the general belief that the god did not make his appearance till after the islands were peopled, and that he first ruled, in human shape, over some of the towns" (Cross MS.b, Hudson MS. 1839–42, Hale 1846: 52-53, Williams 1858: 251).

- That he was right to do so, even biblically-influenced traditions generally agreeing Fiji was occupied by autochthonous "land-people" long before "the Gods came down to make the earth", Degei "drifted from some foreign land below the horizon", or "the chiefs *mataqali* ['clan'], after being expelled, drifted from Tonga" (Wilkinson 1909: 10, 12).

That being appreciated, the following can be taken as encapsulating pre-Christian Fijian understanding of Degei as god and chiefly invader.

> No one knows the origin of Degei. He was first seen on the beach at Ra in the form of a man, dressed in the native girdle [*malo*] of *masi*, or paper-cloth, with long trains of it hanging to the earth, as is the custom among the chiefs. Not being recognized and worshipped at that place, he went to Mbengga [Beqa], where he was first discovered to be a god. But the land was stony, and he did not like it. He looked towards Kandavu, but would not dwell there. He then went over to Rewa, and took up his abode in that district. Soon after this, a powerful god, by name Wairua, came from Tonga to Rewa, and to him Ndengei resigned the government of that town, on condition of always receiving for himself the choicest parts of all kinds of food (such as the head of the pig and tortoise, &c.). After living awhile in this situation, Ndengei had an attack of leprosy, and determined to remove to Verata, which has ever since been considered impregnable. Here he resolved to no more be seen by men, and for this purpose took the form of a serpent. (Hale 1846: 52)

For mythology this is strikingly human history, complete with reinforcement from Tonga and contraction of leprosy. Hale, however, only knew half the story, because although he understood Degei's entourage included "the deities of particular classes or professions, as *Rokola*, the god of the carpenters, *Rakavonu* [Rakavono], of fishermen", he—unlike Osborn—did not notice traditions that linked Degei to a cave in the sacred Kauvadra range in Rā, northeastern Vitilevu, in which he was incarnate in a great "serpent", and tied Rokola and his *mātaisau* to a major insurrection there which culminated in Degei flooding them and his twin rebellious "grandsons" and particular protégés of Rokola out of their otherwise impregnable fort. Consequently, Hale did not know about the dynastic rivalry and infighting associated with Degei and the *kalouvū*. Accounts of the *mātaisau* rebellion, for instance, focus upon Nakausabaria and Nacirikaumoli, Degei's twin grandsons, who were meant to be the firstborn of his "eldest son" Rokoua by his principal Tongan (Samoan?) wife Buivesi alias Bilovesi alias Buinakauvadra, "grandmother of other deities", but were reputedly fathered by a chip of *vesi* flying from Rokola's adulterous adze (see Lyth MS.a, Waterhouse 1866: 357, Clunie 1986: 83, 167-68, Parke 2014). Hale, then, did not appreciate that Degei either exiled the twins and *mātaisau*, or flushed them down the Wainibuka to

Rewa, where Rokola died or left them, and from whence offshoots dispersed to serve other Nakauvadra-derived chiefs and found canoe-building colonies elsewhere (Cross MS.c, Hunt 1848, Williams 1858: 252-53, Waterhouse 1866: 357-58, Heffernan MS., Toganivalu MS., Hocart MS.a, Barker 1925b, Thompson 1938: 193, 1940: 216). Unlike Diaper, Hale accordingly was unaware that, before the coming of the *mātaisau*, the different parts of Fiji were much more isolated because the art of building deep-sea-voyaging canoes was unknown (see Taliai Tubou and Tui Oneata in Fison 1904: 27-31, 87-98, Hocart 1952a: 90).

Remarkably, Nakauvadra accounts of the *mātaisau* rebellion are augmented by a Tongan one whereby, "before the time of Ulukalala ['Ulukālala 'i Ma'ofanga, died 1797], the carpenters were driven from Vavau during a war and went to Fiji", and "built a fort, so strong that the Fijians could not take it" (Gifford 1929: 145). This Vava'u tradition is no slavish copy because, whereas Hale understood that during a "great flood" associated with Degei's arrival "there came two enormous double canoes, commanded by one Rokona [Rokoua], and the other by his head workman, Rokola", the Tongan version presents the voyagers as Tangaloa and an unnamed "son", and compresses the first 24 generations of the Tu'i Tonga genealogy into a scenario whereby they descended to Tonga from the Langi 'Sky' and, "after sojourning a while"[!], left for Fiji, where their carpenters built a fort "so strong that none could enter there without its occupants' consent", from which they repelled attack upon "jealous" Fijian attack until a great Fijian god "came down… to fight for them against the god Tangaloa and his carpenters", raising a flood that swept it away, scattering them "to all parts of the world" (Hale 1846: 55, Gifford 1924: 201). Despite its uniquely Tongan perspective, Gifford suspected the account to be influenced by a Fijian one concerning Degei's expulsion of the *mātaisau* from Nakauvadra (Fison 1904: 27-31). Gifford cautioned, though, that "the possibility of its being an old Tongan tale, now largely forgotten, should not be overlooked" (1924: 13). That was prudent. Firstly, because although Gifford understood the rebellion was sparked by Rokola's twin protégés shooting *Turukawa*—Degei's pet pigeon—he did not know Turukawa was imported from Tonga, where the prerogative of shooting, eating, catching and taming *lupe* 'Pacific pigeon' (*Ducula pacifica*) was hedged about by *tapu*, restricted to chiefs and *matāpule* and dominated by the Tu'i Tonga, whose pigeon-catching mounds still stud the Tongan landscape (see Gifford 1929, McKern 1929, Suren 2009, Parke 2014: 29, 32, 120). Secondly, because he had overlooked a tradition concerning the Lakeba war-god Tui Lakeba, in which Taliai Tubou, Tui Nayau, compressed the history of the Tu'i Tonga dynasty into a Tongan born son of Tangaloa, who descended upon Fiji from the 'Sky'

and made sweeping conquests before returning to Tonga to overthrow his father's enemies (Fison 1904: 49-57, Clunie 2013a: 176).

Traditions, then, indicate that the *mātaisau* came from Tonga with Degei. That they were Samoan before they were Tongan was implied moreover by the *mātaisau* themselves describing Rokola as having "eight arms" and their other great deity *Oronabasaga*, "twin god and son of Rokola and grandson of Degei", as "a being consisting of a man and a woman grown together like Siamese twins". Rokola thus seems to have been descendant from the primal Samoan god *Fe'e*, who embodied himself in the *fe'e* 'octopus', as did *Haele Feke*, tutelary god of the great Samoan-descended Tongan *matāpule*, Motuapuaka. As for Oronabasaga: the Nakauvadra twins—who were reputedly born conjoined but subsequently separated—were both boys, whereas the Oranabasaga, with whom they were particularly identified, were male and female, joined at the back. This associates Oronabasaga with the primal Samoan goddesses Taemā and Tilafaigā, who were initially conjoined at the back, but later separated. The rebellious Nakauvadra twins, then, may have been regarded as incarnations of Oronabasaga (see Lyth MS.b, Williams MS., 1858: 218, Turner 1884: 38-39, Krämer 1999: 51, Collocott 1921a: 231, Gifford 1929: 319, Clunie 2013b).

Degei and the Fatafehi

Turning to Degei as chief and god-man: Hale failed to find Wairua, Degei's Tongan reinforcement, in Tonga. This is not surprising, Wairua more properly being *Komaiwairua* 'He-From-Two-Rivers', 'Two-Rivers' alluding to his spirit-house at the Wailevu-Nasali junction at Rewa. The god spoke Tongan through the medium of his priest and was otherwise named "Bakinimoka, also the designation of a deity in the Friendly Islands" (Lyth MS.a, Waterhouse 1866: 391). Just who that Bakinimoka was is unclear, but his family is traceable. The name Bakinimoka identifies him with the great sailing-, weather- and war-god of Lakeba, Batinamoka—alias Tui Lakeba or Sereivalu, whose spirit-house, Nautuutu, had sacred earth from Tonga implanted in the lower tier of its *yavu* 'foundation plinth', Tonga and Lakeba being *vanuavata* 'connected lands' because "they have the same god" (Hocart 1929: 190). Moreover, Tui Lakeba was incarnate in the *tavake* 'tropicbird' (*Phaethon* sp.). This *vaka* 'godly embodiment' (Fijian *waqa*) immediately associates him with the Tu'i Tonga dynasty. The *tavake* was a *vaka* of Hikule'o and his deified Fatafehi descendants, Fatafehi (*fehi*-platform/canoe/litter) being the family name of the Tu'i Tonga and, as Kaeppler puts it, "a metaphor for a man of the Tu'i Tonga blood line" (Cook 1784 [I]:412, Beaglehole 1967: 179, 950, 952, Lyth MS.b, Kaeppler 1999: 175).

Komaiwairua/Tui Lakeba, then, was a Fatafehi and, if not heir apparent, immediately related to the Tu'i Tonga. The *tavake* incarnation, furthermore,

was shared by Rātūmaibulu alias Degei, *kalouvū* of the Rokotuibau, sacrosanct "god-man" of Bau, whose dynastic identification with tropicbirds cannot be coincidental because Ratumaibulu/Degei and Hikule'o likewise both, haunted the *fehi/vesi* tree. The relationship is not as immediately transparent: tropicbirds were *lawedua* in Fiji and Rātūmaibulu was associated with weather, crops and fertility. Rātūmaibulu's war-god role, however, was subsumed in the late 1700s or early 1800s when executive power was wrested from the Rokotuibau by an ascendant *vūniivalu* 'war-chief' in spiritual league with Rātūmaibulu's son Rā Cagawalu, *kalouvū* of the Butoni canoe-men, who, like their Levuka counterparts, had been banished by the Rokotuibau a generation earlier. After besting his father, Rā Cagawalu succeeded him as the paramount Bauan war-god. The Rokotuibau retained his spiritual ascendancy, the *vūniivalu* governed, and both great gods were worshipped at Rātūmaibulu's great Navatanitawake spirithouse, where Rātūmaibulu was accorded seniority, while Rā Cagawalu, who was probably buried within the upper tier of its *yavu*, was alluded to as *Okoyamainayavucerecere* 'He-From-the-High-Spirit-house-Plinth' (see Cross MS.b, Lyth MS.b, MS.c, Parke 1998, 2014, Sahlins 2004).

Navatanitawake conventionally means 'Platform-of-the-Pennant', *tawake* denoting the *manumanu* 'pennant' flown from the yard of the Rokotuibau's *waqatabu* 'sacred canoe'. Its position proclaimed his paramount spirituality—the *vūniivalu* and lesser chiefs flew their *tawake* from the boom. As with *Fatanitavake* 'Platform of tropic-birds'—"the name of the chief Ma'afu's place in Fiji", however, it is apparent Navatanitawake archaically meant 'The-Platform-of-the-Tropicbird' (Fijian *tawake* is cognate with Tongan *tavake*) and Rokotuibau's *tawake* was not just mimicking a tropicbird tail streamer, but was housed and treated as a supreme godly embodiment by his uniquely privileged *tūniliga* 'handler chief", and streamed from his yardarm to warn others to accord him sailing privileges matching those commanded by the similarly *fehi*-hulled *fatafehi* '*fehi*-platform'—the *vakatapu* 'sacred canoe' of the Tu'i Tonga, who was likewise a *tavake* (see Toganivalu MS., 1912, Gifford 1929: 242, Geraghty 1983: 84). This explains the phenomenon whereby the Levuka canoe-men of Lakeba—whom the Rokotuibau exiled from Bau in the 18th century, but who remained spiritually and politically tied to the island, even retaining the prerogative of installing its *vūniivalu* as Tui Levuka—saluted passing tropicbirds with the *tama* 'worshipful cry' and obeisance accorded to gods and high chiefs, accompanied by a prayer for fair winds and safe passage (see Cargill 1841: 183, Jaggar 1988: 15, Lyth MS.b, Twyning 1850: 88-89, Hazlewood 1914: 273, Williams 1858: 89, Seemann 1862: 195, , Hocart 1929: 69-70, Capell 1941: 281.) [I must further note that Rewa *gonenitoga* addressed Semoana's sea-krait in the same way and Cakaudrove *gonedau* did likewise to the krait and tiger shark (Rougier 1924: 19).]

Historically, this identification of the Fatafehi with Komaiwairua/Tui Lakeba and Tu‘i Tonga with Rātūmaibulu alias Degei is crucial, because Rātūmaibulu, under other names, was *kalouvū* to other core dynasties (Williams 1858: 219, Waterhouse 1866: 365). Fortunately, the character of the relationship is settled beyond doubt by the equivalent scenario at Tui Lakeba’s Nautuutu spirit-house. There, descendant chiefs were literally buried at the top of its tall *yavu*, while Tui Lakeba was figuratively entombed lower down, where *keletapu* ‘sacred soil’ from Tonga was implanted. Tongan *keletapu* is cognate with Fijian *qeletabu/qelekalou* ‘sacred-/god-earth’ reserved during the burial of Nakauvadra-derived Fijian chiefs; retaining the soil was central to maintaining contact with the chiefly spirits. These most fundamental spiritual arrangements were, moreover, repeated at Oneata, where Tongan *keletapu* was similarly implanted in the *yavu* of Nawa’s spirit-house at Oneata, where “Fijians did not pray” but “the king of Tonga used to come” to make offerings and seek godly sanction before proceeding further westward. Nawa was the Fatafehi goddess, also known as “Nau‘aa” or “Gauaa”, the *fahu* ‘privileged sister’s daughter’ to Hikule‘o, tutelary god of the Tu‘i Tonga and, accordingly, the “intercessor through whom the gods were addressed” by him (Thomas MS., Thomas in Larsson 1960: 66, Cargill 1841: 245-47, Cargill in Schütz 1977, Fison 1880, Gifford 1923: 116, 1929: 134, Hocart 1929: 190, 199, 1952b: 42).

Degei/Rātūmaibulu and Havea Hikule‘o

Given that Hikule‘o was the Tu‘i Tonga’s Fatafehi namesake and godly patron, Degei and Hikule‘o should prove to have much in common. As, indeed, they do, despite their relationship having been obscured from the anthropological outset by Degei being “supposed by some to be a corruption of the first part of the name *Tanga-loa*”, when his name really corresponds to Tengei, a little known “serpent-god in the Friendly Islands” (Hale 1846: 183, Waterhouse 1866: 362). Hopefully Tengei will eventually manifest himself in some crusty Tongan document. But meanwhile the snake leaves little to the imagination, and it is likewise obvious that, besides incorporating the earthquake-inducing and fire-making attributes of Maui/Mafuie, Degei is a comparatively recent Fijian extrapolation of the Tongan Havea Hikule‘o, ruler of Pulotu, that invisible ancestral island paradise the ancestors of Tongan chiefs, other than Sky-descended ones, came from, and to which chiefly and *matāpule* souls repaired to be deified. Hikule‘o himself was otherwise Saveasi‘uleo, ruler of Samoan Pulotu. Indeed, their corresponding roles as paramount arbiters of life and death, feast or famine, peace or war are projected by their titles, Degei’s *Rātūmaibulu* ‘Chief-from-Bulu’ correlating with Hikule‘o’s *Tu‘i Pulotufekai* and Si‘uleo’s *Tui Pulotu* (see Pritchard 1866: 110, Clunie 2013a: 185-87).

Then too these gods have overlapping incarnations: Si‘uleo embodied himself in a *si‘uleo* ‘[banded?] moray’ or had the head and torso of a man but tail “of an eel or serpent”, which disappeared into the sea (Krämer 1999: 51, 134, Turner 1861: 237). Hikule‘o—like his relative Hemoana/Semoana/Dakuwaqa, who otherwise was incarnate in a great shark—among other things, embodied himself in a *tukuhali* ‘banded sea-krait’ (*Laticauda* sp.), which has an eel-like tail, or had a human head, torso and limbs but long eel- or sea-krait type tail that anchored him to the rock of his “stone cave in Bulotu” (Thomas MS., Cross 1833: 880, Wilkes 1845 [III]: 23, Gifford 1929: 289). And Degei either embodied himself in a *gata* ‘Pacific boa’ (*Candoia bibroni*) or *dakulaci* ‘banded sea-krait’, or was incarnate in a cave dwelling ‘serpent’ whose tail or body was fused to the rock (Hale 1846: 52, Williams 1858: 217, Waterhouse 1866: 356). Given these correspondences, it is not surprising their realms should similarly correlate.

Samoans, for instance, tended to confuse Si‘uleo’s Pulotu with Sā-le-Fe‘e—the submarine and subterranean realm to which the lowly spirits of the much hybridised remnant of the *taufanua* ‘land-people’ descended—so tended to associate it with Falealupo, at Savai‘i’s western tip. The confusion is explained, however, by the presence of two distinct *fafā* ‘spirit portals’ just off Falealupo: the *lualoto taufanua* ‘deep hole for land-people’ into which *taufanua* souls jumped to proceed underground to dreary Sā-le-Fe‘e, and *lualoto ali‘i* ‘deep hole for chiefs’ into which *ali‘i* and *tulāfale* souls jumped to be conveyed to Pulotu on a “sepulchral-canoe” (Turner 1861: 235-38, Pratt 1977: 356, Stuebel 1987: 16, Krämer 1995: 115, 1999: 24, 51). Pratt, then, was wrong to label these *fafā* “the Samoan Hades”, it being clear that—just as in Tonga, where Pulotu-bound chiefs and *matāpule* denied the *kāifonua* access to even Maui’s subterranean Lolofanua/Lolotonga—Si‘uleo’s Pulotu, like Hikule‘o’s Pulotu, lay far off to the west in what Samoans variously defined as “Fiji… the islands of the gods”, “Pulotu of Fiji” or “Tafiti ‘apa‘au ‘Winged Fiji’”, and Tongans knew as Tongamama‘o ‘Faraway Tonga’ or located in “the lower Fiji islands” (Cook 1784 [I]: 40, Beaglehole 1967: 1368, Wilson 1799: 27, Vason 1810: 151, Thomas MS., Thomas in Cummins 1977: 70, Turner 1884: 12, Stair 1897: 293-94, Krämer 1999: 31, 496, Churchill 1916: 65, Gifford 1929: 288, Geraghty 1993).

Equating Pulotu with Burotu is straightforward: Fijians mostly believed Burotu to be an invisible or intermittently emergent island paradise “inhabited by gods but not all the gods”, located “close to the root of the skies” (*vūnilagi*) or at or about Matuku in the Yasayasamuala group (Heffernan MS. 1876–77, Sahlins 1962: 234, Geraghty 1993). Nor is it too hard to match Degei’s Bulu with Pulotu/Burotu. The Samoan tendency to confuse Pulotu with Mafuie’s Sā-le-fe‘e (the similarly subterranean location of Maui’s Lolofanua) and the

Tongan belief that Pulotu might be "approached either through the earth or by sea", accounts for why Fijians thought Degei's Bulu—into the watery portal of which the souls of chiefs and *matanivanua* plunged à la *fafā*—to be submarine and/or subterranean, up in the Sky, or simply synonymous with Burotu, both of them containing three Skies or horizons (see Farmer 1855: 132, Williams 1858: 246-47, Seemann 1862: 399, Pritchard 1866: 364-65, Waterhouse 1866: 414, Collocott 1928: 138, Gunson 1990: 16, Geraghty 1993: 347).

As the foregoing implies, Samoan, Tongan and Fijian means of spiritually accessing their spirit realms also have much in common. Degei's *i-cibaciba* 'ghostly departure place' at Naidelide, Rokoua's celebrated equivalent at Naicobocobo at the western end of Vanualevu, and innumerable lesser Fijian *i-cibaciba* clearly correlates with the chiefly *fafā* at the western end of Savai'i and the *Hala ki Pulotu* 'Road to Pulotu' portals at Foui and Niuaunofo in western Tongatabu (Osborn MS. 1833–36, Lyth MS.a, Pritchard 1866: 401, Heffernan MS. 1876–77, Collocott 1928: 12-13, 129). The prescriptive manner in which ghostly canoes conveyed souls from the respective portals to Pulotu/Burotu/Bulu for deification was, moreover, uncannily similar. Fijians, for instance, believed chiefly souls sailed to Bulu/Burotu on a *vesi*-hulled or *vesi*-prowed canoe, those of their *mata* on a breadfruit-prowed- or -hulled one (Waterhouse 1866: 410-12, Fison 1880: 148, Thomson 1895: 351, St Johnston 1918: 42). And Tongans not only agreed they were "conveyed in a very large fast-sailing canoe", but that "the spirits of all Chiefs go to Bulotu… on a piece of a tree called *fehe* [*fehi*]; but that the spirits of matabules go to Bulotu on a piece of the bread-fruit tree; and that the spirits of the poor remain in this world, to eat ants and lizards" (Wilson 1799: 278, Cross 1833: 879).

Other such parallels are easily drawn, but need not be pursued, for it is now evident enough that Si'uleo, Hikule'o and the much younger Degei all trace back to the same Tangaloan source and that, while Degei, like the other *kalouvū*, of course became Fijian, neither he nor they were autochthonous deities.

Degei, Tu'itoga, Navatu and the Nakauvadra Diaspora

Hale, who did not have enough genealogical data to date his traditions, inflated their antiquity (but not, in his brilliance, the depth and character of Tangaloan involvement in Fiji) by postulating they reflected primary Polynesian intrusion into a Melanesian Fiji, followed in due course by hostilities which caused the Tu'i Tonga and his people to remove to Tonga (1846: 178-86). It is clear, however, that the dissolution of Degei's Nakauvadra chiefdom began at about the turn of the 16th to 17th century and proceeded through the early 1600s, not least because evidence to that effect is peppered throughout a set of remarkably matter-of-fact genealogical histories from the highlands of western Vitilevu, which had hitherto been

Figure 3. Nakauvadra range as seen looking SW from Volivoli point. Far right: southeast point of Malake Island in middle ground. Degei's Navatu/ Nakauvadra stronghold is the shark-tooth crag between Malake point and similarly triangular hill on far shore. Mt Uluda with Degei's more celebrated spiritual shrine at high point of namesake Nakauvadra range on distant skyline.

comparatively little affected by Tangaloan intrusion (Brewster 1919, 1921a, 1921b, 1922, Brewster MSS 1921-25, 1923, 1931).

These histories, recorded for Brewster in the 1880s and 1890s by Vilikesa Kalou and "district scribes" steeped in local traditional lore, and augmented until 1925 by continuing correspondence, invariably begin with the dispersal overland or by voyaging canoe thence overland from Nakauvadra after the *mātaisau* rebellion. Historically, they confirm that before "the coming of the gods" from Nakauvadra, the highlands were inhabited by clans of autochthonous *qeledina* 'true soil' people who at best traced their *kalouyalo* 'ghost-god' antecedents back a few generations. From the coming of the *kalouvū*, however, detailed chiefly pedigrees reveal that many *qeledina* clans, voluntarily and otherwise, affiliated themselves and their ghost-gods to one or another incoming *kalouvū*, thereby forming *yavusa* 'tribes' founded by the incoming god's union with a *qeledina* woman whose first-born son—*vasu* 'privileged sister's son' to his mother's brothers—not only became its first chief, but also on death was venerated as its *vū* 'founding spirit'. Being infused with the *kalouvū*'s overarching spirit, this hybrid god-man, and through him his semi-divine successors, were uniquely qualified to intercede with the *kalouvū*

to secure the ongoing spiritual protection and prosperity of the tribe, and to receive first-fruits and other offerings on his—and ultimately, Degei's—behalf.

Because they chronicle Tangaloan intrusion into what was primarily an autochthonous Melanesian Fijian society and are frank about the Tongan and Samoan origins of their *kalouvū*, these traditions uniquely define the advent of the Fijian chiefly system, which is archaeologically associated with the appearance and spread of stone-faced, often tiered *yavu* 'burial/spirit-house/chiefly-house foundation plinths' across Fiji in the 15th and 16th centuries. These *yavu* essentially followed the same plan as the *langi* tombs of the Tu'i Tonga, which began to appear in the 13th century (see Hornell 1926: 32, Gifford 1929, Best 1984, 2002, Marshall *et al*. 2000, Campbell 2001: 30, Field 2006). The relationship of *yavu* to *langi* is more or less self-evident once you know that, but because *yavusa* only trace themselves to the *yavutū* 'original *yavu*' or *korotū* 'original settlement' of their founding chief (*vū*), their Tongan roots were so effectively masked that Gifford (1952: 339-40) could only unearth three Vitilevu *yavusa*—two *gonenitonga* clans at Rewa and the more recently arrived Toga people of Nadrogā, none of whom came with Degei—with Tongan *yavutū*. He could not but ponder, however, whether *yavusa* Toga of Tailevu (*yavutū* Nakauvadra) and the Toga *yavutū* of the *yavusa* Toga of Rā might have Tongan roots and, like Hale before him, wonder about those of the *yavusa* occupying Toga Island on the lower Wailevu/Rewa, whose *kalouvū*—had these two bright stars but known it!—was Rātū *alias* Muaicikiciki (Tongan Mauikisikisi), who drew Toga and its chiefly occupants from Mu'a, Tongatapu, on his godly fishing line (see Hocart MS.a).

Despite such masking, however, W.H.R. Rivers also found the *kalouvū* of Brewster's highland traditions were nothing like the dark-skinned (*loaloa* 'black') frizzy-haired (*uludina* 'true-headed') *qeledina* whose startlingly archetypal Melanesian skulls so flabbergasted Flower, but were tall, *damudamu* 'coppery-skinned' and *uluwai* 'straight- or wavy-haired' (Flower 1880, Rivers 1914 [I]: 264, 272). Indeed, although Brewster's local authority, Kalou identified the *kalouvū* of the Colo West (Navosā) *yavusa* as Tongan, he noted some were Samoan; the *yavutū* of the *noi*-Yasawa, for instance, was *Sawai* because their *kalouvū* "was a Savaii man", and the sons of the *noi*-Davutukia *kalouvū* were Savai and Tuitogalevu (Brewster MS. 1923). Coupled with other such instances and what had happened at Nakauvadra, this explains why so many unmistakably Tongan- and Samoan-derived *yavutū*, *korotū* and *yavu* names came to be scattered about the western highlands, and why a similar "string of Polynesian place names" running round the western and northern coast and running eastward through Lōmaiviti to Lau were traditionally associated with a "massacre" near Nacilau, 11 km west of Navatu (Roth1953: 56, Parke 2014).

Besides confirming Degei's *kalouvū* were Tongan and Samoan interlopers, Brewster's traditions concur so closely with other Nakauvadra accounts as to indicate that the dissolution of the Nakauvadra chiefdom and dispersal of the *kalouvū* about Fiji occurred in two stages: first, the expulsion of Rokola, his twin protégés and rebellious *mātaisau*, and perhaps the i-Sokula chiefs and their Cakaudrove canoe-people; and second, another outflow when or perhaps shortly after the Fatafehi finally withdrew. Collectively, the traditions mention successive generations of Degei without determining how many. Some claim he ordered his "sons" to disperse from Nakauvadra to prevent them fighting each other after the *mātaisau* rebellion, but that may just have been the final straw. Implications of earlier dynastic tensions and rivalries were rife enough to suggest that Degei may have earlier been forced to withdraw from Verata by his *vasu* 'privileged sister's son' Rokomoutu and Rokomouto's younger brother, Rokorātū of Rewa. Later Rokola and the fugitive *mātaisau* fled to Rewa, there being indications of hostility between them and Degei's "eldest son" Rokoua, himself apparently a Degei. Indeed, although some Vitilevu highlanders thought Rokoua sailed off into the Sky in a gigantic voyaging canoe sculled by a "thousand oars, one of them made by a skilled Tongan" (Kleinschmidt 1984: 189), another highland tradition details his assassination at Rewa (Seemann 1862: 195-99). It thus seems that, rather than initially landing in Rā and working outward from there, Nakauvadra was Degei's his last chiefdom.

Bearing this likelihood in mind, whether they were instrumental to early Fatafehi conquests at Rewa and Verata or associated with subsequent challenges, it seems inescapable that the extraordinary array of stone-faced canoe docks and slipways notching and retaining the artificially reclaimed shoreline at Bau—which Hornell was told had been there since "time immemorial"—are Fatafehi invasion relics (Toganivalu MS., Hornell 1926). This is so because:

- As Hornell recognised, these "megalithic sea works" are only otherwise matched by the hauntingly similar ruins of the Kolongahau or Mouno canoe-pier and reclaimed foreshore separating the Fatafehi capital at Muʻa, Tongatapu, which were reputedly built by the Hau Tuʻi Haʻatakalaua in the 15th century, when the Fatafehi dynasty was in turmoil (Collocott 1928: 16, McKern 1929, Spennemann 1988, Clark *et al.* 2014).
- Fijian traditions agree voyaging canoe construction was introduced by Degei and the *mātaisau.*
- As former residents, the exiled Levuka and Butoni mariners continued to maintain strong links to Bau and its chiefs, to whom they remained spiritually bound.

Bau's celebrated later history as a canoe power, then, seemingly traces to the island's reclamation by the Fatafehi as a naval stronghold in the 16th century, Bau commanding the southeastern Vitilevu coast as effectively then as it did when enabling Bau's rise as a canoe-power in the late 18th century, and its subsequent conquests of Verata and Rewa. This seems the more certain because the strategy involved was quintessentially Tangaloan and had been employed earlier at Manono, which commands the gut between Savai'i and Upolu, and formed the hub of continuing canoe-based power in Samoa (see Williams 1837: 482-85, Erskine 1853: 88-89, Gordon 1904: 1996, Stuebel 1987: 129, Krämer 1999: 208-9, Tuimaleali'ifano 1990: 36, Barnes and Hunt 2005: 251-52). Indeed, history seems to have repeated itself when Degei established his Nakauvadra stronghold at Navatu, an eminently defensible coastal crag and fine canoe port.

Brewster grasped that Navatu lay at the heart of Degei's Nakauvadra kingdom from one of his old district scribes, who, in linking Degei—in his Rokovolivanua guise—and Tuitoga—*kalouvū* of the *qali* Yalatina of the highlands inland from Tavua—to Navatu, patiently spelled the matter out as follows:

> The original village of the Tuitoga was Navatu at Rakiraki, which was your former place of work as Stipendiary Magistrate. It used to be very high, but was broken up by Degei because he was jealous as it exceeded in height his own village at Nakauvadra. He broke it in two the foot of it being Navatu on the salt water and the name of the head of this stone was called Cubu. (Brewster MS. 1921–25)

As a timely reminder, Cubu—a rocky islet close to Navatu—contains a cave associated with Bilovesi/Buivesi/Buinakauvadra, Rokoua's queen (Parke 2014). The conflict just alluded to was obviously more political than geological and connected to the *mātaisau* rebellion. The key point, though, is that Degei, Rokovolivanua and Tuitoga's connections to Navatu are substantiated by evidence that Degei was "forced to reside" at Kauvadra, a "large cave at the mouth of a Bay in the District of Rakiraki", that Navatu was "the abode of the supreme god Degei" (Cross MS.c, Seemann 1862: 223), and by Wilson's observation:

> On my way [from Vūnitogoloa to Rakiraki] the people showed me the hill [Uluda] in wh. Dage resides & the one [Navatu] on wh. he formerly lived in a large cave… he left the cave because the women of Navatu the nearest town make pots & the constant noise annoyed this lazy god, so he sought a quiet retreat on the top of a higher hill. (Wilson MS. 1853–59, 8 May 1856)

This brings the great Nakauvadra conundrum to an historical head. Firstly, because Degei being "forced to reside" in his cave corresponds with Tongan belief that Hikule'o was anchored by his "long tail, which prevents him from

going farther from the cave than its length will admit of", and that Tangaloa and Maui thus tethered him to constrain his otherwise unbridled lethality (Wilkes 1845 [III]: 23, Farmer 1855: 132-33; compare Herda 1990: 38). Secondly, because it determines that Degei—chief and Tuitoga—resided at coastal Navatu, where Degei—the god's—original cave, and fabled *kauvadra* 'wild pandanus tree' were located, and that his celebrated cave on Mount Uluda, tallest of the namesake Nakauvadra range, was a purely spiritual shrine. Real life Nakauvadra, then, was a coastal rather than a mountain kingdom.

Archaeology Mirrors Tradition: The Depth of Tongan and Samoan Embroilment in Fiji

On the basis of genealogical dating, Brewster's highland Vitilevu and Tongan Fatafehi traditions are straightforward. Chiefly succession passed from father to firstborn son, avoiding brotherly succession complications and the selection vagaries of less spiritually exalted Tongan and Fijian *sauniivalu*/*vūniivalu*-type lineages. Given this, it is remarkable that: (i) Brewster's highlanders agree the great dispersal from Naukauvadra spanned the early to mid 1600s, (ii) Gifford's (1951a, 1951b) western Vitilevu genealogies confirm the *mātaisau* were expelled from Nakauvadra at about the turn of the 16th-17th century, (iii) Thompson's (1940: 214) Kabara traditions date the invasion of Lau by Daunisai and his Nakauvadra-derived followers—who arrived there well after fugitive *mātaisau* had settled at Kabara—to the mid-1600s, and (iv) Tu'ila'ila's revelation that his great-great-great-grandfather, the Cakaudrove war-god Rā Odrau or 'Omainatavasara—recognised in Muala tradition as Kubuavanua or Tui Vanuakula (who reputedly came from "Afirika" via Tungua, Ha'apai, so arrived much later)—"came from Tonga" traces his arrival to about the turn of the 17th-18th century. By that time the Tu'i Kanokupolu had supplanted the Tu'i Ha'atakalaua as Hau of all the Tongas, the Tu'i Tonga had been home for a century or so, and the Dutch were about to sail by, guns blazing (Lyth MS.b, Sahlins 1962: 234).

Historically, then, Fatafehi Nakauvadra dissolved in or about the early 1600s. To date the beginning of their invasion, and really understand Fijian and Western Polynesian canoes though, we must hark back to onset of Tangaloan intrusion in the region, and work our way forward from there.

The prevailing 20th century conceit that Polynesian culture evolved from Lapita-borne "Proto-Polynesian" settlement in Fiji then Western Polynesia about 3000 years ago has recently been torpedoed by the emergence of a much later aceramic—so archaeologically stealthy—movement from Island Southeast Asia which arced eastward through southern Micronesia before swinging southward and reaching Samoa about 1500 years ago (Addison and Matisoo-Smith 2010).[6]

Proceeding on that hitherto heretical basis: McLean (2008) was right. The arrival of these canoe-borne intruders sensibly accounts for otherwise irreconcilable physical and cultural differences between the generality of "Polynesians" and more overtly "Melanesian" Fijians. Accordingly—regardless of whom the Lapita chiefs and navigators were, or what became of them—western and eastern highland Vitilevu Fijians may quite closely reflect the character of the autochthonous population of Fiji and Western Polynesia, who, indeed, are described in Tongan traditions as small and black, akin to the dark-skinned *Leka* 'Smalls' the *kalouvū* encountered on Vitilevu (see Poulsen 1977: 8).

Should that prove true, it follows that "Ancestral Polynesian Culture" was generated between about AD 500-1000, essentially by incorporating autochthonous Melanesian contributions into the overriding culture of what tradition determines were Tangaloan invaders, Tangaloa inescapably being the great sailing- and sky-god who led them. This formative process was not, however, confined to Samoa, Tonga and their satellites; it is increasingly apparent that core aspects of Western Polynesian culture—following Burrows (1938)—were generated by contemporaneous Tangaloan settlement in Fiji. Geraghty's (1993) convincing identification of Pulotu/Burotu with the Yasayasamuala is supported by Tongan recollection that, with the exception of the Langi-descended elite, chiefly ancestors came from Pulotu in southern Fiji, and Samoan traditions that not only geographically associate Pulotu with Fiji, but also chronicle primal Tangaloan movement southward from Samoa to *toga* 'south', and have "Sau'ea" and "Se'uleo" sail westward from there to discover and settle Pulotu (Stair 1897: 293-94). Samoan traditions, furthermore, collectively chronicle the invasion of Samoa by Saveasi'uleo and his warrior daughter Nafānua from "Pulotu of Fiji", purportedly to relieve Savai'i relatives from eastern oppression. The invasion not only led to Si'uleo and Nafānua becoming primal Sāmoan war-gods, but also was launched by their landing at Falealupo in westernmost Savai'i, subsequently the pan-Samoan spiritual departure point for Pulotu. Upolu and Manu'a traditions, moreover, relate that Fitiaumua 'Fiji-the-Foremost'—which sobriquet Saveasi'uleo acquired in Fiji—swept on through Upolu to Manu'a, where he founded a great pan-Samoan kingdom (see Turner 1884: 224, Stuebel 1987, Krämer 1999).

These Samoan traditions, like their Tongan and Nakauvadra-related counterparts, are so collectively consistent as to provide winner-tell-all approximations of past happenings. The implications are profound, Si'uleo's invasion of Western Polynesia from Pulotu potentially resolving:

- What triggered the great migration eastward from Tonga and Samoa into a previously unsettled Eastern Polynesia in the 11th century, the contemporaneous migration westward to found Polynesian outliers in

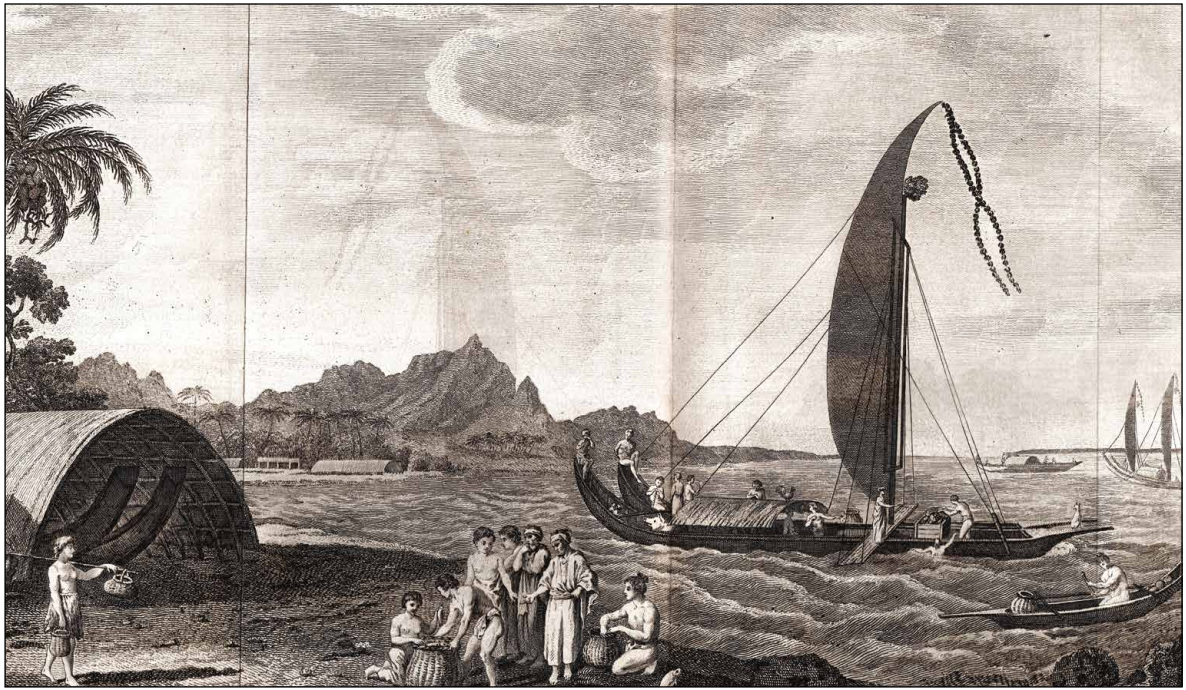

Figure 4. Rai‘atea voyaging canoe and *fōlau*/*hōlau* canoe hangars, 1769. An illustration of East Polynesian ancestral relationships to *tongiaki* and other Tangaloan-rigged Western Polynesian canoes (Hawkesworth 1773).

Melanesia, including, inevitably, Fiji, and flight as far northward as Kiribati to escape the wrath of Savea (see Grimble and Grimble 1972, Wilmhurst *et al*. 2011, Kirch 2012, Carson 2012).

- Why Western Polynesian chiefs traced their forebears to Pulotu and Eastern Polynesian ones to Savai‘i, besides Upolu, Vava‘u and the like.
- Where the Tongafiti of Eastern Polynesian traditions came from—Pulotu alias Tongamama‘o conceivably also having been Tongafiti.

Historically, these happenings seem more likely to be real because they accord with archaeological evidence from Fiji, where the unprecedented emergence of a massive fortification sprinkled with Samoan adzes at Lakeba in about AD 1000 was followed over the next couple of centuries by the northward spread of further such fortifications and adzes (Frost 1974, Best 1984, 2002, Sand 1993, Sand *et al*. 1999, Marshall *et al.* 2000). Indeed, associated radiocarbon dating corresponds with the founding of the Tu‘i Tonga dynasty in what genealogically dates to about AD 950; this in turn correlates with Manu‘a traditions indicating that Tuifiti—who, like his Fatafehi counterparts, was spiritually incarnate in the *fehi/ifilele* tree—was contemporaneously sent from Manu‘a to Fiji by, guess who? (Turner 1884: 63, Krämer 1999: 11, Gifford 1929: 39).

The age of the great Tangaloan immortals—when sailing-gods descended from the ‘Sky’ to fish islands from the sea and stalk the land—ended in Western Polynesia with the founding of the Tu‘i Tonga and Tuifiti god-man dynasties by, it seems, Saveasi‘uleo. Quite when the Fatafehi involved themselves in Fijian affairs remains unclear, but they were certainly implicated by the reigns of the 10th Tu‘i Tonga, Momo, and his son Tu‘itātui, to whom the commissioning of the first *langi* in the 13th century is attributed. Tu‘itātui’s brother, Fasiapule, for instance, voyaged to and from Fiji and had a Fijian henchman, while Tu‘itātui is credited with reforming the Falefā ‘Four-Houses’ of the Tu‘i Tonga court to accommodate an influx of chiefs and *matāpule* from Samoa, Rotuma and Fiji, most pertinently by incorporating the Fale-‘o-Tu‘italau to accommodate Tu‘imotuliki and associated *matāpule* who had withdrawn from Moturiki in Lōmaiviti, Fiji (Gifford 1924: 45, 1929: 65-67, Bott 1982: 97-98).

The onset of *langi* construction—which is archaeologically associated with importation of adze stone from Fiji and Samoa—is telling because it testifies that long distance Tongan voyaging—and the dynamics that drove and sustained the centralised Tongan state, which could only survive through domination and exploitation of the wider region—were in train by AD 1200 (Aswani and Graves 1998, Clark and Matinsson-Wallin 2007, Clark *et al.* 2014). Turmoil, moreover, is implicit in Tu‘imotuliki’s withdrawal in a movement that corresponds with Samoan traditions chronicling the withdrawal

of Tuifiti, Tuilaʻepa (Lakeba), Tuilautala (Laucala) and allied "Fijians" from eastern and northern Fiji to seize Manono and campaign outward from there (Stuebel 1987, Krämer 1999). Indeed, whether or not Tuifiti and his allies were displaced by the Fatafehi, Tangaloan activities in Fiji and Western Polynesia had apparently been plagued by warfare ever since Siʻuleo left Pulotu, Tuʻimotuliki's withdrawal from Moturiki and his "supernatural" descent from Mauiatalanga and Mauikisikisi suggesting, for instance, that traditions chronicling the deaths of those primal Tangaloan god-men in combat with the great man-eating "dog" Filoputaputa at Moturiki have historical foundation (Reiter 1907, Caillot 1914, Gifford 1924: 121-22, 136-37).

Subsequent to Tuitātui's death, growing dependency of Tongan fortunes upon deep sea voyaging is projected by the removal of the Tuʻi Tonga capital from exposed Heketā to sheltered and fortified Muʻa in the 13th century, and extensive foreshore reclamation and the construction of stone- and timber-faced canoe docks there during the turbulent 1400s or early 1500s. What ensued was a characteristic cycle of periods of disciplined dynastic calm interleaved by rising tensions, which could only be relieved by war: the 19th Tuʻi Tonga Havea I was assassinated in the late 1300s, the 22nd Tuʻi Tonga Havea II was murdered by a "Fijian" retainer in about 1450 (Gifford 1929: 54). The boil did not burst, however, until the assassination of Takalaua, Havea II's successor, triggered major conflict. In the course of this warfare, Kauʻulufonua—Takalaua's eldest son and 24th Tuʻi Tonga—drove his dynastic enemies from Tonga, then harried them through Western Polynesia and Fiji in protracted campaigns, which culminated in the capture of the ringleaders at ʻUvea (Gifford 1924: 34). Triumph turned sour, however, when upon returning to Tonga Kauʻulufonuafekai found his brother—the first Tuʻi Haʻatakalaua, who had governed as a pan-Tongan *hau* 'governor' during his absence—unwilling to relinquish his authority.

Whether or not the Tuʻi Haʻatakalau then drove Kauʻulufonua from Tonga is obscure. But he or his immediate successor was surely expelled. Samoan traditions claim that the 25th to 28th Tuʻi Tonga dwelt there in the 16th century, and that, like Kauʻulufonua, each of them—Vakafuhu, Puipuifatu, Kauʻulufonua II and Tapuʻosi—had highborn Samoan wives (Krämer 1999: 648-49, Herda 1995: 42-46, Campbell 1989: 9-10, 2001: 38-39). Their corresponding involvement in Fiji has only recently been grasped (Clunie 2013a: 164-65). It is now apparent, however, that they moved back and forth between Fiji and Samoa, backed by various Tongan, Samoan and no doubt Fijian factions. Whether they were as militarily committed in Samoa has yet to be determined, but it seems that conflicts and dynastic infighting proceeded apace on both fronts; Tuʻi Tonga Vakafuhu was reputedly killed and his heir, Puipuifatu, driven who knows where by a younger son who had been active in

Fiji, and was subsequently slain in Tonga; the Tu'i Ha'atakalaua also having high-born Samoan wives and interests; and the Samoan power base shifting westward from sacrosanct Manu'a westward to Upolu and Savai'i during this time (Krämer 1999: 398-99, Herda 1995: 44-46). It is further remarkable that the genealogical timing of Fatafehi embroilment in Fiji again correlates with radiocarbon dates supplied by archaeology, which this time round records the appearance and spread of *langi*-like *yavu* 'foundation-plinths', accompanied by material evidence of Tongan-derived *yaqona*-ring rituals, ring-ditch fortifications and an unprecedented flurry of intensive fortification up the Sigatoka valley in the 15th and 16th centuries (Best 1984, 2002, Marshall *et al*. 2000, Field 2006, 2008).

Fatatehi Withdrawal from Nakauvadra Coincides with the Eendracht*'s Historical Encounter with* Tongiaki *in 1616*

The wider consequences of Fatafehi embroilment in Samoan and Fijian affairs in the 16th century are too involved to discuss here. Insofar as voyaging canoes are concerned, though, the dates of the Fatafehi withdrawal from Nakauvadra straddle the first European contact with *tongiaki* in 1616, when the *Eendracht* intercepted one standing northward towards Samoa, met others at Niuatoputapu and Tafahi, and was attacked by a swarm of 23 of them a few days later (Dalrymple 1771, De Villiers 1906; see Fig. 5). The high chief's canoe was "a big sailing prow" and the others big enough to carry a fishing canoe on deck or 25 fighting men. Coupled with the engraving of the intercepted *tongiaki*, which seems to be roughly 13 m long, this suggests they were about as long (13.43 m) as the medium-sized old *drua* in the Fiji Museum.

Given their number, it is singular that Lemaire described men with "the flap of their ear slit, hanging almost down to their shoulders" who cannot but have been Fijian. And significant that the Lātūmailangi of Niuatoputapu at that time, Puakatefisi 'Pig from Fiji', who was reputedly sent to Niuatoputapu by the Tu'i Tonga to secure its loyalty, was part-Fijian; his Mā'utu successors belonging to the Fale Fisi (Dalrymple 1771: 26, Gifford 1929: 284, Bott 1982: 106, Suren 2009: 34-40).

Furthermore, at Futuna, Schouten and Claessen recorded kava as *kava*, while Lemaire recorded *acona* (Fijian *aqona*, *yaqona*), suggesting he may have been attended by a Fijian *matāpule* (Dalrymple 1771: 37-38, 45, 47, 53-55). This implies that some of the *tongiaki* may have recently been in Fiji. Regardless of where they were from, however, their presence at Niuatoputapu and on the high seas in 1616 effectively confirms that the Tu'i Tonga and his followers had returned to Tonga from Fiji and Samoa on *tongiaki*, that *tongiaki* had carried Degei and the *kalouvū* from Tonga and Samoa to Fiji, and that *tongiaki* were the *waqadrua* 'twin-canoes' Rokola's *mātaisau* built there.

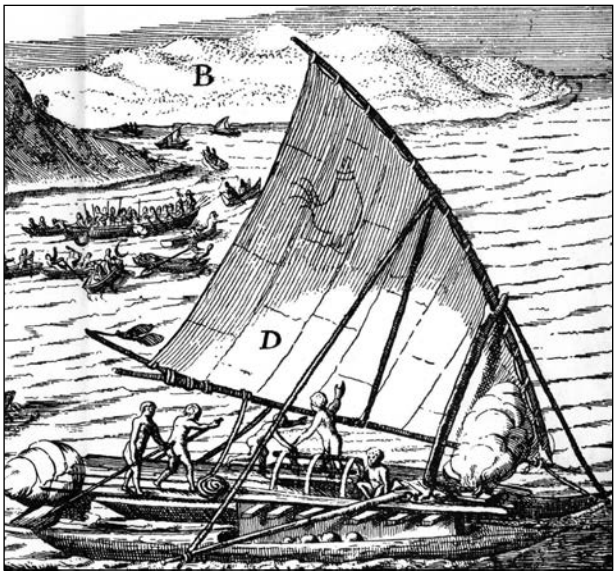

Figure 5. *Eendracht tongiaki*, 1616. Cock emblem on sail and tassels dangling from jack-staff appended to boom transferred from Latumaipulu's larger *tongiaki* (Schouten 1619).

MISCONSTRUING HISTORY: CAPTAIN COOK, THE WESLEYANS AND THE PERPETUATION OF MARTIN'S HYPOTHESIS

The Wesleyans re-cast Degei in their own Image

Having reached the cusp of the traditional and historically-documented eras, and before grappling the canoes themselves, it is necessary to consider the impact of two highly prejudicial factors that have blocked understanding of voyaging canoe development since the 1850s. Namely, a persistent misapprehension that concerted Tongan embroilment in Fiji only really got underway in the 18th century, after the Tongan adoption of Fijian *drua*, and a related misapprehension that Degei was an autochthonous Fijian deity.

The impression of late Tongan embroilment was generated in 1770s Tonga, when Cook's people were not fluent enough to understand subtleties and did not appreciate that chiefs were so spiritually identified with their deified forebears that they spoke of their exploits in the first person. Consequently, they had trouble discriminating between the recent and deep history, and generally erred on the side of recent.[7] Once seeded, this misapprehension

ramified; the great flush of activity associated with the adoption of the Micronesian-rig, compounded by Martin's *drua* hypothesis, providing the perfect cover. Logically, the notion should not have survived the 1840s, when Hale not only recognised that Tonga had been anciently involved in Fijian affairs, but also reasoned that Degei and the *kalouvū* were Polynesian. Sadly, however, *après lui la déluge*. The Biblicist convictions of the Wesleyan missionaries who supplanted Hale as arbiters of Fijian and Tongan traditional history and culture compelled them to derive their prospective flocks from the Old Testament. Accordingly, they read Jewish traits into Tongan and Fijian practices, classed Tongans as Semitic and Fijians as Hamitic, associated Noah's deluge with Degei's floods, cast Degei as a degenerate echo of Jehovah, and even—when Degei's embodiment in a "serpent" led Fijians to associate him with Satan—promoted an evocatively named, otherwise unheard of, "Ovē" to preside over him (see Cargill 1841: 286-88, Jaggar 1988: 6, 89, Hunt 1846, Wallis 1851: 55-57, Farmer 1855: 35-36, Young 1858: 199, 227-28, Williams 1858: 3-4, West 1865: 253-55).

The Wesleyans, then, ignored Hale's recognition of Degei as a Tongan immigrant, and instead cast him as godly creator of the Fijian universe, whose origins could only be explained by associating him with the Lost Tribes of Israel, who "went towards the East, carrying with them some of their neighbours, the sons of Ham, from Africa", to be seen no more (Lawry 1851: 30). Indeed, even the Waterhouses—who recognised that the overtly Melanesian *qeledina* of highland Vitilevu were "aborigines" whose "sole deities" were "the spirits of their forefathers" and, upon learning that they did not venerate the "gods without birth" (*kalouvū*) of the chiefs, realised the latter were Polynesian "intruders"—were compelled by faith to isolate Degei from the *kalouvū* and project him as "a perverted idea of the true and only God" and paramount autochthonous deity (see Macdonald 1857: 250, Waterhouse 1866: 362, 368-69). This construct became so entrenched that even the greatest Fiji scholars of the 20th century conformed to it. Even greater damage was done, however, in 1858 with the publication of Williams' great ethnological classic—a celebratory volume of the great Wesleyan triumph of 1853–1855—in the wake of which there was no prospect of the Wesleyans according legitimacy to Tongan involvement in Fiji by acknowledging its antiquity. Hence Williams' ruling "that the gods of Eastern Polynesia seem to be unknown to the Fijians" (1858: 216), and his failure to recognise the great body of immigrant *vūlagi* traditions when proclaiming:

> In considering the origin of the present inhabitants of Fiji, we seek in vain for a single ray of tradition or historical record to guide us through the darkness of antiquity. The native songs are silent in the matter, and no hint of a former immigration is to be heard: the people have had no intercourse with other

> nations except as visited by them; and the popular belief is that they never occupied any country but that on which they now dwell. (Williams 1858: 17)

The misapprehensions engendered by this and other palpably propagandist yet subtle half-truths have distorted perceptions of Fijian culture and history ever since. Indeed, France (1966, 1969) tabled the foregoing as decisive evidence in his devastating exposure of the Wesleyan Native Training Institutions' role in instilling the belief that the Fijian ancestors came from Africa, and Thomson's opportunistic seeding, promotion and exploitation of a biblically inspired, quasi-traditional myth, whereby Degei and company voyage from Africa aboard a great *Kaunitoni* double canoe and land at Vuda on Vitilevu's western coast. Unfortunately, in following Williams, France overlooked Hale and did not know Osborn, so could not see that Thomson's *Kaunitoni* edifice overlies an unmistakably pre-Christian Nakauvadra foundation. Accordingly, Capell and Lester (1941: 324-27) notwithstanding, he cast doubt on all Fijian migration traditions, perplexing some and luring others up a historiographical cul-de-sac (see Geraghty 1977, Parke 2014). To restore Naukavadra traditions to scholastic and traditional respectability, and scotch a groundless controversy, it therefore needs noticing that France failed to notice Thomson's *Kaunitoni* chicanery was spawned by the fact he had no idea that Malake Island (see Fig. 3) lies within plain sight of Navatu when he translated the following from an unmistakably bona fide Nakauvadra tradition:

> It is said that the ancestors of the Fijian… drifted [*ciri*] to a land called Malake, and that after abiding there for a time they sailed and drifted until they came ashore on a point to the westward. There they disembarked, and built houses, and dwelt; and their numbers increased, and they therefore called the name of that place Vuda. (Jonacani Dabea in Thomson 1892: 144)

As faithfully translated by Thomson, this cannot but specify landfall and settlement at Malake Island, Rā, from places unknown, followed by a movement westward round the northern Vitilevu coast and establishment of a second settlement at Vuda point in the far west. Thomson, however, assumed Malake lay off to the west in Melanesia, and, enthused by the reaction of the *Journal of the Polynesian Society*—which urged its "members in the New Hebrides and Solomon Islands" to enquire "if the name of Malake is known by any of the natives of those islands"—built himself an anthropological reputation by quietly shelving Melanesian Malake and, through the agency of his inventive Fijian clerk, constructing further "traditional" proof that the autochthonous Fijians arrived and settled at Vuda from a now nameless "land in the far West", and that some subsequently sailed eastward from Vuda to Malake, Rā (Thomson 1895, 1908: 6).

Martin's Hypothesis Progresses to the 20th Century

Having been salvaged by the Wesleyans and braced by Thomson, Martin's autochthonous Fijian *drua* sailed tranquilly onward into the 20th century, only coming close to capsize when—on the strength of a model made under old King George of Tonga's supervision in 1890—a pre-*Kaunitoni* Thomson noticed the "*tongiaki* was like the *ndrua* in build" (1894: 308). There was no Damascene awakening, however, the hint failing to shake his faith in the "remarkable paradox" whereby:

> The Tongans were the great navigators of the Pacific; the Fijians are not known to have voyaged beyond their own group. The Tongans were so expert with the adze that they rapidly displaced the Fijian canoe-builder in his own country. And yet the Tongan counterpart to the *ndrua* was the *tongiaki*, a craft so clumsy and ill-finished that it did not survive the eighteenth century, when the Tongans learned the art of canoe-sailing from Fijians. (Thomson 1908: 294-95)

Thomson's clinging to convention is remarkable because he was well versed in not just Fijian traditions but also Tongan counterparts indicative of ancient Tongan embroilment in Fiji (1894: 306-7). Indeed, he wrote that: "The imprint of Tongan immigration is to be seen, not only in the blood of the [Melanesian] tribes with whom the immigrants mingled, but in their mythology, for whereas the religion of the inland tribes is pure ancestor-worship, that of the coast tribes is overlaid with a mythology that is evidently derived from Polynesian sources" (Thomson 1908: 22). He saw no incongruity in that, however. Martin and Williams, both of whom he self-evidently plagiarised, had convinced him that "at the time of Cook's visit, increasing intercourse with Fiji was rapidly changing the Tongan for the worse" (Thomson 1894: 318), because "from 1790 to 1810 it had become the custom for Tongan chiefs to sail to Fiji in their clumsy *tongiaki*, join in the native wars, and take as their portion of the loot Fijian *ndrua*, in which they beat back to Tonga, and in a very few years the *tongiaki* was extinct" (Thomson 1908: 294-95). Indeed, he countered Fornander's (1878) theory about an ancient Polynesian *séjour* in Fiji by asserting that the "imprint of Tongan immigration" in Fiji was entirely accounted for by accidental drift-voyaging by *tongiaki* over time, and that deliberate return voyaging and concerted Tongan activity had only been enabled by their adoption of *drua* in the late 1700s (Thomson 1908: 12-20).

Generally speaking, the legacy of historical obfuscation has been such that, from Hocart onward and in the face of increasingly contradictory evidence, Fiji scholars have tended not to adequately reconcile these inherent incongruities, and to take Thomson and the Wesleyan's late Tongan

involvement and autochthonous Degei constructs at face value. Accordingly, when Hornell went to Tonga and Fiji to investigate canoes in 1925, he had no reason to suspect that Martin—as confirmed by Williams, Thomson and other such plagiaristic authorities—might be wrong. Or not to think that, "At the time of Cook's visit to Tonga in 1773, intercourse with Fiji had recently become frequent, and both Tongans and Samoans were busily engaged in discarding their own inferior type of double canoe for that of Fiji" (Hornell 1936: 329).

Indeed, Hornell was so pre-convinced that he went to quite implausible lengths to confirm the legend that, thanks to "their exceeding ingenuity and ability as canoe designers… indigenous Fijian canoebuilders… evolved the largest, swiftest, and most seaworthy double canoes ever constructed". In doing so, however, he painted himself into a conceptual corner by deriving *drua* from a hypothetical "earlier and more primitive type" of "equal-hulled", "old type" New Caledonian double canoe, "borrowed, possibly, from the proto-Polynesians", and "the large sailing outrigger of Micronesia". Logic should have told him otherwise: New Caledonia lies far downwind, equal-hulled New Caledonian canoes modelled after Micronesian-rigged *tongiaki* were historically known, and he knew that "unequal-hulled" Micronesian-rigged New Caledonian voyaging canoes had "been introduced by Tongan settlers and castaways using the Fijian design of the *ndrua*". As it was, however, the construct helped justify the foregone conclusion:

> How the Fijians came to seize on upon the Micronesian design and modify an outrigger type into a double canoe one shall never know, but they certainly did accomplish this feat. At the same time they adopted the Oceanic lateen in its entirety, retaining, however, the crutch form of the masthead, which, as is known from the reports of Schouten and Cook originally held the yard between the its crescentic horns. (Hornell 1936: 344)

This is sad, because in noticing that *drua* had inherited the *tongiaki* masthead—and perceiving that Cook voyage evidence established that *tongiaki* were being converted to sail under the Micronesian rig in the 1770s (1936: 271)—Hornell seems to have sensed that "Mariner" had got it wrong. Like Thomson, however, he missed his moment, going on to speculate: "The voyaging of the Marshall and Gilbert Islanders, noted navigators and confirmed wanderers, almost certainly went as far south as Fiji, and it was in all probability from these people that the Fijians gained the knowledge which led to the designing of that magnificent vessel, the ndrua" (Hornell 1936: 344).

There is no doubt that the Micronesian rig was derived from Kiribati. Or that Kiribati canoes occasionally ventured as far south as Samoa and even Futuna. But even though he had no idea of the extent of historical Tongan

involvement in Kiribati at the time of the rig's adoption (see Geraghty 1994a), it should have occurred to Hornell that whether or not it sailed south on a Kiribati or Tongan canoe—or even on a Kiribati canoe riding piggyback on a *tongiaki*—the rig had most probably been transferred via Samoa. Subconsciously, though, he seems to have smelt a rat, because he embarked on a quixotic quest for signs of a lost Fijian voyaging capacity to counterpoise Mariner's inconvenient truth about Fijian reliance upon Tongan voyagers, and Williams' damning confirmation that: "Fijians do not make bold sailors, and none have yet taken their canoes beyond the boundaries of their own group…. I never heard of but one Fijian Chief who had attempted to steer his canoe to Tonga, though the people of that group, having the wind in their favour, pay yearly visits to Fiji" (Williams 1858: 85).

This was futile. Hornell (1936: 334) was only able to unearth three witnesses, none whom support his argument. Firstly, he tabled Lawry, not realising he was quoting Hoole, a Missionary House editor and compiler, whose statement that "These islanders are bold navigators, and make somewhat distant voyages…" was cribbed from Wilkes, who had actually been referring to *kalia*, not Fijians, when he observed "they make very long voyages,—to Tonga, Rotuma, and the Samoan Islands". Or, indeed, noticing that Hoole commented it was "still the case" that "no native of Feejee would venture to Tonga, except in a canoe manned with Tonga people" (Wilkes 1845 [3]: 347, Lawry 1850: 255). Next, he called upon Wilkes (!), repeating Hoole's misreading of what is admittedly a somewhat cryptic sentence. The last shot in his locker was Speiser's alleged reference "to Fijian voyages to the New Hebrides"; but all Speiser really said was that "voyages to other islands [archipelagoes] were not made by the natives [of Vanuatu], whereas Fijians, Tonganese and other Polynesians came to the New Hebrides", without implying they returned home (Speiser 1991: 224). This, of course, confirms a long history of one-way flight and accidental drift voyaging to Melanesia from Fiji and Western Polynesia, and an absolute dearth of evidence that any Fijian-crewed canoe ever came home.

Hornell, then, was grasping at straws. And for all that this desperately sorry stuff is still dredged up to support notions of past Fijian voyaging prowess (Ewins 2014: 174), it cannot justify his Thomsonian conclusion that, because there are historical references to Tongan drift-voyaging to Melanesia, but allegedly no instances "of such involuntary settlement on the part of the Fijians", this was due to:

> … the superior sailing ability of their [*drua*] canoes, they were normally able to continue a given course, even against a head wind. Doubtless some lost their bearings and went astray when the sun and stars were obscured,

> but these must have been few compared with the number of Tongan canoes blown out of their course on voyages to and from outlying and distant island dependencies of Tongatabu. (Hornell 1936: 334)

In deference to Hornell—whom, despite appearances to the contrary, and like Martin, I admire—the worth of the technological detail and perceptive observations contained within his encyclopaedic contributions will never wane. Insofar as the transition from Tangaloan-rigged *tongiaki/drua* to Micronesian-rigged *kalia/drua* is concerned, though, apart from recognising Micronesian-rigged *tongiaki*, he failed to advance beyond Martin.

Pirogues: Neyret and the Unravelling of Martin's Hypothesis

Haddon and Hornell's surveys (Hornell 1936, Haddon 1937, Haddon and Hornell 1938) were supplemented by Neyret's great contribution (1976), the Fiji content of which is particularly instructive.[8] Most pertinently, although Neyret accepted the convention that Tonga adopted Fijian *drua*, he did not agree that the Micronesian rig reached Fiji on a Kiribati canoe, thinking it more likely came on a double canoe from Rotuma or 'Uvea (1976 [II]: 80). He also noticed that the internal flange-lashing method of forming and stitching hull components together was Samoan, not Fijian, and had reached Fiji via Tonga; and that the upright, wedge-shaped cutwater prow of *drua, camakau* and lesser Fiji-built canoes was not just derived from the chiefly Samoan *tafāga* fishing canoe, but a hallmark of the Lemaki, Manono-derived *mātaitoga*, who were sent to Lau from Tonga to build voyaging canoes and settled at Kabara, in, he thought, the early 1800s (1976 [I]: 77-78).

In referring to Neyret, it struck me that the Micronesian-rig was unlikely to have been carried to Fiji in the way he proposed because, although the Tongan-influenced 'Uveans and Rotumans made deep-sea voyages, they were more beneficiaries than innovators. Indeed, the Micronesian-rigged *tongiaki* conversions seen in Tonga in the 1770s were more sophisticated than the ones they were building in the 1820s. The key point, though, was that Neyret had effectively proposed that the rig was carried to Fiji on a *tongiaki*. Coupled with his Lemaki observations, this rather suggested that it had progressed from Samoa to Tonga thence Fiji on a *tongiaki*. Thus enlightened, I worked back through old records with fresh insight and, in due course, concluded that, evidentially rather than prejudicially, the *kalia/drua* traced back through a Micronesian-rigged *tongiaki/drua* to the Tangaloan-rigged *tongiaki*. Neyret then, essentially set me on the path which led to my contending that the *kalia* was not a copy of a pre-existent Fijian *drua* but, like the *drua* itself, the outcome of process outlined at the beginning of this article (see Clunie 1986, 1988).

HYBRIDS: THE TRANSITION FROM *TONGIAKI* TO *KALIA*

Having got thus far, in proceeding to the canoes it should be borne in mind that from the onset of Tangaloan intrusion into the region through to the mid 19th century, building a voyaging canoe was always an expensive, time-consuming business which could not be undertaken without strong local authority, command of a wide range of resources, employment, sustenance and rewarding of a team of specialist canoe-wrights, and the provision of a construction hangar. To put things in historical perspective: it took two or more years to build a largish *kalia* using steel-edged tools. Tahitian canoe-wrights, however, reckoned canoe-building tasks had taken them ten times as long using stone tools (Wilson 1799: 192). Once built, moreover, these already massive investments required heavy ongoing maintenance. Lashings had to be renewed annually, rigging and sails required regular replacement; West's observation (1865: 51) that sails were carried ashore and housed even before chiefs landed clearly is indicative of age-old practice. The canoe itself would, moreover, last from 20-30 years if hauled ashore between voyages and stored with all its gear in an airy hangar in the Tongan manner (Cross MS.c: 15 June 1841). None of this was new: the similarity of 18th century Society Island and Tuamotuan *fōlau/hōlau* 'canoe-hangars' to Tongan *alafolau* (Fijian *volau*) substantiate it as ancient Tangaloan practice (compare Figs 4 and 6).

There was then, always a chronic demand for sail mats, cordage, and other resources that could only be met by ranging far afield, collecting materials and distributing suitable pandanus and coconut cultivars—coir lashings requiring particularly long stapled coconut fibre.[9] It is likewise plain that Tonga did not have the capacity to sustain a supply of hull-building timbers, so was bound to resort to overseas construction, where intensive exploitation could in any case only be maintained for so long at any one locality, not least because of wastage, a tree only splitting into two or three planking blanks (Twyning 1850: 161).

Historically, then, reliance upon long distance voyaging canoe traffic as much drove as supported the expansion and continuation of the so-called "Tongan Maritime Chiefdom". The canoes themselves were militarily and economically indispensable on both home and foreign fronts, and voyaging was necessary to build and maintain them. Voyaging, moreover, was spiritually and politically impelled by the need to collect and advantageously redistribute scarlet Fijian *kula* feathers, mother-of-pearl shells, whale teeth and vast quantities of *pule* 'egg-cowries' needed to maintain relationships with gods, mark divinely-sanctioned authority, and found and maintain dynastic alliances (Clunie 2013a).

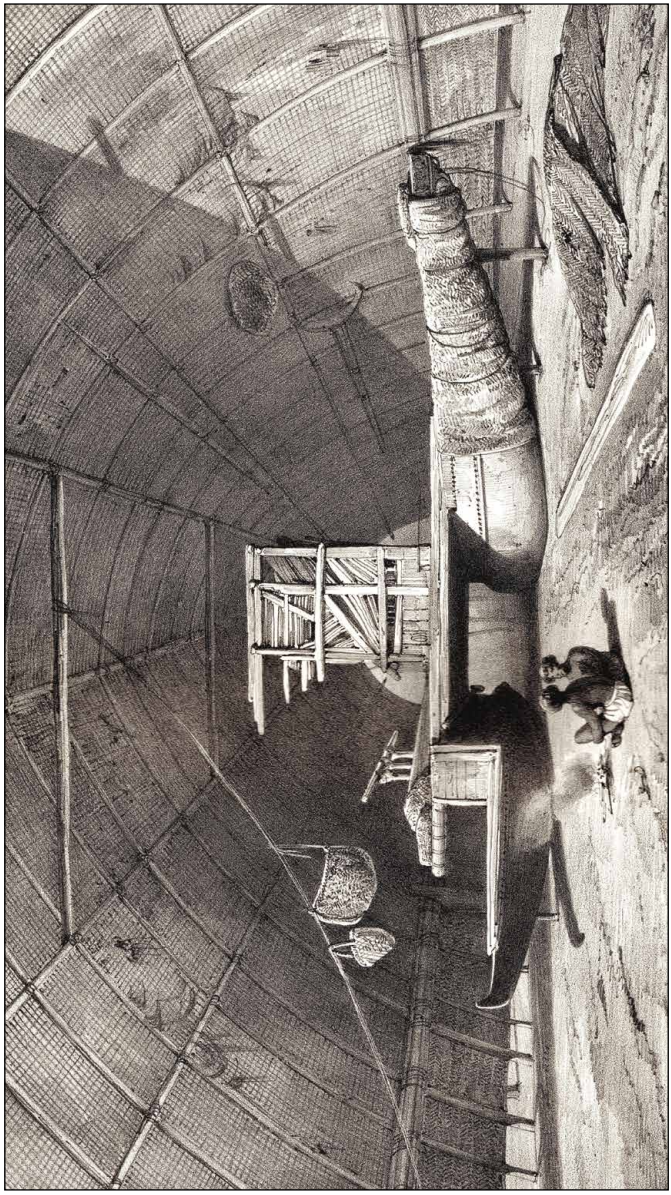

Figure 6. *Kalia* in *alafolau* canoe hangar, Tongatapu, 1838 (Dumont d'Urville 1846).

Tangaloan-rigged Tongiaki *and* Hamatefua

Thanks to earlier surveys of Austronesian canoe rigs, it is understood that all known Fijian, Western Polynesian and Micronesian canoe rigs descended from a fundamental Tangaloan type that was carried in two distinctive ways, both of which travelled from Western to Eastern Polynesia in the 11th century (see particularly Hornell 1936, Doran 1974, 1981, Horridge 1986, 2008). Because Eastern Polynesian canoe terms tend to correspond with Tongan terminology, which is mostly cognate with Samoan and less so with Fijian, Tongan terms will be used here.

The more basic form of rig was carried by small to medium-sized outrigger canoes such as chiefly plank-built *tafa'anga* and lowly *va'akau* or *pāpaotuingutu* 'dugouts'—and in Samoa, *tafāga*, *soatau* and even smallish *amatasi*—all of which were suited for paddling (see Figs 7, 10, 11). When sailing, these mounted a triangular mat sail (*lā*), open across the head (*'ululā*), but fastened to a pair of spars (*sila*) along the longer leading and following sides (*kaulā, sila*), except when changing tack, when the narrowing lower half of the sail was unleashed from the spars. These two spars converged at the pointed *vū* 'tack' or foot of the sail, where the tip of the boom (*silalalo*) was slipped into a grommet fastened close to the end of the longer and stronger spar, which served as mast (*kautu'u*, *silat'u'u* 'standing-spar').[10] The standing-spar, which stood upright, was heeled into a cupped socket (*tu'ungasilatū*) in the middle of a thwart extended across the hull immediately abaft the forward outrigger boom. It was secured by a forestay (*tukumu'a*), which slanted down from roughly half height to belay to a perforated lug (*ava'ituku*) close to the front of the long prow end-cover (*taumu'a*). And was laterally braced by: (i) two portside shrouds (*tauama*) which arose from the same point as the fore-stay and diverged out and down across the outrigger to belay close to the outside ends of the front and back outrigger cross-booms (*kiato*), and (ii) a starboard shroud (*taukatea*), which slanted out and down and was belayed towards the outboard end of an out-rigged rigging/balance board (*huasi*; Samoan *suati*). When on the starboard tack, a crew member was stationed on this board as a counterpoise, his weight preventing the outrigger float from heeling under, veering and capsizing the canoe This was a very handy rig; the sail was readily controllable with the long sheet-rope (*maealalo*) attached roughly half way up the boom, and it was only necessary to swing the boom round behind the standing-spar when wearing round—passing the stern through the wind—to change tack.

As deep-sea voyaging canoes, the otherwise similar sails of *tongiaki* and *hamatefua* were naturally more expansive, heavier and subjected to far greater stresses, so were mounted differently. Essentially, the mast transformed into a convexly curved yard, which kept the old *kautu'u*/*silat'u'u* name, and the

Figure 7. *Tafa'anga* paddling canoe bearing upright Tangaloan rig, and Micronesian-rigged *tongiaki* ambling along on the starboard tack in the old Tangaloan manner, with sail swung to port side of mast and tack bridled between the prows, 1777 (Webber). Copyright: Dixson Library, State Library of New South Wales.

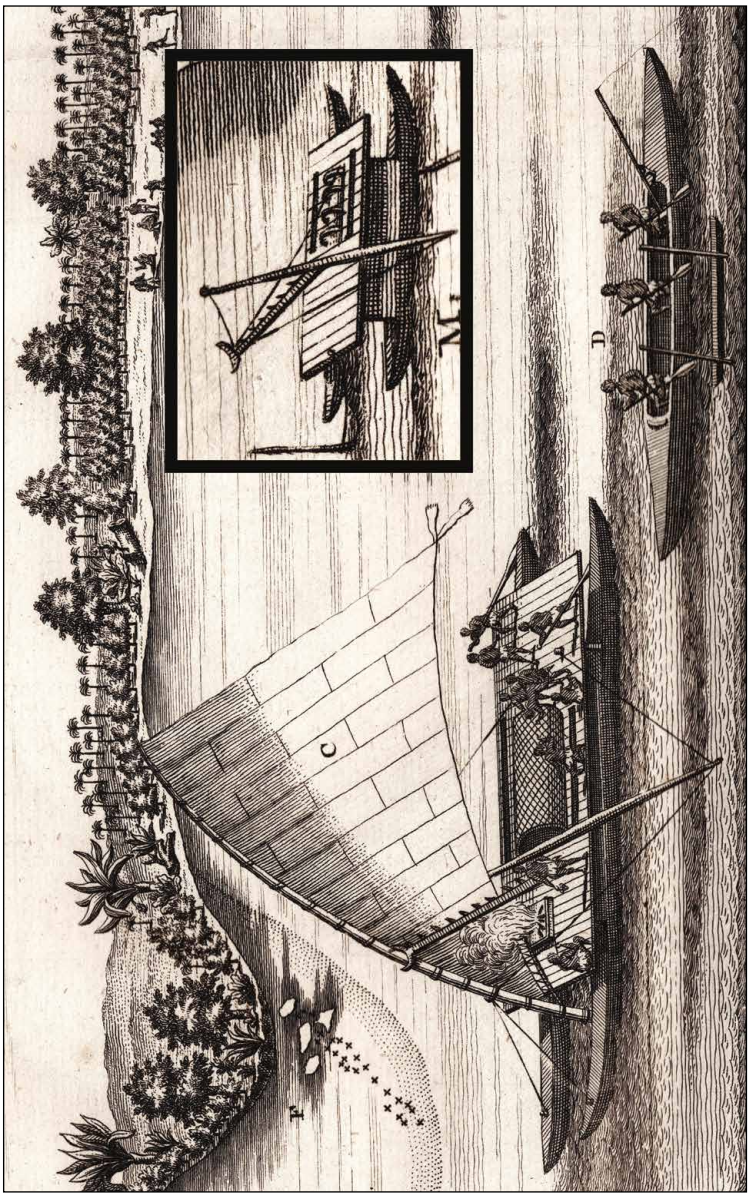

Figure 8. *Tongiaki* on port tack, 1643. Inset shows how mast was rigged to be raised and lowered (Valentijn 1726.

boom became an under-slung *kaulalo*/*silalalo* 'lower spar'. The boom had a *hafe* 'brailing-line' fastened to it and returned over the yard to the deck so that the sail could be brailed up when need be. In use, the *tu'uaki/tefitosila* 'foot' of the yard was carried forward and, in *hamatefua*, seated in a socket sunk into the fore end-cover, or, in *tongiaki*, bridled between the two prows. Rather than stand upright, however, the yard tilted backward to rest at about a third of its length across the forked head (*'ulufanā/'ulupale*) of a stocky prop or mast (*fanā*), highly reminiscent of the fork-headed *tekelā* 'sail setting-pole' used to boom out the sail when running downwind or reversing (see Fig. 15). The notched heel (*pesikuku* 'claw-clutch') of the mast, which raked strongly forward, was seated upon a ridged mast-step (*tū'ungafanā*). This enabled the mast to be pivoted back and forth (*tokoto*) when raising or striking sail. In *hamatefua*, the step was mounted atop the keel (*takele*) abaft of the forward outrigger cross-boom (*kiato*). In *tongiaki*, it was located towards the front of the platform overlying the starboard hull (*katea-mata'u*), and was backed by a great rigging-spar (*huasi*)—the out-rigged ends of which projected far out to each side. This long spar was laid athwartships, secured by lashings that passed down through the platform and fastened round an underlying cross-beam (*kiato*).

The Tangaloan ancestry of both of these rigs is determined by: (i) the characteristic shape and narrow pandanus mat panels of their sails (Stokes 1900); (ii) the marginal bolt-rope (*kau'ilā* 'sail-handle'), round which ties were looped to fasten the sail to the spars; (iii) the method whereby longer spars were composed of two or three heat-bent sections which met in sloping, tightly woolded scarf joints (*fuhinga*) fished by two or more *loloi* 'elongating/reinforcing rods' (Fijian *i-roroi*); and (iv) the peculiar form of the projecting tops (*hikihiku*) of the *hikusila* 'topmost spar component' (Samoan *si'ui*; Fijian *i-sukui*), over which the bolt-rope cringles at the upper corners of the sail-head slipped, these following a distinctive crescentic configuration of ancient Tangaloan origin.[11] The antiquity of the propped-up rig is, moreover, confirmed by its appearance in Gilsemans' 1642 sketch of Māori canoes in New Zealand, where Tongan *kautu'u* 'standing spar' was echoed by *kautū* and *rākautū* 'sail-mast' as the more commonplace freestanding Māori sail was known (see Tasman 1898, Best 1925: 183, Hornell 1936: Fig. 130).

Unfortunately, no one view captures all *hamatefua-tongiaki* rigging components. Correlation of details drawn from all known views, however, shows that, except when raising and lowering the mast—when a pair of shrouds was extended from the masthead to the tips of the *huasi* to brace it and running backstays (*tukumuli*) used to pull it back upward on its pivot (see Fig. 8 inset)—the rig was supported in much the same way as the freestanding type was; it being the yard, not the mast, which was secured by stays and braced

by shrouds. The only real difference was that more lines were necessary on larger *hamatefua* and a rather busier network carried by *tongiaki*, their rig being worked entirely from the deck-platform.

As noted earlier, the *vū* 'tack/foot' of a *tongiaki* sail was bridled between the prows rather than heeled upon the starboard fore end-cover. This meant that besides leaning forward like that of a *hamatefua*, the mast also sloped towards the port side to align the yard with the tack. Accordingly, the paired forestays diverged down from the yard to pass respectively through a channelled lug (*ava'ituku*) jutting out from the inboard side of each prow end-cover. Having returned through their respective lugs, the stays then converged again and fastened about to the foot of the yard. Their free ends then diverged back to the platform, where they were separately belayed to the rigging-spar, inboard of their respective hulls. This doubly triangulated forestay arrangement prevented the foot of the yard from kicking upward or backward, and allowed it to be adjusted as need be when wearing, when the boom and sail were released from the yard forward of the masthead, and drawn back to the platform by a line which ran back from the foot of the boom to pass through a slot bored through the middle front of the platform. The yard, meanwhile, was laterally braced, by one or more paired sets of shrouds which slanted down to port and starboard to pass through channels bored through each projecting arm of the rigging-spar before slanting back inboard to respectively converge upon, pass through, and belay about lugs located just inboard of each hull well back on the deck platform (see Fig. 8). Or, more likely, return round a cross beam via channels bored through the platform at those points.[12]

Knowledge of Tangaloan-rigged *hamatefua* hinges upon a drawing and engravings made after a sketch Gilsemans made at Nomuka in 1643 (see Anderson 2001). The image used here (Fig. 9) is from Valentijn (1726), not because it is better than Gilsemans' formal drawing (reproduced in Tasman 1898; Hornell 1936, Sharp 1968)—both have their pros and cons—but because Valentijn, who had access to Gilseman's original field sketches, included extra features.

Collectively, the most striking thing about this old model *hamatefua* is its combination of autochthonous Melanesian- and intrusive Tangaloan-derived characteristics—it, like the *tongiaki,* was an extraordinary hybrid. The mast, of course, did not stand upright as depicted, but leant strongly forward. But otherwise, the rig and elongated hull end-covers separated by a long open well are self-evidently Tangaloan, whereas the *katea* 'hull' with its identically tapered ends (*mu'a*) is not only clearly autochthonous, but indicative of descent from a canoe that sailed either end foremost, not in the tack-shifting Micronesian way, but by following a Melanesian technique

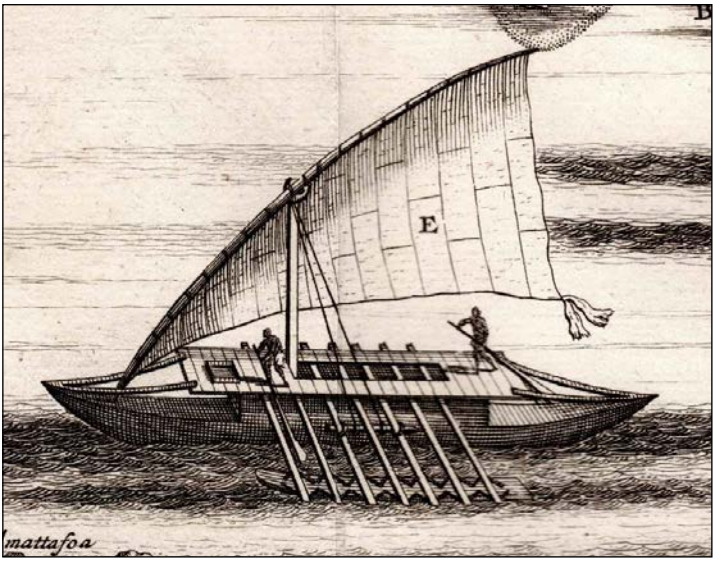

Figure 9. Tangaloan-rigged *hamatefua* ambling along on the port tack without any *huasi* balance/rigging beam out-rigged to starboard, 1643 (Valentijn 1726). (See Fig. 11 for comparison.)

whereby a sail turning upon an upright mast was mounted towards each end. This combination of early Tangaloan rig and authochthonous hull forms is the more remarkable because double-ended canoes fitted with the old Melanesian rig were transferred from Western to Eastern Polynesia in the 11th century, where they survived historically in the Tuamotus. Autochthonous influences are, moreover, further evident in the multiplicity of *kiato* 'outrigger-booms', indirect attachment of the *hama* 'float' to the *kiato* via twinned pairs of long, convergent, hammered-in *tutuki*/*tukituki* treenails made of hard stiff wood, and the presence of an extensive *fungavaka* 'deck-platform' supported upon especially raised washstrakes.

Given the Tangaloan rig, it is notable that Gilsemans' *hamatefua* lacks an outrigged *huasi* 'balance/rigging board' projecting out to starboard for bracing and counterpoising purposes when on the starboard tack. That seems not have been an oversight, however, because *huasi* were demountable and not always fitted when intending to sail a short way in calm weather and stay on the port tack (see Fig. 11). Indeed, the comparatively closely inboard fixing of the port stays to the under-slung belaying bar and buoyancy provided by the

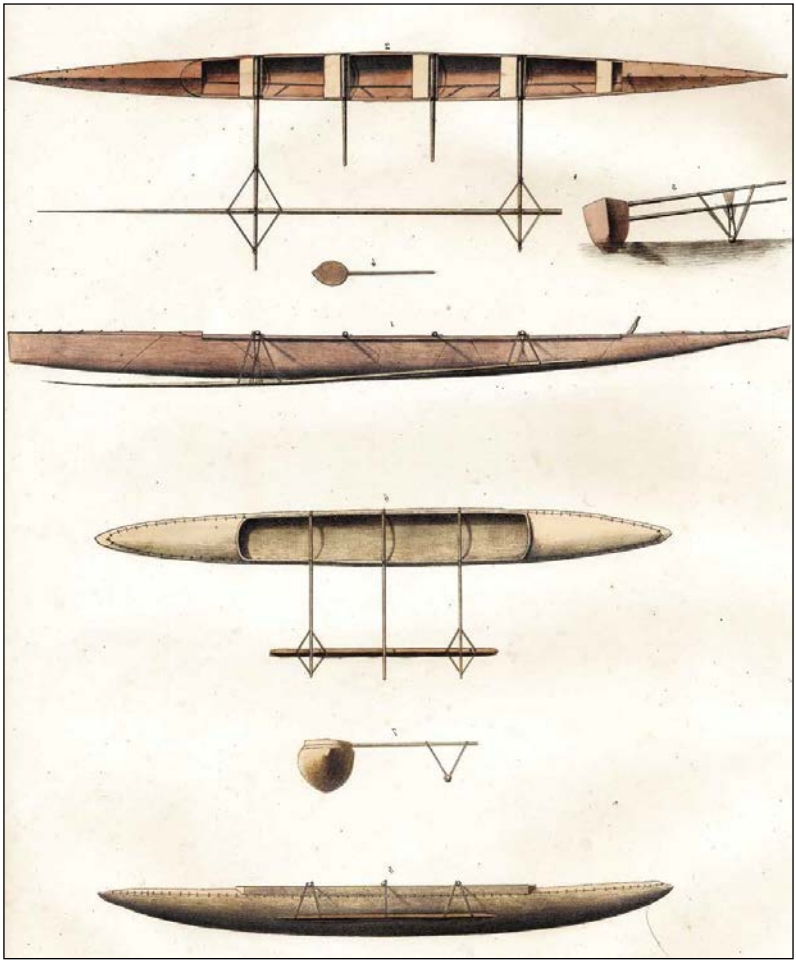

Figure 10. *Tafa'anga* and *pōpao-tuingutu* showing contrast between Tangaloan and autochthonous Melanesian hull forms, 1827. The latter was inherited by *tongiaki* and *hamatefua*; the former was applied by the Lemaki to *kalia* and *hamatefua* (Dumont d'Urville 1833).

extraordinary breadth and size of the float—the use of an unusually bulky float was confirmed in 1777 (Beaglehole 1967: 938, 1367)—suggests that only a comparatively short *huasi* was needed. In this respect it is also notable that, in addition to the steersman, Valentjin introduced a man standing well forward on the outrigger side of the deck-platform, plying a *fohehua* 'sculling oar' (Fijian *i-sua*), which is consistent with next to no breeze. Sculls and paddles were routinely used to assist *kalia/drua* and *hamatefua/camakau* under such circumstances, paddlers standing or sitting on the end-covers to reach the water, scullers standing on the platform. Valentijn's sculler is particularly significant, however. Firstly because he forestalls Bligh's 1792 account of a Fijian canoe using "a large Paddle to scull with as the Friendly Islands do" by 150 years (Henderson 1937: 165). Secondly for suggesting that Gilsemans overlooked the stringers needed to establish a strongly braced outrigger lattice of autochthonous Melanesian type, the closely placed innermost pair of which crossed over adjacent cross-booms to form sculling-oar slots. Accordingly, the absence of butterfly-shaped *ava'ihua/viligahua* 'sculling-oar slots' from *tongiaki* decks in historical views is probably attributable to artistic negligence and does not imply that, in addition to sweeping their *fohe'uli* 'steering-oars', *tongiaki* did not use *fohehua* to scull with in light breezes, when becalmed or to otherwise propel them.

The greatest single surprise packed by this Tangaloan-rigged *hamatefua*, however, is the matching pairs of rails slanting down from the fore and aft corners of the deck to converge above each end of the hull. Drawing upon equivalent struts fitted to the leeward side of Micronesian-rigged *kalia/drua* and *hamatefua/camakau*, Neyret thought they were guardrails, the forward pair used by those tending the tack, the aft pair to help restrain the steering-oar on both port and starboard tacks. This is plausible, the foot of the yard being stepped in a socket (*tu'ungasilatū*) well forward on the prow end-cover, and Tangaloan-rigged *hamatefua* turning on their heel when wearing. Indeed, coupled with Pâris' description of Levuka-crewed *camakau* skipping about on seas chopped up by a brisk trade-wind, the very lively character of Tangaloan-rigged *hamatefua* convincingly accounts for the paired guardrails, and explains why only the leeward rails were transferred to their tack-shifting Micronesian-rigged successors, which always kept the outrigger to windward (Pâris 1843 [1]: 114, Pl. 117).

Before leaving these peculiar rails, which re-surfaced as leeward guiderails on large *kalia/drua* in the 19th century, a diversion is called for, one of various Fijian terms for them having been deployed to challenge my finding that Fijians did not actually teach Tongans how to build and sail *drua* (Clunie 1986, 1988).[13] Essentially, this was done by casting *i-vāvādā* as a Western Fijian word meaning "something like 'instrument to facilitate stepping'",

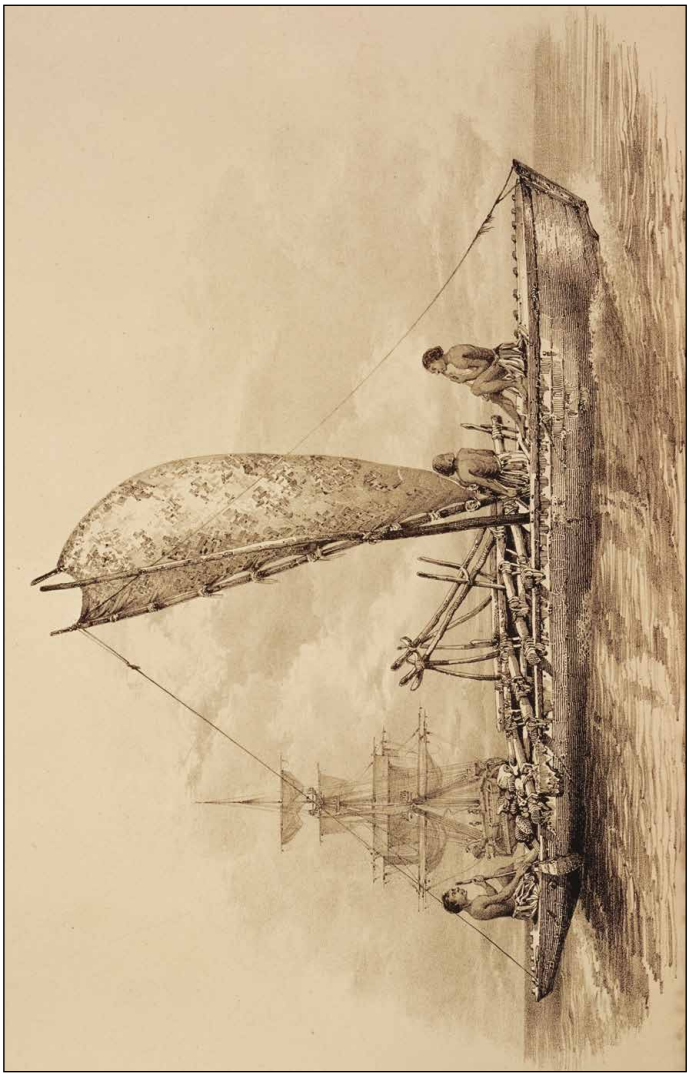

Figure 11. Informally-rigged Samoan *amatasi* ambling along with its *suati* balance/rigging beam and its peculiar stick stand resting on outrigger lattice, instead of out-rigged to starboard as when sailing seriously, 1838 (Dumont d'Urville 1846). Copyright: Alexander Turnbull Library, Wellington.

and projecting that "linguistics" thereby confirm that "Tongans and Samoans borrowed the double canoe from Fiji" (Geraghty 1994b). The interpretation is less than secure: Western Polynesian *vā* = 'a gap between two things', Tongan *vā'atā* = 'to have a space between two things'. But be that as it may, to pretend that the history of anything so complex as a *kalia* might turn upon a single word is implausible The musket, its individual components, ammunition and accoutrements, were, for instance, all defined by terms drawn from pre-existent Fijian technology (Clunie 1977: 96-97, 1983). In any case, the whole construct was predicated upon a belief that *i-vāvādā* are fundamental to the working of the Micronesian rig, when there is no historical record of such a strut on: (i) any Micronesian canoe, (ii) any Micronesian-rigged Western Polynesian double canoe recorded in the 17th-18th centuries, Fiji-built or otherwise, (iii) any autochthonous Melanesian double canoe, or (iv) any Western-Polynesian-derived Micronesian-rigged double canoe in Melanesia, including those that mimicked *kalia/drua.* Indeed, even the latter did not begin carrying *i-vāvādā* (and another lee-side guiderail) until the early 19th century, when *i-vāvādā* were transferred from *hamatefua/camakau* to facilitate tack-shifting aboard *kalia/drua* that had become too massive to otherwise work the Micronesian-rig.

Historically, then, although rails of this peculiar *hamatefua* type were retrofitted to otherwise fully-fledged *kalia/drua*, and in due course became standard fittings, they clearly had nothing to do with the adoption of the Micronesian rig.

Tongiaki, as the accompanying figures show, were true double canoes, the matching *katea* 'hulls' of which followed the same lines as the *hamatefua* hull. These hulls, like those of their descendants, were separated and linked athwart the notched tops of their supporting *pāfā* 'washstrake boxes' by a battery of strong *kiato* 'cross-beams' which were braced by underlying stringers (*fakamanuka*), and surmounted by a platform composed of strong planks laid athwartship (not fore-and-aft as Gilsemans misrepresented). As with its narrower *hamatefua* counterpart, moreover, the sides of this expansive platform overhung the port and starboard hulls, while its forward and after ends cantilevered far out beyond the breakwaters of the washstrake boxes, supported by props rising from the hull end-covers. These props (*lafitupu*?), as Neyret found when sailing *drua* and *camakau* in Fiji, doubled as baffles, splitting oncoming waves and spilling their water to either side, discouraging it from splashing onto the platform. Indeed, the unusual slightly hump-backed deck of the Pâris *kalia* (see Fig. 15)—coupled with the need to safeguard *tafa'anga* fishing canoes, which *tongiaki* occasionally carried stacked abaft the deckhouse—suggests it was principally to counter wave-wash that the *tongiaki* platform canted gently upward (the slope is artistically exaggerated

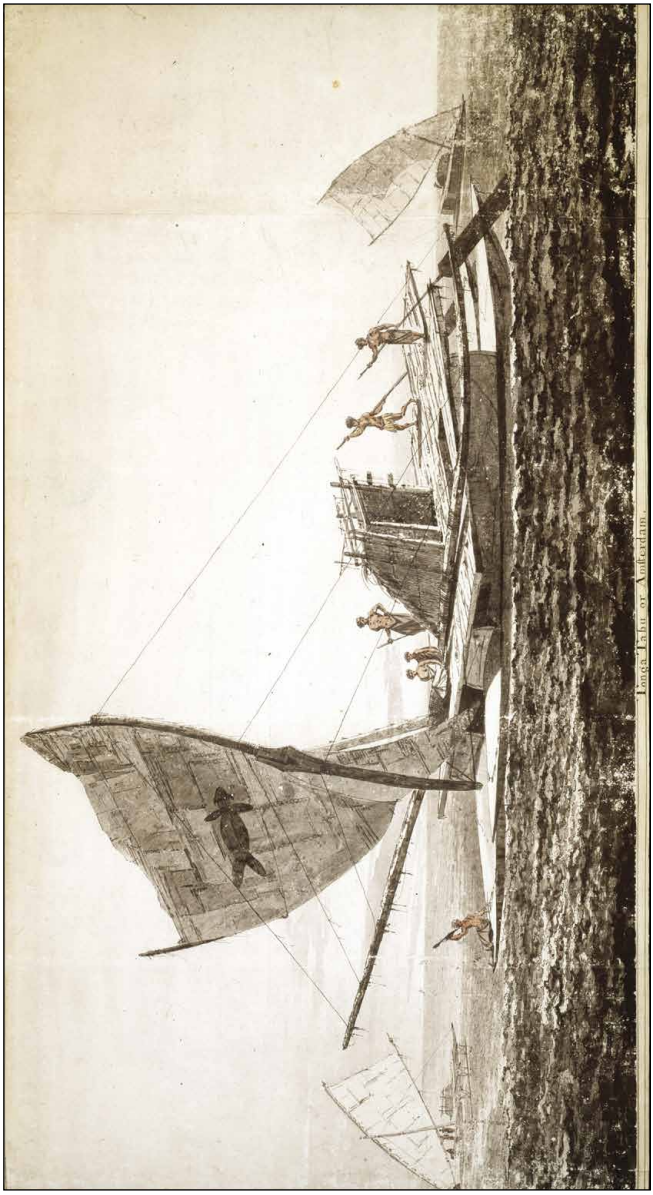

Figure 12. Two Tangaloan-rigged *tongiaki*, 1774. The vessel in the foreground is about to wear round to follow the other on the starboard tack, the tack of its sail having been released from yard and boom, ready to swing sail and boom round behind mast as it wears. Left: a large, already fully-fledged Micronesian-rigged *hamatefua* (Hodges). Copyright: British Library, London.

in most views) from fore to aft. Otherwise, apart from a long hatchway slot overlying each hull and the great *huasi* spanned athwartship just abaft the mast, the deck notably bore a tunnel-like, hoop-raftered *falevaka* 'canoe-house', which, as befitted a canoe that sailed on both tacks, was aligned fore-and-aft abaft the *huasi* in the middle of the platform between the hatchway slots.

Because the same essential form of hull, end-cover and washstrake box construction was inherited by *kalia/drua* and has been well documented by Hornell, Neyret and others, ribbing and other internal fittings are not described here. In terms of hull planking technique, however, it is particularly lamentable that although the manner in which both prows of Lātūmaipulu's *tongiaki* disintegrated when she rammed the *Eendracht* indicates that they were composed rather than dug out, none of the 17th century observers referred to it. Accordingly, until the antiquity of the "hidden" Samoan flange-lashing technique that so astonished Cook voyagers in the 1770s is established, it would be rash to assume *tongiaki/hamatefua* were always planked in that way, it being conceivable that the old Tangaloan through-lashing and plugging technique—whereby opposing edges were butted together and the joint covered by a batten before being stitched together—was still in vogue when Rokola accompanied Degei to Fiji some two centuries earlier (dee Burney 1975: 84). Indeed, Rokola's title, which commemorated the *kola* 'wedges' his *mātaisau* used to split timber and drive under canoe lashings to tighten them, may say something about this, Fijian *kola* corresponding to Samoan *olaola* 'adze handle-tightening wedge' and pan-Polynesian *ora*/*mataora* 'splitting or tightening wedge'. Samoan and Tongan canoe-wrights, however, distinguished the small wedges used to tension the outwardly invisible lashings binding edge-flanged *fono* 'components' together as *matalafi* 'hidden eyes'. Far from being degenerate then, Rokola's *mātaisau* may have reached Fiji before the flange-lashing technique was perfected in Samoa, and so found themselves technologically time-warped and hopelessly outclassed by incoming *mātaitoga* in the 18th century. Certainly it was impossible to build such lightly and tightly constructed hulls using conventional Tangaloan techniques. Firstly, because the flanges themselves doubled as ribs which allowed the intervening planking to be dubbed much more thinly. Secondly, because the scarfed and variously interlocking crenulated, V and even M-W joints of irregularly formed *fono* were infinitely stronger than those of more regularly coursed, end- and side-butted, through-sewn Tangaloan planking of the type that was still used above the waterline to connect the washstrakes and end-covers to the hull. It is therefore conceivable that, with the accompanying advent of steel-edged tools, the *mātaisau* abandoned *vakavonovono/tābetebete* hull planking altogether and resorted to *vakataucoko* 'dugout' hull construction, using

the *vakaveikoso* technique of end-butting and lashing two dugout lengths together when making larger hulls (see Neyret 1976 [1]: 56).

Bearing all this in mind, to place the voyaging capabilities of the much maligned *tongiaki* in perspective, we should recognise that while it probably did make the occasional return trip from Vanuatu and New Caledonia, its return range undoubtedly extended northwestward from southernmost Tonga through Tuvalu and across the equator into Kiribati, and westward from Samoa and Niue to Fiji and Rotuma. And also remember that it was the *tongiaki*'s seaworthiness and massive carrying capacity that enabled the expansion and maintenance of the "Tongan Maritime Chiefdom" over many centuries. In assessing their performance, moreover, Thomson's claim (1908: 294-95) that they "could lie close to the wind on one tack, but on the other the sail was broken up into pockets by the mast, which held the wind and stopped all headway" is a canard. Tongans had told him that "in tacking [wearing], the sail was unlaced from the yards and carried to leeward of the mast" (1894: 308). Indeed, Schouten was astonished by the ready way in which *tongiaki* wore round, describing how the two steersmen "ran forward … with their oars when they wish to turn", stressing that "the canoe would turn itself if they only took the oars out of the water and let it go, or only let the wind carry it along" (De Villiers 1906: 200). Cook and *Bounty* voyage descriptions, moreover, back Schouten, Anderson noticing how "in working to windward they shift the sail to the opposite side in tacking [wearing], which is done very quickly from the command two very large paddles which they steer with have over them", Wales that "their very large Sails of Matts,… jibes round when they want to Tack in a very convenient Manner", and Morrison that "the yard is fixed to swivel about on the masthead" (Beaglehole 1967: 938, 1961: 848, Morrison 2010: 32). Contemporary illustrations, furthermore, not only depict *tongiaki* sailing freely on both tacks, but show how the back of the mast was notched with footholds to facilitate regular access to the masthead, and how the bolt-rope was unlaced from the yard from that point downward so that the boom and tack could be swung round behind and to the far side of the mast when wearing (See Figs 2, 8 and 12). In terms of rig development the foregoing is important because it is evident from the way in which the boom and tack of the sail were routinely freed from the yard and swung about when wearing that the propped-up Tangaloan rig foreshadowed the tack-shifting Micronesian one. Indeed, it only took the introduction of halyards to enable sail, yard and boom to be swung about in unison, upon which the potential for a canoe to sail either end forward would have been obvious to Micronesian mariners familiar with double-ended Melanesian craft. Further indications that the tack-shifting Micronesian rig evolved from the old Tangaloan one are evident in: (i) the retention of *huasi*-like lee platforms on Marshall and

Caroline Islands canoes, (ii) the retention of the Tongan and Fijian terms for wearing—*hua* 'lift up, turn over' and *cavu* 'pull up' respectively—for the tack-shifting manoeuvre, and (iii) the way in which the latter was intiated by turning the stern towards the wind, as if about to wear round. The remaining mysteries, then, are when and where Micronesians encountered halyards; the new rig was already in use in the Marianas when Magellan reached there in 1521 (Pigafetta in Hornell 1936: 413).

Historical accounts agree that in setting out on a voyage (*folau*) Tongan navigators were prepared to wait for weeks or months for a favourable wind and normally did not embark without one, not worrying about season but taking advantage of it when and as it came. That being so, provided the weather held for them it is apparent from the range, build and handling characteristics of *tongiaki* that they, like their Micronesian-rigged successors, were well suited to slanting northward and southward across the prevailing southeast trades, and capable of making very fast passages. There is also no doubt they could work to windward under gentle conditions and clear that they, like their successors, could sail to within about three points[14] of the wind, although that did not represent the true course. This entire stable of shallow-draughted, round-bottomed canoes was prone to sagging away to leeward.

Despite what can now clearly be seen to have been an illustrious voyaging past, however, the sardonic Tongan *takanga'atongiaki* analogy for a fair weather friend rings true. It has always been apparent that compared to their Micronesian-rigged offspring *tongiaki* were at great disadvantage when overtaken by squally or stormy weather or in attempting to beat to windward against brisk trade winds. They were unable to strike sail without lowering the entire rig, the ends of the out-rigged *huasi* were prone to dipping under with potentially disastrous consequences if the sail was taken aback, and unless the seas were kept on the quarter the twin hulls worked against each other, twisting the platform and wrenching the lashings. It was obviously impossible to repeatedly leash and unleash the sail from the yard, swing the boom to the other side of the mast or otherwise attempt to wear under such conditions. Thus caught out, it is clear that unless they could slant away to shelter, *tongiaki* had little chance of keeping company for long. Indeed, individual canoes were unable to do other than lower the rig and drift downwind until conditions eased, their increasingly exhausted and exposed crews battling to keep the prows pointing towards but just off oncoming seas, bailing desperately to keep from swamping as water spurted in through the working seams, and as a last recourse jettisoning rig and cargo to lighten ship.

Small wonder then that storm-tossed *tongiaki* were recalled as being dangerous and impossible to control in storms, and, if they could avoid leeward hazards, prone to drifting far downwind and not returning. Or that,

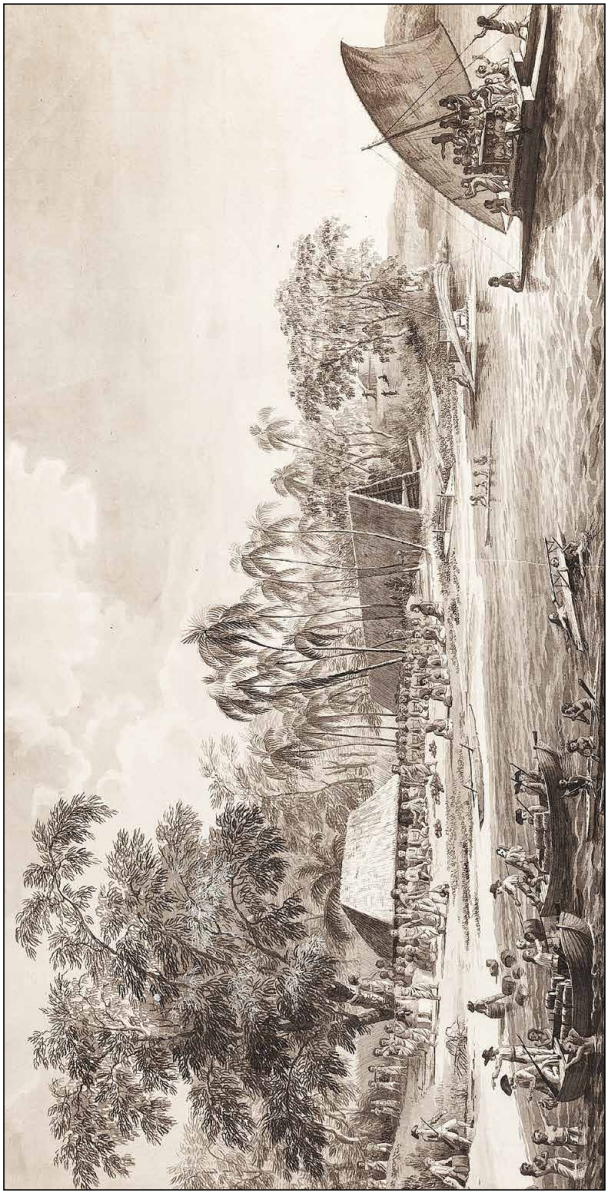

Figure 13. Two Micronesian-rigged *tongiaki* at Vava'u, 1793 (Drawn by Fernando Brambila, the Malaspina Expedition artist). Copyright: Museo de América, Madrid.

Lehā, the Tu'i Tonga's principal canoe-wright, and Lehā's *matāpule* kinsman Lemaki, were in Lau building Micronesian-rigged *tongiaki* when Captain Cook first sailed into Tonga in 1773.

Micronesian-rigged tongiaki *and* hamatefua

Whether or not the Micronesian rig reached Kiribati itself much before the 18th century—and regardless of whether it came to Tonga, Tonga went to it, or they met halfway in Samoa—it can hardly be coincidental that construction of *tongiaki*-type *va'atele* ceased in Samoa in the mid half 18th century, and that two Manono-derived canoe-wrights, Lehā and Lemaki, removed from Tongatapu to Lau to build voyaging canoes at about that time. Or that they had just made their reputation by adjusting the masthead of the Tu'i Tonga's racing canoe, boosting its performance (see Turner 1861: 268, Hocart MS.a, Thompson 1940: 34, Reid 1977: 17, Hooper 1984, Tuimaleali'ifano 1990: 34-41). Lehā, as it happens, was killed soon enough, and succeeded in Tonga by another *matāpule* namesake. Lemaki, however, stayed on as the Tui Nayau's principal canoe-building *matāpule*, settling at *vesi*-rich Kabara, and pioneering the construction and ongoing development of Micronesian-rigged *tongiaki* from there.

Deciphering the character of the Micronesian-rigged *tongiaki* Lemaki and his *mātaitoga* were building at Kabara in the 1770s is not straightforward because Cook voyage illustrations variously misrepresent and confuse features. Ellis' field sketches are informative but hazy. Hodges' casual habit of combining details drawn from different Tangaloan- and Micronesian-rigged canoes particularly bamboozled the engravers (Figs 2, 12). And even Webber innocently contributed to the confusion by faithfully depicting a Micronesian-rigged *tongiaki* being sailed in the old Tangaloan way (Fig. 7).

Confusion notwithstanding, however, once correlated with other evidence the views assembled by Joppien and Smith (1985a. 1985b) agree that although the matched hulls and prow end-covers of Micronesian-rigged *tongiaki* were inherited from Tangaloan-rigged *tongiaki*, these new-model canoes had otherwise been modified to work the Micronesian rig in a tactic whereby the canoe shifts tack by: (i) turning the stern towards but not across the wind, slowing forward progress, (ii) spilling the wind from the sail, (iii) freeing and lifting the tack from the step overlying the prow, (iv) carrying the slapping sail manually aft with help from the mast as it is pivoted back through the vertical to rake towards the stern, (v) heeling the yard upon the step overlying the stern, which becomes the prow as the now inside-out sail is sheeted home, and (vi) powering away on the opposite tack, the steering-oar having already been transferred to the new stern.[15]

Accordingly, while the mast-bearing hull of a Micronesian-rigged *tongiaki* was still called *kateamata'u* 'starboard hull' and its old portside companion

kateahama 'outrigger/port hull', the canoe effectively now had windward and leeward rather than port and starboard sides.

In adapting *tongiaki* to sail like this, the tops of the washstrake boxes were levelled to support a flat rather than canted deck-platform and the rigging-spar jettisoned. Except when bailing—which was only necessary when the canoe was working hard—the hatchway slot overlying each hull was loosely boarded over to provide a fore-and-aft gangway when moving the sail back and forth. Although not illustrated, it is also apparent the mast-step had already assumed the compact rectangular form of its socketed Tarawa equivalent but retained its old pivoting ridge, taking on the *vungakoto* form employed thereafter. (The term *vungatoko* perhaps also applied to its predecessor, being cognate with *tu'u'anga* 'standing-place', *vūanga* 'tack/yard-step', Rotuman *fūaga* 'place where anything stands' and *tākoto/tokoto* 'lie something down' (see Hornell 1936: 351, Fig. 210, Clunie 1986: 19, Fig. 24). This step was in a new position, fastened through the platform to the central *kiato* boom immediately inboard of the weather gunwale of the leeward/*mata'u* hull. The mast now was rooted halfway between the ends of the hull and much taller. It was still horned at the head and, regardless of whether the old *tongiaki* mast had been similarly composite, was now headed by a rigid *fehi* 'masthead' (*tomotomo*), scarfed to a strong but flexible and much lighter *tamanu* (*Calophyllum neo-ebudicum*) *fanā*, and secured by tightly wound wooldings.

As with the old *tongiaki*, the rig was stayed and braced entirely by running rigging. Rather than being propped upon the masthead, however, the yard was now suspended less than a third of the way down from its upper end on a pair of halyards (*maeafailā*). The uppermost halyard passed across the *pale* 'crutch' of the masthead, then descended to belay about a cleat attached to the mast or a clamp on one or other of the deckhouse pilasters. The lower and heavier halyard passed in the Kiribati way through a slot underlying the masthead. It then ran out to windward, descending to a long slot that was extended fore-and-aft just inboard of the outside edge of the platform to expose the cross-beams so that lines could be belayed about them in the same way as they were belayed about the exposed booms of outrigger canoes. Upon reaching the slot, the halyard passed through it and was either belayed about one of the second-from-central cross-beams, or turned round it to belay to a rail running just inboard of the slot. In its most primitive form, this belaying-rail consisted of a spar supported upon several short legs, but by 1774 this was already being supplanted by a short-beamed, centrally-positioned sawhorse-like *koli* 'dog' (see Figs 2, 14).

Instead of being bridled between the prows, the foot of the yard (*fakavete*) was now heeled just abaft the prow of the *kateamata'u*, next to the old-style *ava'ituku* lug the forestay passed through. It was either seated in a socket

(*tu'ungatilatū*) of the old *hamatefua* kind, or heeled against the inside apex of a little crescentic step (*vūanga*) on the end-cover and retained by a lanyard looped to a slotted cleat immediately abaft the *ava'ituku*, thus obviating the need to lift the yard from a socket. The foot of the boom was inserted into a grommet fastened just above the yard foot, and the foot of each spar armed with a protective scarfed-on *fehi* point..

Otherwise, the rigging, which had formerly concentrated upon the yard, focussed upon the mast, which was now braced to windward by three strong *lopa* 'shrouds' which fastened to the mast just below its juncture with the scarfed-on masthead, where the retentive wooldings prevented them from slipping. These shrouds diverged downward and outward towards the *hama* hull where they respectively belayed round the central cross-beam and each adjacent one in the same way as the halyard, or turned back round them to belay to the dog. Two pairs of running stays (*tuku*) were fastened to the mast at the same point as the shrouds, and diverged fore and aft to respectively pass through pierced *ava'ituku* lugs jutting out from the inside ends of the prows at both ends of each hull before returning back to deck, passing through holes bored through the ends of the platform just inboard of each hull. The lee stays ran back to belay to a clamp running down the face of their respective deckhouse pilasters, the weather ones to the belaying-dog.

Because there were no leeward shrouds, to prevent the mast from being flung across the outrigger when the sail was taken aback, smaller *hamatefua*—which were similarly rigged but of course only carried one pair of stays—simply adopted the Kiribati *tura* 'mast-shore': a downwardly slanting strut, the head of which was lashed to the mast at about chest height while the forked lower end clutched onto the middle outrigger boom and locked against a stringer (see Fig. 1, also Grimble 1924: 118, Fig. 17). On *tongiaki* and big *hamatefua*, however, the function of this *teke* (Fijian *vagaloa*, *rokoroko*) was provided by the heavy rounded lintel (*fōlahi*, Fijian *i-vorati*) of a new form of deckhouse that opened out to leeward. This beam was supported by two stout pilasters (*poutu'u*) and backed by the rafters, which curved back down to windward to mortise into the deck.

Although clearly designed with that purpose in mind, this remarkably compact deckhouse—which according to Samoan tradition, where it was tellingly known as *falefa'amanu'a* 'Manu'an house', was developed there, then transferred to Tonga (Krämer 1999: 604)—was backed and surmounted by a framework supporting a decked *fata* 'bridge' for the chiefly party to sit upon, and otherwise very well thought out. Its reed-panelled ends and pandanus-thatched roof protected the interior from wind and spray, and privacy across the open front was achieved by a plaited coconut-leaf dropdown *pola* 'curtain' like those used on open-sided Tongan and Samoan houses.

These remarkable improvements clearly sufficed for the Micronesian-rigged *tongiaki* and *hamatefua* of the time, which evidently ranged between 12 to 22 m in length, the 1774 plan of a 21.03 m long old-model *tongiaki* corresponding with other contemporary estimates (Cook 1777: Pl. 16).[16]

Once mastered, these Micronesian-rigged *tongiaki* clearly outmatched the old Tangaloan-rigged ones, whose disappearance was no doubt speeded by conversion and inevitable reality that many of their hulls sailed on under the new rig. Indeed they seem to have been so satisfactory that, although demand clearly remained high in both Fiji and Tonga, there does not seem to have been much incentive to improve upon them until well into the 1790s, when the supply of metal tools picked up. Micronesian-rigged *tongiaki* very like those Cook encountered in the 1770s were accordingly met with at Tongatapu in 1792 and Vava‘u in 1793. Indeed, Mariner shot both steersmen from the sterns of what was probably one of the last of them shortly before his departure from Tonga in 1810 (see Fig. 13, Labillardière 1800: Pl. XXVIII, Martin 1818 [2]: 14). Their days were numbered, however. Demand for larger and larger canoes was beginning to challenge the rig’s working boundaries. And in contrast to the *hamatefua*—which was perfected by 1774 (see Fig. 12)—their performance was far from optimal, the Micronesian rig having evolved in tandem with outrigger-canoes, and they still being *tongiaki* from the washstrakes downward.

Accordingly, for all that they were more seaworthy than their predecessors and could surely beat much more effectively to windward under even brisk conditions, Micronesian-rigged *tongiaki* suffered all of their predecessor’s incapacity to head into rough seas without the hulls working against each other, weakening and ultimately disintegrating the canoe. The depth of this handicap can best be gauged by referring to Pâris’s discussion of the phenomenon and his descriptions of *kalia/drua*—which as a hybrid compromise between the outrigger and double canoe were much better suited to the rig—“carrying themselves very well” but “creaking in the most disconcerting way as soon as the waves get a bit lively”, so much so that the sounds could be “heard from afar” (1841 [1]: 115, 117, 121).

It is therefore not surprising that although some Micronesian-rigged *tongiaki* reached Melanesia by deliberate flight voyaging and in marauding *folau* flotillas, others drifted there in the old time-honoured way. Canoes derived from them continued to be built by descendant canoe-wrights in New Caledonia and Pentecost far into the 19th century, and derivative *hamatefua* lookalikes being recorded from New Caledonia northward to the western Solomons. They were, however, capable of getting back, for in 1852 New Caledonians told Mary Wallis that about a year after the visit of a Tongan canoe in about 1792–93, two more arrived “to teach them how to build canoes,

Figure 14. Tonga/'Uvea-derived New Caledonian Micronesian-rigged double canoes at Isle of Pines, 1853. The vessels are still on the very cusp of the change from Micronesian-rigged *tongiaki* to *kalia*, which was accomplished by the Lemaki in the late 1790s (Glen Wilson). Copyright: John Denham, London.

their countrymen having told them that their canoes were bad", and that the men and women aboard stayed for several years (see Fig. 11, also Dillon 1829 [II]: 112, Erskine 1853: 339-40, 353, Wallis 1994: 146, Haddon 1937: 8-12, Firth 1961: 109-21, Neyret 1976 [I], Lewis 1994: 301-3).

The demand for the canoes being produced by the Lemaki and other *mātaitoga* in Lau was so strong that already advanced Tongan embroilment and military adventurism there evidently surged over the final quarter of the 18th century, making it inevitable that, with the example of the *hamatefua* staring them in the face, the twin hull drawback would eventually be recognised and overcome (see Labillardière 1800, Wilson 1799).

Kalia*: Micronesian-rigged, Outrigger-hulled Canoes*

Kalia sail into history in 1799 with the notorious Tongan marauder Tu'ihalafatai and his followers, who, having murdered the Tui Nayau's brother, fled Lakeba with Niubalavu, his Tongan *mūala* 'navigator,' in hot

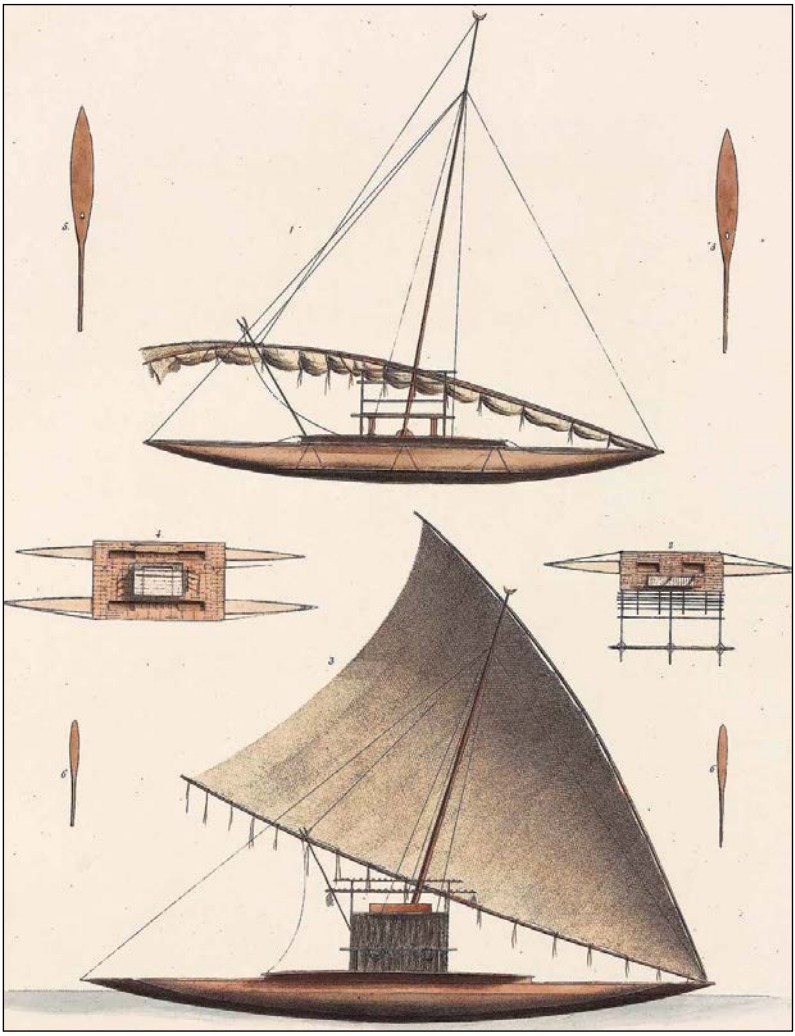

Figure 15. *Hamatefua* and *kalia*, Pâris 1827 (Dumont d'Urville 1833). Both conservatively retain the old *tongiaki* hull form. Copyright: Science Museum Library, London.

pursuit, "leaving their own canoes [Micronesian-rigged *tongiaki*] behind them, and coming away in the better formed ones of the Fiji Islands". The performance of these canoes, one of which was lost, confirms they were *kalia*. Lauan tradition records that in battling against a "fresh South Easter", Tu'ihalafatai shifted tack "seventy-seven times" in order to get home. Niubalavu, moreover, must also have been sailing a *kalia*, he arriving within hours of Tu'ihalafatai (Martin 1818 [I]: 70, Hocart MS.a).

Before proceeding to consider these phenomenal craft, because Fijian and Western Polynesian canoe classifications are invariably descriptive, it is worth considering whether the term *vaka-kalia* 'canoe-?' suggests that the Lemaki—who subsequently ramified and dominated production of large and incomparably prestigious *drua/kalia* in Fiji—masterminded their development. It might, because although Neyret was *sans doute* that *kalia* corresponded to Fijian *muakaria*—a prow cut off close to the point terminating in a small shield-shaped end—there is *doute*, this form of prow being *koso* 'cut down' in Tonga (Neyret 1976 [II]: 115, Rabone 1845: 144). Some *mātaitoga* evidently persisted in retaining the old pointed or "peaked" *tongiaki* prow—Fijian *muatovuga* (Hazlewood 1850)—into the 1820s (see Fig. 15). But the Lemaki had long since reconfigured the *katea-mata'u* of their *kalia/drua* and *hamatefua/camakau* by constructing them along much the same lines as a Tongan *tafa'anga*/Sāmoan *tafānga* fishing-canoe (see Fig. 10), fitting them with a vertically wedged cutwater prow at one end and tapering the other off to a *mu'akoso* (Fijian *muakaria*). Indeed, the cutwater prow—which in due course became standard on all sorts of canoes—was, among more mundane Fijian names, identified as *muanikabara* 'Kabaran prow', and even as *muanilemaki* 'Lemakian prow'. It might therefore be that the cutwater prow (*mu'akalia*?) shares something with the peculiar cliffed forehead of the bluff-browed *kalia* cum *ulurua* 'two head' parrotfish (*Bobometopon muricatum*), which, along with turtles and *tuitui* oil, was a first-fruits offering of the Rewan *gonenitoga* (Capell 1941: 83).

Neyret found that the Lemakian prow, as its cutwater form decrees, enables a canoe to sail closer to the wind than the snub-nosed *muakaria* prow does. In the event, however, very few canoes with twinned cutwater prows—Fijian *muavakadranibalawa* 'pandanus leaf-prowed'—were built, and the *muanilemaki-muakaria* combination prevailed. *Kalia*, however, were revolutionary enough, because in wedding a shorter and slighter *hama* hull of *tongiaki* type to a not so very much longer but more heavily built *katea* they had drastically reduced the double canoe handicap, thereby enabling the Micronesian-rig to fulfil its potential while retaining much of the stability and carrying capacity of a *tongiaki*.

Apart from that great breakthrough, although *kalia* surely included fittings that had developed earlier but passed unrecorded, they were otherwise more refined and streamlined than their immediate predecessor. Extrapolating backward from the first available illustrations of the 1820s with the advantage of later evidence: (i) the *kalia*'s deck-platform was more compact than its predecessor's, and provided with discrete bailing and lading hatches above each end of both hulls; the deckhouse remained unchanged, but the belaying-dog (Fijian *kalinidali* 'headrest for ropes') now stood upon two or three upright rather than four slanting legs and was elegantly rather than rustically formed. Whether or not they had yet been transferred from *hamatefua/camakau* as canoes grew in size, it also cannot have been too long before guiderails were run between the leeward corners of the platform and corresponding prows, and a low slung rail (akin to an early form of belaying-rail) run along the lee side of the deck to assist in shifting the sail.

The rig, too, had been simplified and improved. Because the *kalia* was now effectively an outrigger-canoe rather than double canoe, it was stayed like a *hamatefua/camakau* with a single set of running stays that slanted fore and aft to pass through their respective *ava'ituku* lugs at the prows of the leeward/*mata'u* hull before returning to the platform via a run of horizontally-bored *hau* 'leads' aligned along the weather side of the end-covers to the deck to be belayed to cleats on the deckhouse pilasters. These little drum-like leads precisely correspond with a contemporaneous form of kava-bowl suspension-lug particularly identified with a surviving cluster of very early early *tānoadina* 'true *tānoa*' *yaqona* bowls of a form hitherto exclusively associated with the Fatafehi. This is significant because it again places the Lemaki at the heart of *kalia* development, traditions indicating that they introduced *tānoadina* production to Fiji in the late 18th century (Clunie 1986: 172-73, Boissonas 2014: 372-73).

The double halyard system had been retained. But it had evidently been realised that the lower and heavier one effectively doubled as a shroud because the old tripartite shroud system had given way to: (i) a single *lopa* 'shroud' (Fijian *loba*) attached at the old point immediately below the masthead/mast scarfing, and (ii) a heavy new *tikitiki* 'upper shroud' (Fijian *i-sikisiki*) fastened just below the horns of the masthead and immediately above a pair of projecting ears, which prevented it from slipping down.

Insofar as size is concerned, *kalia* historically ranged between 12-33 m in length. Comparatively few of them, however, were longer than the big 22 m *tongiaki* of the 1770s, which Cook voyage observers agreed could effectively carry 80-100 men. The first great behemoth recorded—the 32 m Lemaki-built *Dranivia*, which caused a sensation—was on the stocks in 1829,

so presumably canoes 27 m and more long were being built from the early 1800s onward. Some *hamatefua/camakau* matched them in length. The huge 27–33 *kalia/drua* of the 1830s to 1860s of course made up the loss in carrying capacity by size. These huge canoes could certainly carry 150 to 200 adults, and some at a pinch 250 or more (Lawry 1825). It took a highly skilled crew of 40 to 50 to sail them, however. And they were so difficult to handle that Fijian chiefs of the 1840s were not only still reliant upon *mātaitoga* to build them, but employed Tongans to sail them.

* * *

The extraordinary speed and voyaging capabilities of these great craft—which now sailed with a single steering oar of similarly gargantuan length and weight—and their ability to beat to windward is well attested in contemporary records which contain convincing instances of large *kalia* slanting hour after hour at speeds of 15 to 16 knots across fresh winds, and similarly heading for hours within three points of them, thereby giving the lie to Lewis's assumption that because Micronesian outriggers habitually travel on "a good full and bye" though able to point much closer to the wind, double canoes and *kalia* did likewise (1994: 269). Indeed, Haley's description of how one of "these huge affairs" came up over the horizon and overtook the *Morgan* as she was battling close-hauled against a moderate gale of about 25 knots in 1852 shows just how they really performed.

> In two hours the canoe had overhauled us. She was abeam and not over a half-mile to leeward. This gave us a fine show to see her as she dashed through the seas, as much under as she did over them. Seeming not to heel over, she sent wreaths of foaming water by her sides, somewhat as a sled runner might dash light snow in running through it…. It was a pretty sight to see the thing dash by us with the mat sail swelled out to its fullest extent, the sheet and halyards tight as bars of iron, sending the long covered ends of the canoes half their lengths into the seas that they hardly raised to ride over, or cared for. On she went, gaining to the windward and ahead of us so much that… two or three hours after she passed us, the canoe was as far ahead as could be seen.… Our ship was a good sailor, and weatherly in heavy weather. During the time the canoe was in sight, the wind was steady. Our progress through the water could not have been less than six or seven knots. That craft must have sailed nine or ten knots and gone to windward besides. (Haley 1950: 251-52)

For all their superb design and vastly improved performance, however, *kalia/drua* still suffered from the age-old double canoe drawback, one who knew them particularly well confirming others in noting:

Figure 16. *Kalia/drua* of the combined Tongan and Fijian fleets shifting tack in rounding a reef to approach Ovalau. *Vunivalu* of Bau's *drua* in foreground on port tack with its *muanilemaki* cutwater prow half buried in sea preparing to shift tack, canoe at right in the middle of shifting tack, the obscured canoe just completing the manoeuvre, and the others tearing away on the starboard tack with their *muanilemaki* prows now astern, 1855 (Glen Wilson). Copyright: John Denham, London.

> They never sail except the wind is favourable, but should they be caught out at sea, which is frequently the case, the greatest care is taken to keep the swell on the quarter, for should a heavy sea be driven in between the canoes, there is great danger of the sennet lashings being forced off; the canoes parted, and as a matter of course wrecked. (Twyning 1850: 163)

Moreover, like their predecessors, they were at their most stable sailing close to the wind and grew ever more skittish as the wind passed behind the beam. Their worst point of sailing was running directly downwind when, if the wind was fresh, they by all accounts became dangerously unstable, the forward press of sail depressing the bows and preventing the steering-oars from biting properly, causing the canoe to veer unpredictably, be taken aback and even broach-to (see particularly Pâris 1843 [I]: 121-22). Also, as record after contemporary record testifies, even momentarily mishandled *kalia* were prone to being taken aback, breaking yard, mast and steering-oar and crippling or even killing steersmen. When things got really rough, moreover, they had no recourse but to strike sail, lower the mast and drift, baling furiously, struggling to prevent the hulls from being forced asunder, sculling desperately to work away from leeward reefs, and so on. In the time-honoured way, there is instance upon historical instance of canoes in sight of their destination being blown back whence they came or far beyond, breaking apart, drifting onto reefs, being lost with the loss of scores of lives or never being heard from again. There was nothing new in that, however, and the strategic and other advantages that they offered and created were such that until the 1860s *mātaitoga* flocked to Fiji to compete with the Lemaki and other resident *mātaitoga* (Jafau) to build them. Whereupon, with yet another Tongan invasion of Fiji well underway, the old Tangaloan wheel stopped turning, spiked by foreign political, commercial and religious interference.

On current rather than early 19th century knowledge, then, it is evident Martin got it wrong and apparent too that, although they were built in Fiji, these magnificent dinosaurs were no more Fijian *drua* than Tongan *hamatefua* were Fijian *camakau*. They were the end products of some 1300 years of Tangaloan embroilment in Fiji and Western Polynesia, during which autochthonous Melanesian canoes were crossed with intrusive Tangaloan ones to produce offspring which engendered others in an evolutionary progression which—between the 13th and 19th centuries, and with the benefit of a strong injection of Micronesian genes in the early to mid 18th—was largely driven by Tongan monopolisation of deep-sea voyaging enterprise, and Tongan exploitation and incorporation of principally Samoan canoe-building expertise, and the innovative adoption of precedents drawn from across the region.

GLOSSARY

Note: This listing defines a range of mostly maritime terms as they specifically apply to Tangaloan- and Micronesian-rigged canoes. It does not attempt to define maritime terminology more widely.

Aback: A sail is taken aback when it is accidentally blown back against the mast by a sudden wind shift or the momentary carelessness of the steersman or person tending the sheet.

Abaft: Behind, in or toward the after part, or stern, of the canoe.

Abaft the beam: To the stern or backward side of an imaginary line drawn across the middle (waist) of the canoe.

Aft: At or towards the stern.

Amidships: At the centre of the hull.

Athwartships: Across the canoe; from side to side.

Beam: The breadth of the canoe at the midpoint of the hull, its widest part.

Beat to windward: To work into the wind by repeatedly changing tack, thereby proceeding on a zigzag course.

Before the wind: To sail with the wind directly astern.

Belay: To "stop" and secure a tautened rope by twining it round a cleat or outrigger cross-boom (*kiato*) so that it can be readily released.

Bolt-rope: A rope folded into and sewn round the edge of the sail to prevent it from tearing. The sail ties connecting the sail to the spars are looped round it.

Boom: The spar to which the lower edge of the sail is attached.

Brail: To haul the boom up to the yard to shorten or truss up the sail.

Brailing-line: Rope fastened to the boom and passed over the masthead or yard to enable boom and sail to be brailed up to the yard.

Broach-to: To veer uncontrollably to windward or leeward when taken aback, thereby bringing the canoe broadside on to wind and sea, endangering mast and steering-oar and potentially capsizing.

Butt: The vertical end of a plank. To join butt-ended planks together end-to-end following the old, regularly laid Tangaloan hull planking technique.

Clamp: A vertically aligned strut running down the outside face of a deckhouse pilaster for line belaying purposes. The free ends of the running stays and sheet were belayed to these clamps.

Cleat: A strong stick lashed across and projecting out to either side of the lower part of the mast for brailing-line or halyard belaying purposes.

Cringle: A loop of rope formed at each upper corner of the sail's bolt-rope so as to slip over the top ends of yard and boom respectively.

Cross-beam: A beam spanning across the twin hulls of a double canoe to connect them together and support the platform.

Cross-boom: An out-rigged boom connecting the hull to the outrigger of an outrigger-canoe.

Deck: The platform laid over the cross-booms/beams above the hull. In a *tongiaki* or *kalia* it spanned both hulls.

End-cover: The long watertight boards (*tau*) covering each end of the canoe hull forward and aft of the washstrake-box upon which the platform is raised.

Fish: To secure the scarf joint connecting the masthead to the mast or that linking yard and boom components together by laying two or more long fish/fishing-pieces (reinforcing rods) across the joint and tightly woolding or binding the assembly together. Damaged outrigger cross-booms were sometimes strengthened in this way.

Fore-and-aft: Aligned between bow and stern, forward and backward.

Grommet: A tightly whipped rope ring attached to the foot of the yard, into which the foot of the boom was inserted.

Gunwale: Upper edge of the open canoe well. Applicable to Fijian and Western Polynesian paddling-canoes but not platform-surmounted voyaging canoes

Halyard: The rope(s) attached to the yard of a Micronesian-rigged canoe to support the sail and enable it to be raised and lowered.

Heel: The foot or lower end of a canoe mast or yard.

Jack-staff: A short detachable staff on which a flag or other emblem is flown.

Jibe: To swing the sail from one side of the mast to the other.

Keel: The strong hardwood spine (*takele*) upon which the hull was built.

Lee: The side opposite to that from which the wind is blowing.

Leeward: To or beyond the lee or downwind side.

Outrigger: Conventionally, the lattice and float assembly projecting out to the port side of an outrigger-canoe to stabilise it. Technically and historically, the *huasi* 'balance/rigging-beam/spar' that extended out beyond the side(s) of a Tangaloan-rigged canoe was also an outrigger.

Platform: See Deck.

Port: Historically larboard: the left-hand or outrigger (*hama*) side of the canoe, looking towards the bow.

Prow: The bow of the canoe.

Quarter: In terms of an approaching sea, between bow and beam, or beam and stern.

Rake: The slant of a mast.

Rig: The way in which mast, sail and rigging are arranged.

Rigging: The ropes and lines whereby mast and sail are secured and controlled. On European vessels, "standing rigging" supports the mast and "running rigging" moves and controls the sails. In Tangaloan and Micronesian-rigged canoes the stays and shrouds required constant adjustment, so all of the rigging was running rigging.

Scarf: To join the ends of two adjoining timbers by notching, halving, or sloping the ends to fit them together, thereby strengthening the joint.

Scull: To row by working and twisting an oar from side to side, rather than pulling it backward in the European way. Sculling is an old Asian technique.

Sheet: The long rope attached to the boom to control the sail's movement and alignment.

Shift tack: To transfer the tack/foot of the sail from one end of the hull to the other when tacking in the Micronesian way. This term is coined here because the popularised "shunt" (deviate?) does not properly define the procedure in English.

Shroud: The rope(s) extended to either side to provide lateral support for the yard of a Tangaloan rigged canoe or mast of a Micronesian-rigged canoe.

Sinnet: Flat braided or plaited cordage, usually but not necessarily composed of coir (coconut husk fibre).

Spar: Any pole used for rigging purposes.

Starboard: The right-hand side, looking towards the bow.

Stay: The rope(s) supporting the yard of a Tangaloan-rigged canoe and mast of a Micronesian-rigged canoe.

Step: Timber component upon or into which a yard or mast is stepped or heeled.

Strake: Technically a line of timbers extending from stem to stern in the sides of a hull. Historically, only the washstrakes of Western Polynesian voyaging canoes hulls were laid in so orderly a manner. Their hull components were otherwise irregularly laid and formed.

Stringer: A pole laid and fastened fore-and-aft across the outrigger cross-booms to brace the outrigger lattice. In *tongiaki* and *kalia*, the stringers underlay the cross-beams, otherwise they overlaid them.

Tack: The lower forward corner of a Tangaloan-type canoe sail (or any other fore-and-aft sail).

Tack: The course of a canoe in relation to the wind direction and alignment of its sails. A canoe is on the starboard tack when the wind comes across the starboard side, on the port tack when the wind comes across the port side. Double-ended Micronesian-rigged voyaging canoes always sail on the port tack.

Tack: To change tack by turning the bows of a vessel through or across the wind to bring the wind to the other side of its sail(s). Neither Tangaloan-rigged nor Micronesian-rigged canoes followed that procedure.

Taken aback: See Aback.

Thwart: A plank extended across the hull from side to side to provide a seat or serve as a step for the mast or yard.

Treenail: A long cylindrical pin made from hard, tough wood; used to secure the float of the outrigger to the cross-booms.

Washstrake: A washboard running along the upper edges of the hull, between wind and water.

Washstrake-box: The four-sided box upon which the cross-booms/beams connecting the hull to the outrigger or two hulls of a double canoe together were raised in order to carry the platform well clear of the water.

Wear: To change tack by turning the stern through or across the wind. Tangaloan-rigged canoes did this.

Windward: The side toward which the wind blows; the weather side.

Woolding: The rope(s) used to strengthen a damaged mast or spar or a scarf joint in a composed mast or spar by woolding (winding and binding) it tightly round and to either side of the affected area. The woolding encompassed any fish/fishing-pieces (reinforcing rods) spanning and reinforcing the joint or weak-point concerned.

Yard: The spar from which the sail is suspended.

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NOTES

1. Regarding the origins of Polynesian culture, Te Rangi Hiroa—who isolated the godly "Tangaloa period" of Samoan history from earlier and later eras (1930: 147)—usefully summarises historical recognition of the need to distinguish between so-called "Indo-Tangaloan", "pre-Tangaloan" and "post-Tangaloan" cultures (1944: 501-5).
2. Tu'i Tonga Paulaho told Cook that Fatafehi (*fata*: 'regal canoe', platform, litter; *fehi*: *Intsia bijuga*) was a pseudonym for Hikule'o (see Beaglehole 1967: 179, Wilson 1799: 276-77). Consistent with the chiefly practice of attaching a tutelary god's name to a personal one as a family name, individual Tu'i Tonga and their immediate relatives called themselves Fatafehi (Beaglehole 1967: 950). As a spiritual abode of Si'uleo and Hikule'o, the bloody-hearted *fehi* tree (Fijian: *vesi*) was sacred to Tu'i Tonga, Tuifiti/Tu'i Fisi of Samoa and Tonga, and Degei in Fiji. *Fehi* wood was accordingly confined to godly/chiefly usage.
3. Fijian *muala* 'navigator' is cognate with Tongan *moala*, the title of Mariner's "Cow Mooala", *toutai* 'navigator' and canoe-wright of the Tu'i Kanokupolu (Gifford 1929: 150). The following provides an interesting insight: Niubalavu, a son of Tu'i Kanokupolu Mumu'i (died 1797), who was serving as the Tui Nayau's *muala* at Lakeba before Kau Muala first ventured to Fiji in the 1790s, was still there in 1830, when Twyning (1850) was befriended by "a Tongataboo chief named Maula Newballave, signifying Captain Long Coconut,… who gave me the name of Maula-tare, i.e. the White Captain" [*mualatani* 'foreign navigator']. The post evidently became hereditary, Hocart (1929: 54) noting that "One Tongan" at Tubou "bears the title of Moala, which is said to mean navigator".
4. Although the *mātaisau*-derived *mātai* came to mean 'carpenter' in Fiji, the autochthonous equivalent of Tangaloan *tufunga* was *dau* 'expert practitioner', which was used alongside or in lieu of *matāpule/matāvule* in such hybrid combinations as *tūdau* or *tūnidau* 'chief expert', which in turn relate to Samoan *tū* 'to stand' (Tongan *tu'u*), *mātaitū* 'chief carpenter' and *lātū* 'head-builder, leader of an undertaking'. *Lātū* was a chiefly title in Tonga, and occurred as *rātū*, a title pertaining to some *kalouvū* founder-gods and their descendant chiefs in Fiji. *Mataisau* 'expert craftsman' also occurs in the Polynesian outlier languages of Mele, Vanuatu, and Rennell and Bellona, Solomon Islands (Clark 1998: 40, Elbert 1975: 174).

5. Osborn's "fire pan" incident corresponds with a Cakaudrove tradition in which, having been bested in war by Degei, Dadakulaci and Dakuwaqa (Semoana) fled Nakauvadra with "their son, together with many of his people" aboard the "*Lamipela*" or *Lolopeau* , a gigantic *drua* which was forced to jettison its "fireplace, bringing up the island of Naigani", to escape being swamped by a "mighty sea" whipped up by Degei, who subsequently capsized the canoe. Dadakulaci/Dakuwaqa, however, hauled up Taveuni Island to save his/their protégé (Gardiner 1897: 190). This identifies the *Lamiela/Lolopeau*—one of two gigantic double canoes that reputedly brought Degei and the *kalouvū* to Fiji—with the legendary *Lomipeau* of Tongan and 'Uvean tradition, the jettisoned hearth of which "became a new island, with the oven forming a volcano" (Pollock 1996: 439). These accounts are echoed by another one in which the eldest son of Rokomautu of Verata threw the contents of his "fireplace" overboard at Naigani during a hurricane (Ramoli and Nunn 2001: 19). The canoe-hearth transmogrifies into a casket of graven stone tablets in the biblically affected tradition Thomson's clerk, Ilai Motonithothoka alias Denicagilaba 'Hurricane-shit', concocted for him in 1894 (see Thomson 1908: 6-9).
6. Ancestral Polynesian migration from Indonesia via Micronesia has been postulated since the 18th century by, among others, Wilson (1799: lxxxv-vi), Hale (1846), Gifford (1924: 8-9), Hiroa (1938: 40-49) and Howells (1973). Hale's (1846: 195-96) identification of Western Polynesian and Fijian Pulotu/Burotu with Buru Island in the Moluccas (Maluku, eastern Indonesia) is compellingly supported by northern Kiribati traditions concerning ghostly chewing of *te renga* 'the mixture' (betel) at the ancestral spirit island of Bouru (Grimble and Grimble 1972: 242-45). For a competing range of currently conflicting viewpoints, see Burley 2013.
7. To cite a simple instance: I once saw no reason to question the established view that Tongans did not use war bows until the late 18th century, understanding that they told Cook voyagers how discomfited they had been by Fijian war arrows, and that they understood Tongans did not use war bows, but that war bows had come into use by the early 1800s (Clunie 1985). It transpires, however, that their informants had been recalling historical encounters with war bows and arrows in Fiji and had long since adopted them. Some of the men who repelled Cook at Niue in 1774, for instance, were armed with bows (Forster 1982: 53-58). Also in 1774, Sparrman mentioned that Tongan warriors demonstrated "how they would loose the arrows from their bows at a distance of thirty or forty paces" before closing with their adversaries (1953: 96).
8. Neyret gained extensive canoe voyaging experience as a missionary in Fiji in the 1930s–40s. *Pirogues Océaniennes* (1976) was serialised earlier in *Triton* supplements to *Neptunia* (1961–68), and earlier articles, most notably Neyret 1950.
9. The natural range of *fehi*, which occurs between Madagascar and Western Polynesia, remains indeterminate. *Fehi* may, however, be a Tangaloan introduction to Fiji and Western Polynesia. Whistler considered "it such a useful tree that it would have been introduced to Polynesia if it weren't there originally", and thought it likely to be "a naturalized ancient introduction" to Samoa and Tonga (2009: 137-38, 1991: 29). The presence in Fiji of sacred groves of *vesi* associated

with Degei, and tradition that *vesi* sprang up "wherever any [*mātaisau*] canoe grounded" (Waterhouse 1866: 358), suggests *fehi* may have been deliberately planted at suitable locations during the 16th century Fatafehi invasion. A sacred *ifilele* grove dedicated to Tuifiti similarly occurred at Savai'i (Turner 1884: 63), another to Tu'i Fisi at Ha'avakatolo, Tongatapu (Collocott 1921a: 232).

10. Tongan *vū* 'tack or foot of sail' is cognate with Fijian *vū* 'tack or foot of sail', 'origin, bottom, basis, root', and with wider Polynesian *pū*/*fū* 'origin, cause, source, foundation, base, foot', etc. This old Tangaloan term is thus indisputably cognate with Fijian *kalouvū* 'founder-god' and *vū* 'founding-ancestor of a chiefly lineage'.
11. This peculiar Tangaloan motif (Hornell 1936: 316-17, figs 233-34) likewise graced the heads of certain Fijian *i-vutu* 'pudding-pounder' handles (Clunie 1986: 36-37, fig. 56, 151-52). It also occurred in New Zealand—where the form was recognised as an amulet of Rongo (Hawaiian Lono), the primary Eastern Polynesian weather and crop fertility deity, and a representation of the crescent moon—on the heads of ritually-associated digging-stick and canoe paddle hafts (Best 1925: 166, fig. 120; see also, wider discussion in Clunie 2013a: 200-1).
12. The presence of this elaborate running-rigging system confirms that *tongiaki* rigging lines, like those of their Micronesian-rigged descendants, consisted of very tightly laid up ropes composed from strands of twisted *fau* (*Hibiscus tiliaceus*) and similarly long-stapled fibres, rather than short-stapled braided *kafa* 'coir-sinnet'. *Kafa* is good for lashing because it catches and locks up. *Fau* is good for running tackle because it is smooth and supple.
13. Fijian terms applying to these rails include *i-vāvādā*, *i-vāvādawa* (*dawa* = Western Polynesian *tava* [*Pometia pinnata*] a timber much used in canoe-building), *kauniuli* 'steering-oar strut' and *lutunivū* 'drop-of-the-tack'.
14. 1 point = 11¼°; the mariner's compass historically contained 32 points. The modern compass is divided into 360°.
15. For clear contemporary descriptions of the tack-shifting manoeuvre, see Elliot (MS.), Williams (1858: 1855–57) and Thomson (1908: 294). For illustrated descriptions, see Neyret (1950: 14-18), Gillet (1999); Kooijman (1999).
16. A 26 m long canoe seen in 1792 (Labillardière 1800: 356) is most probably indicative of size growth encouraged by the introduction of wrought iron and steel-edged tools.

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ABSTRACT

This article draws upon a wide ranging combination of historical traditions, documentary history and archaeology to demonstrate that Tangaloan-rigged Tongan *tongiaki* and *hamatefua* voyaging canoes were of mixed autochthonous Melanesian and intrusive Tangaloan descent, and that the Micronesian-rigged *drua/kalia* and *camakau/hamatefua* voyaging canoes which succeeded them in Fiji and Western Polynesia were developed from them as an outcome of Tongan adoption of the Micronesian rig in the 18th century, and the corresponding transfer of voyaging canoe construction from Samoa to Fiji.

Keywords: Tangaloan rigging, Micronesian rigging, autochthonous Fijian, Melanesian hulls, Tongan/Fijian gods

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[1] Corresponding author: Sainsbury Research Unit, Sainsbury Centre For Visual Arts, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ, United Kingdom. Email: sfclunie@gmail.com

PACIFIC COLONISATION AND CANOE PERFORMANCE: EXPERIMENTS IN THE SCIENCE OF SAILING

GEOFFREY IRWIN
University of Auckland

RICHARD G.J. FLAY
University of Auckland

The voyaging canoe was the primary artefact of Oceanic colonisation, but scarcity of direct evidence has led to uncertainty and debate about canoe sailing performance. In this paper we employ methods of aerodynamic and hydrodynamic analysis of sailing routinely used in naval architecture and yacht design, but rarely applied to questions of prehistory—so far. We discuss the history of Pacific sails and compare the performance of three different kinds of canoe hull representing simple and more developed forms, and we consider the implications for colonisation and later inter-island contact in Remote Oceania.

Recent reviews of Lapita chronology suggest the initial settlement of Remote Oceania was not much before 1000 BC (Sheppard *et al*. 2015), and Tonga was reached not much more than a century later (Burley *et al*. 2012). After the long pause in West Polynesia the vast area of East Polynesia was settled between AD 900 and AD 1300 (Allen 2014, Dye 2015, Jacomb *et al*. 2014, Wilmshurst *et al*. 2011). Clearly canoes were able to transport founder populations to widely-scattered islands. In the case of New Zealand, modern Māori trace their origins to several named canoes, genetic evidence indicates the founding population was substantial (Penney *et al*. 2002), and ancient DNA shows diversity of ancestral Māori origins (Knapp *et al*. 2012).

Debates about Pacific voyaging are perennial. Fifty years ago Andrew Sharp (1957, 1963) was sceptical about the ability of traditional navigators to find their way at sea and, more especially, to find their way back over long distances with sailing directions for others to follow. To Sharp the obvious answer was island settlement by one-way voyages and accidental discoveries. Interestingly, navigational ability is no longer in contention after the ethnographic and experimental work of scholars and sailors (Finney 2006, Gladwin 1970, Lewis 1994); however, the capability of canoes is still in question (Anderson 2000, 2001, 2015, Anderson *et al*. 2014).

There has been on-going discussion about sailing conditions in the colonisation period and whether ocean routes were easier to traverse at times in the past than they are now. Bridgeman (1983) suggested that climatic change from the Little Climatic Optimum to the Little Ice Age could have

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influenced migrations, and Finney *et al.* (1989) suggested that colonising canoes could have used the anomalous westerly winds of El Niño to sail east. Anderson *et al*. (2006) pointed to the correspondence of ENSO events with eastward migrations attested archaeologically; however, their further suggestion that prehistoric canoes were restricted to downwind sailing is one we wish to investigate. Recent research on climate change by Goodwin *et al*. (2014) shows there were 20-year windows when reversals in prevailing winds coincided with the first settlement of Easter Island and New Zealand, which could have been settled by downwind sailing at those times. They also argue that all of the known colonisation routes of East Polynesia could have been negotiated by canoes lacking upwind capability. This can be regarded as a useful null hypothesis we consider below.

Another recent study by Bell *et al*. (2015) used epidemiological methods to compare four different colonisation theories in a single statistical framework. The results suggested that the two most likely strategies were for migrants to seek accessible islands, but not necessarily the nearest islands, and to travel mostly against prevailing winds on outward exploratory journeys to allow a safer return from failed searches (Irwin 1992). Distance was not a factor, suggesting early seafarers were already adept at long-distance travel.

More information about canoe performance is required to understand colonisation as a process and the nature of subsequent interisland voyaging. Several important questions depend upon the greater or lesser sailing capability of the canoes:

- To what extent was colonisation based on one-way or return voyaging? The former characterised more by voyages of exile and the accidental discovery of new islands, and the latter involving exploration followed by migration to known destinations?
- To what extent was colonisation a strategic process that minimised risk of loss of life at sea, or did one-way voyages into the unknown result in more collateral damage?
- To what extent was colonisation influenced by technological capacity, or by natural forces such as wind direction and climate change?
- To what extent were canoes capable of interisland voyaging after settlement?

Until now, our main sources of information about sailing canoes have included historical linguistics (Pawley and Pawley 1994), archaeological evidence of canoe remains (Irwin 2004, Johns *et al*. 2014, Sinoto 1979) and prehistoric interisland trade (McAlister *et al*. 2013). There is a rich historical literature from early European sailors, who sometimes spoke and sailed with Polynesians (Haddon and Hornell 1997, Salmond 2005). Ethnographic

studies of surviving indigenous navigation and technology from around the Pacific provide useful information (Gladwin 1970, Lewis 1994), and there have been many experiments at sea in diverse boats including modern yachts, contemporary Pacific canoes, and quasi-replica canoes built of modern materials (Finney 2006). In addition, large numbers of virtual voyages have been made by computer (Avis *et al.* 2007, Irwin 2010). To these sources we add wind tunnel testing of model sails (Di Piazza *et al.* 2014, Jackson and Bailey 1999, Marchaj 1987, 1990), and computational fluid dynamics and towing tank tests of canoe hulls (Boeck *et al*. 2012, Flay 2013).

UPWIND *VERSUS* DOWNWIND COLONISATION MODELS

We need to clarify a semantic issue which arises in canoe performance debates because *upwind* and *downwind* (sometimes referred to as *off-wind*) are terms used in different ways with different meanings. On one hand, they can indicate general directions in the ocean which relate to the prevailing wind direction. On the other hand, they can indicate the direction in which a canoe is heading in relation to the wind, in real time. Figure 1 concerns the second meaning and shows terminology for conventional points of sail. When a boat is heading between 0˚ and 90˚ it is in an *upwind* mode (going against the wind); but when it is heading from 90˚ to 180˚ it is going *downwind*. No boat can sail directly into the wind and no informed scholar suggests prehistoric Pacific voyaging canoes could sail within 75˚ from the wind, so that zone is shown as *no-go* in Figure 1. When a boat is sailing with the wind coming from the side it is in a *reaching* mode. In the diagram a *beam reach* is distinguished from a *broad reach*, which refers to wind coming from aft of the beam. Beyond approximately 150˚a boat is said to be *running* with the wind from behind. We have taken the cut-off between reaching and running at around 150˚ because that is where speed declines and, in a boat with two sails, the front sail would be blanketed by the rear one and no longer fill with wind.

Relating those directions to theories of sailing performance, Lewis (1994), Finney (2006) and Irwin (2006) all believe ancient Polynesian canoes could reach and run (sail between 75˚-180˚ from the wind). Goodwin *et al*.'s (2014) model identifies an off-wind sailing vector directly downwind plus a margin of ± 30˚ (150˚-180˚). Anderson has suggested that Māori, and perhaps Marquesan, canoes could have been hard-pressed to maintain a broad reach especially in gusty conditions (Anderson 2001: 33), but if they could manage a broad reach in suitable conditions, the sailing range would be approximately 120˚-180˚. Figure 1 shows the difference between so-called upwind or downwind models could be misleading. What has been referred to as an upwind model actually comprises only 15˚ upwind (75˚-90˚) plus 90˚of downwind sailing (90˚-180˚). The disputed area of the wind rose in

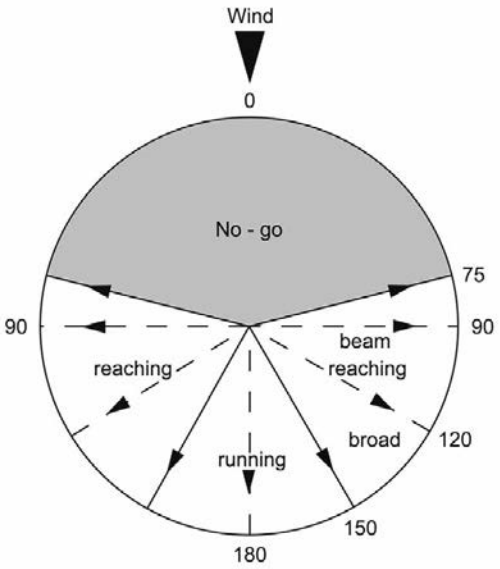

Figure 1. A wind rose shows conventional terminology for points of sail. No current theory proposes that canoes could voyage closer than 75˚ from the wind, but there is debate about whether canoes could sail between approximately 75˚- 120˚ from the wind.

Figure 1 is approximately 45˚ (75˚-120˚), and it would be more correct to define the debate as between predominantly reaching and running models.

The issue might seem trivial, but for the fact that the different points of view are associated with the difference between one-way and two-way voyaging and different models of colonisation follow. Theories about sailing capability of this order warrant scientific measurement and, as it happens, there is an established science of sailing.

EARLY EAST POLYNESIAN AND NEW ZEALAND SAILS

We needed to reconstruct appropriate sails for testing in the wind tunnel and chose the Oceanic spritsail, which was widespread in East Polynesia when Europeans first arrived, and we make the case that it was the earliest form in marginal East Polynesia. The Oceanic spritsail is classified as a fore-and-aft sail which takes the wind from both sides, alternately, and is suited to reaching and running. Typically it had a V-shape with two spars, one stepped on the

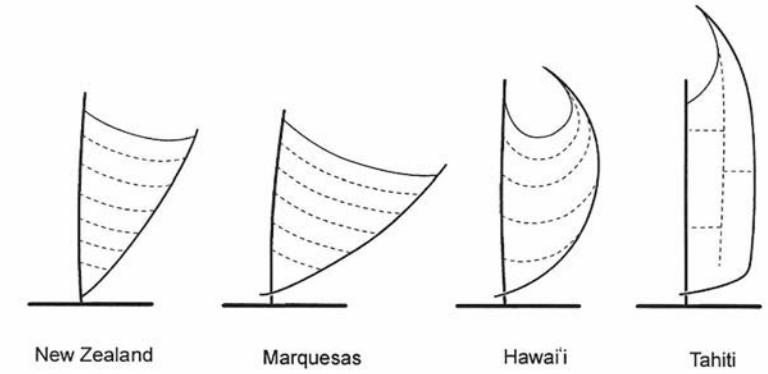

Figure 2. Schematic sketches of oceanic spritsails in New Zealand, the Marquesas, Hawai‘i, and Tahiti in the 1770s (Haddon and Hornell 1997, Irwin 2008). The leading edges of the sail are to the left and trailing edges to the right. Details of standing and running rigging are not shown because the original artists' drawings may be unreliable.

canoe, like a mast, and a trailing spar attached to the bottom of the leading one, trimmed as the canoe sailed at different angles. Figure 2 shows various two-spar rigs recorded at the time of European contact in New Zealand, the Marquesas, Hawai‘i and Tahiti (Haddon and Hornell 1997), although there is debate about the detail of the Māori sail (below). Often complete rigs—spars and sail—were put up and taken down together, as in New Zealand, but by historic times in Tahiti they were sometimes attached to standing masts.

The spritsail could have been the first sail type to reach East Polynesia because it was the only one known to reach the marginal islands of Hawai‘i, the Marquesas and New Zealand, which were settled early and then isolated in later prehistory. Subsequent introductions or innovations in central East Polynesia did not reach the marginal islands. Thus, there was some common ancestry among sails in marginal East Polynesia, but later divergence in isolation on different islands. Basic elements shared by these widely distributed sails observed at the time of European contact can be used to inform us, in a general way, about possible ancestral sails.

There is substantial evidence of early historic sails in New Zealand. A Māori sail in the British Museum, possibly of pre-European age and thought to have been collected by James Cook, is shown in Figure 3. It is made of plaited flax and trimmed with feathers, and it measures 4.40 m high, 1.91

Figure 3. A Māori sail in the British Museum (Oc, NZ. 147), attributed to collection by a Cook expedition. There are loops down both sides of the sail for attachment of two spars, which would intersect below the sail. The leading edge of the sail is to the right and the pennant is attached to the trailing edge on the left, where it served as both a decoration and a "tell-tail". This sail could have been collected because it is particularly ornate.

m wide at the top and 0.34 m wide at the bottom. The spars are missing, but loops along both sides show they could have intersected below the bottom of the sail, which could have been rigged as an Oceanic spritsail. A pennant or "tail" of plaited flax 1.05 m long and 0.20 m wide, with feather trim, was attached to one side near the top. It may have been a decoration that also helped the sailors to trim the sail effectively.

A detailed plan of a Māori canoe with a spritsail was made by Pâris during Dumont d'Urville's expedition in 1827 (Dumont d'Urville 1833), but there were much earlier written descriptions and less formal drawings of sails from the Cook expeditions dating from 1769. Two early written descriptions are unambiguously of triangular Oceanic spritsails. The first refers to an encounter on 1 November 1769, near Whale Island in the Bay of Plenty, between the *Endeavour* and what Banks described as "… a large double canoe, or rather two canoes lashed together" (Beaglehole 1962: 368). The sail is described in the ship's journal attributed to Magra (Frost 1995: 82, from Magra [Matra] 1771), as:

> a sail of an odd construction,… made from a kind of matting, and of a triangular figure; the hypothenuse, or broadest part, being placed at the top of the mast, and *ending in a point at the bottom*. One of its angles was marled to the mast, and another to a spar with which they altered its position according to the direction of the wind, by changing it from side to side (our italics).

On Cook's second voyage, Forster described a sail seen in Queen Charlotte Sound in June 1773: "The sail consisted of a large triangular mat, and was fixed to a mast, and a boom *joining below in an acute angle*, which could both be struck with the greatest facility" (Best 1925: 254, [our italics]).

Figure 4 is a drawing by Spöring of the Whale Island canoe. It shows an upright triangular sail similar to, but larger than, the British Museum sail shown in Figure 3. It is filled with wind from behind and has two spars each supported by a running stay leading forward, and by a sheet leading aft. Magra had the opportunity to see the whole sail and his description is consistent with an Oceanic spritsail. However, Anderson has suggested that the two spars were attached separately to the canoe, unlike the fore-and-aft rig of an Oceanic spritsail, and that the first Māori sail seen by Europeans was misinterpreted by them and could have been some archaic quadrangular form that survived in New Zealand (Anderson *et al*. 2014: 29, 504, Anderson and Boon 2011). This proposition is conjectural because the bottom of the sail is partly concealed in Spöring's drawing and the attachment of the spars is not shown. We are not aware of such a sail recorded by early Europeans elsewhere in marginal East Polynesia and we doubt its existence in New Zealand. We think the early sails drawn and described would have set satisfactorily as

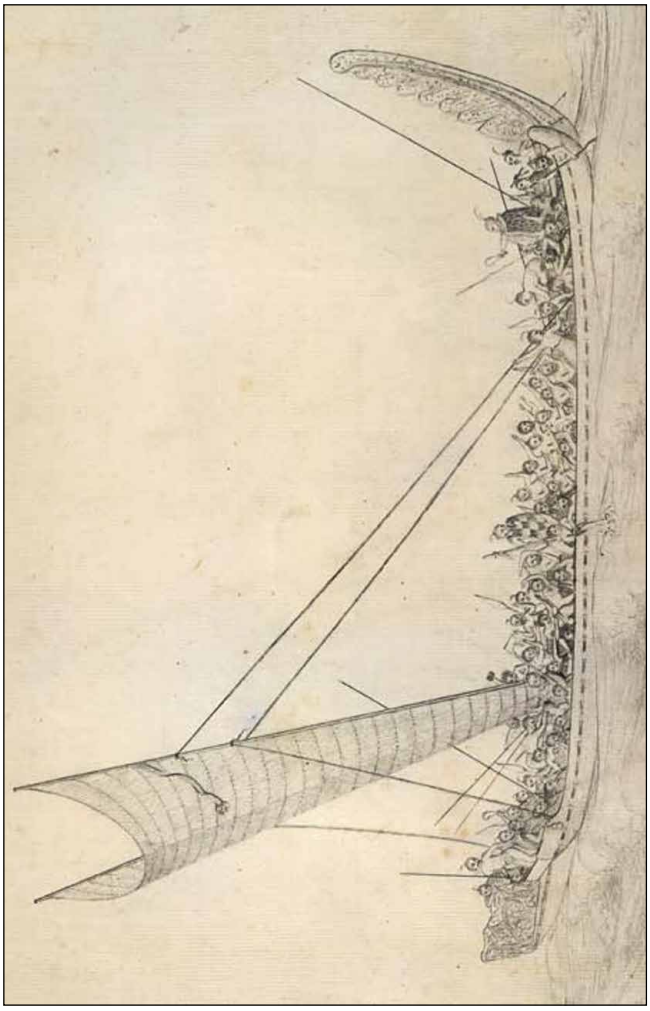

Figure 4. Spöring's drawing of a double canoe seen at Whale Island in November 1769 (Add. MS 23920 f.48, British Library). The two hulls are forms often seen as single canoes; the longer hull (at rear) is a *waka taua* 'war canoe', and the shorter undecorated hull (foreground) is a type described as a fishing or travelling canoe by Haddon and Hornell (1997). Early Māori sails were triangular in shape with apex down and had two spars.

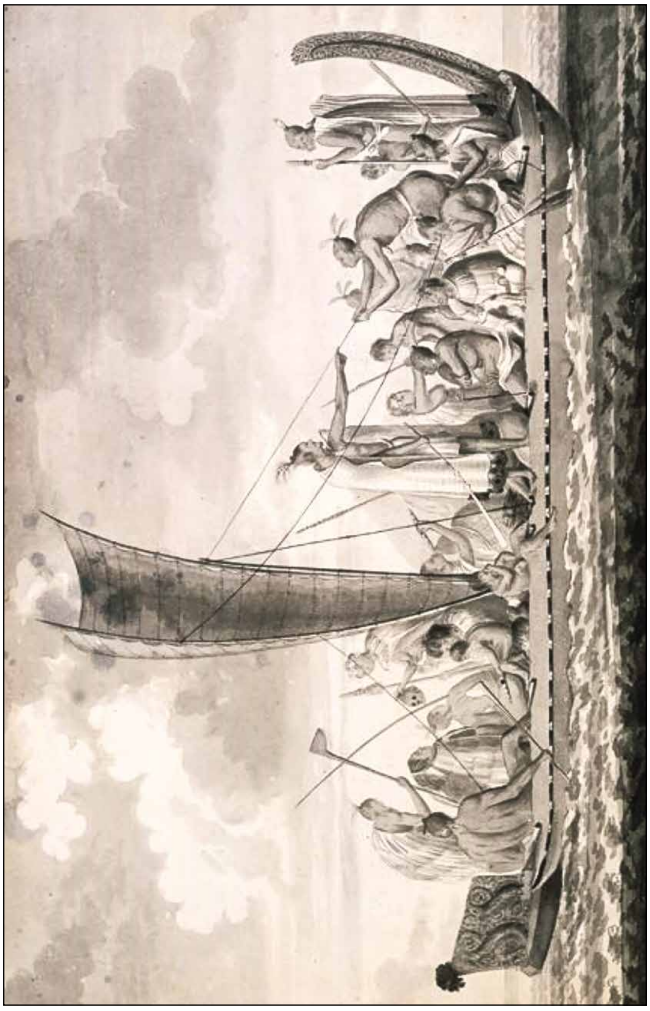

Figure 5. A New Zealand Māori canoe drawn by Sidney Parkinson in 1770 during Cook's first voyage (Add. MS 23920 f. 49, British Library)

spritsails, but not with two spars lashed separately to the hull. While it might work as a makeshift arrangement for running downwind, it would set badly on a reach, and sometimes need a means—such as a third spar—to hold the other two spars apart.

Early historical sketches can be ambiguous because they show sails and spars in different configurations according to the direction of the boat in relation to the wind, which makes it possible to misinterpret different *points* of sail as different *types* of sail, which could explain this issue. Also, unlike photographs, they may not accurately record every detail, particularly of ropes and rigging, and the drawings may have been finished after the event. The point is illustrated by a drawing of a Māori canoe made by Parkinson in 1770, also on Cook's first voyage to New Zealand, shown in Figure 5. This may not have been made of an actual canoe, but drawn from Parkinson's general observations. It shows an upright triangular spritsail, similar to other contemporary Māori sails, but it depicts a mast that Parkinson more likely saw in Tahiti than in New Zealand.

PACIFIC CANOES AND THE SCIENCE OF SAILING

Sailing boats conform to the laws of physics and there is a well-established science of sailing (Garrett 1996). There are known forces at work as shown in Figure 6. Prediction of sailing performance requires analysis of both sails and hulls and here we describe three stages of the first phase of testing at the University of Auckland.

1. The aerodynamic performance of three selected model sails was tested in a wind tunnel.
2. The hydrodynamic performance of three different model hull forms, taken to represent diversity of Pacific canoes, was tested in a towing tank, and independently by computational fluid dynamics (CFD).
3. By combining this information we were able to compare the speed of three different kinds of canoe in varying conditions of wind speed and direction of travel by using a velocity prediction program (VPP).

Aerodynamic testing

Early wind tunnel experiments by Marchaj compared six different sailing rigs from around the world and revealed the high performance of the "crab claw rig" of the Pacific (Marchaj 1987, 1990). In 1992 a model based on a detailed sketch of a Marianas "flying *proa*" made in 1742 during Anson's circumnavigation was tested in a wind tunnel at the Yacht Research Unit at the University of Auckland and reported by Jackson and Bailey in the proceedings of the *Vaka Moana Symposium 1996*, sponsored by UNESCO, the University

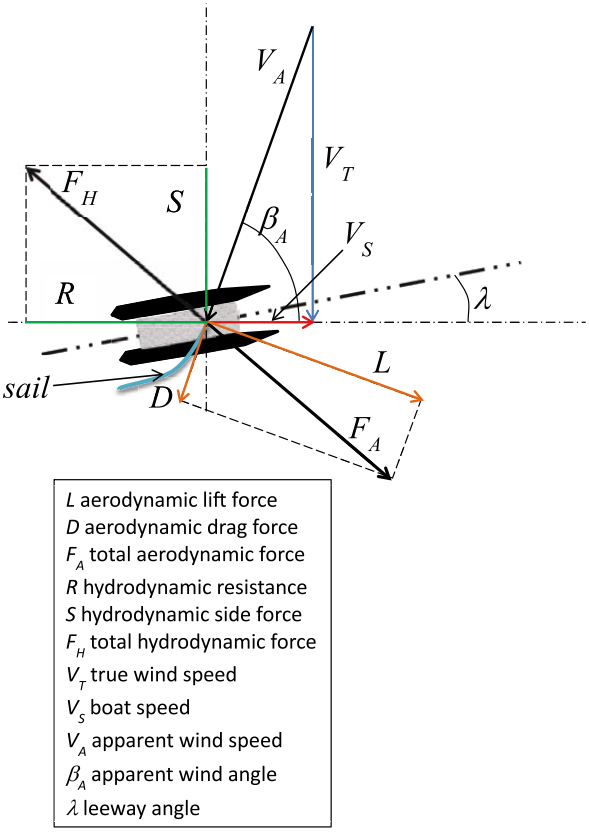

Figure 6. A diagram showing the various aerodynamic and hydrodynamic forces on a Pacific sailing canoe. The apparent wind angle is the angle between the vessel's heading and the wind direction experienced by the vessel. Stages of performance analysis involved (1) testing selected model sails in a wind tunnel (2) testing model hulls in a towing tank and by computational fluid dynamics (CFD), and (3) calculating the speed of different canoes in varying conditions of wind speed and direction of travel using a velocity prediction program (VPP).

of Auckland and the New Zealand National Maritime Museum (Bader and McCurdy 1999). In 2003 Jacobs wrote an Anthropology Master's thesis on mathematical modelling of Oceanic canoe performance using Jackson and Bailey's results, beginning a collaboration of archaeologists in the School of Social Sciences and engineers from the Yacht Research Unit, which has focussed on canoes of the pre-European era.

In 2008 a 1/5th scale model of a 14 m canoe was designed from ethnohistoric sources by Irwin and Flay and built by R. May (2008) for wind tunnel testing (Fig. 7). It could be set up as a double canoe, a canoe with double outriggers, or with a single outrigger set either to windward or leeward. The sail followed the triangular form of the Māori sail, with similar proportions to the Cook sail shown in Figure 3, but adding some curvature to the trailing

Figure 7. A model canoe in the Twisted Flow Wind Tunnel at the University of Auckland in 2008. In this experiment a 2.8m hull was set up as a single outrigger canoe with a triangular *pandanus* sail 1.74m high, 0.71m wide at the top, and with a curvature 120mm deep added as an arc to the trailing edge. The model was rotated on a balance which measured forces and moments at 10˚ intervals and "tell-tails" attached to the sail allowed the trim to be controlled remotely by miniature electric winches. Data were recorded by computer and cameras.

edge, as seen elsewhere in East Polynesia. The sail area was modest and represented the equivalent of 18.5 m^2 on a 14 m canoe, set with the top of the sail 10 m above sea level. One focus of the experiment was on sail material and two sails were made to the same design, one of modern dacron sailcloth and another from a finely-woven pandanus (*Pandanus tectorius*) mat. The sails were set up on bamboo spars. We also made a smaller pandanus sail, to investigate the influence of sail size.

The model was mounted on a balance embedded in a turntable in the Twisted Flow Wind Tunnel at the University of Auckland. The model was tested at angles to the wind between 30˚ and 180˚, at 10˚ intervals. The sail trim was adjusted by small electric winches on the model using tell-tails on the sail to get the trim resulting in the largest driving force. The data were recorded by computer and cameras recorded the shape of the sail. Here we describe results with the leading spar set at a rake of around 10˚ and with a single windward outrigger. Figure 8 shows the driving force coefficient (*Cdf*) as a function of the apparent wind angle (*AWA*) for the three sails. The dacron sail performed slightly better than the pandanus sail up to a wind angle of around 110˚ but thereafter was much the same. We also recorded

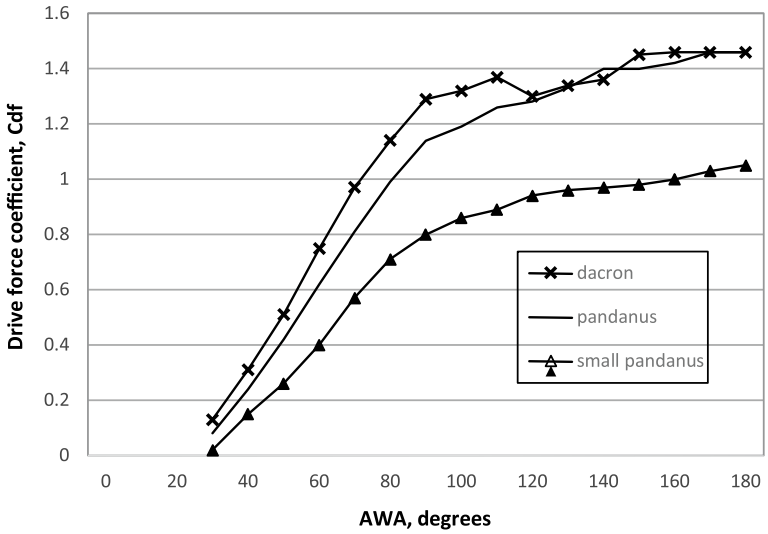

Figure 8. The driving force coefficient (*Cdf*) plotted against the apparent wind angle (AWA) for three sails—dacron, pandanus and small pandanus.

the side force coefficient (*Csf*) and the rolling moment coefficient (*Crm*), as functions of the *AWA*.

We can tentatively compare these results with wind tunnel tests of ten traditional rigs by Di Piazza and colleagues (2014), based mainly on scaled drawings by early Europeans and chosen to represent the diversity of sails across the Pacific. Their study found Oceanic lugsails of the western Pacific (Ninigo, Massim and Arawe), together with the Oceanic lateen of Santa Cruz, to be most efficient, especially at low heading angles. There was variability among the remaining Oceanic lateens and Oceanic spritsails (Di Piazza *et al*. 2014: 20). In addition, the "Marianas *proa*" of Jackson and Bailey (1999) was found to be consistent with their Oceanic lateens. Although different methods and materials were used, our dacron and pandanus sails appear to be of a similar order to some of their lateens and spritsails. Subsequently, further experiments have been conducted at the Yacht Research Unit with the pandanus sail set at different angles of rake.

Hydrodynamic testing

Pacific canoe hulls are long and narrow, and have no keels. Stability is provided by outriggers attached by booms. They provide a *righting* moment that offsets a *rolling* or *overturning* moment, and linguistics dates outriggers of some form to Lapita times (Pawley and Pawley 1994). When lifted from the water their weight rotates them back to the surface, and when pushed down into the water their buoyancy restores them to the surface. They have been described as the world's oldest feedback mechanism and in this sense the double canoe is a member of the outrigger family, and it is immaterial which developed first (Abramovitch 2005). Roll stability is fundamental because it allows sailing with the wind coming from the side as well as from behind.

The earliest canoes probably had round hulls from trees; however, time and experience of manoeuvring across the wind would have influenced canoe design. In order to reach or sail upwind a sail must develop sufficient driving force in the desired heading, and the aerodynamic side force which comes with the driving force has to be balanced by hydrodynamic lift. In the absence of keels, hydrodynamic side force had to be generated by the hulls. By ethnographic times there was a diversity of underwater hull profiles and we envisage an evolution of sectional form from U-shape to V-shape as the latter are better able to generate side force.

The relationship of sailing performance and sectional shape of narrow hulls has been investigated in the Yacht Research Unit with computational fluid dynamics (CFD) (Boeck *et al*. 2012), and towing tank tests by Flay at Newcastle University (Flay 2013). Model shapes were investigated in the

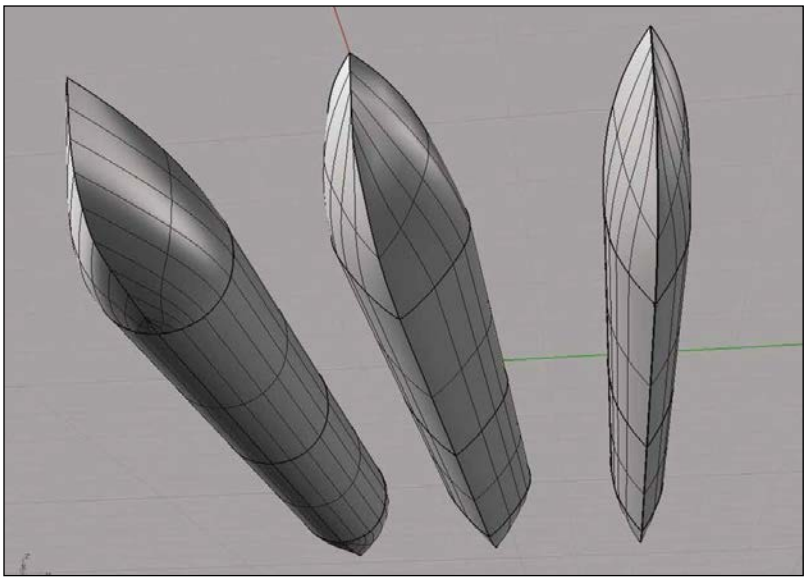

Figure 9. Underwater profiles for three symmetrical canoe forms, U, V1 and V2 representing the diverse canoe hulls found in the Pacific at European contact (adapted from Boeck *et al*. (2012).

towing tank at a scale of 1:10 representing canoes 12 m long and 1.2 m wide. Figure 9 shows three models, a U-shaped design, a moderately V-shaped design V1, and a highly V-shaped design V2. Predictions of lift and drag were made at leeway angles of 0˚, 5˚, 10˚ and 15˚. Analysis shows a windward side force is generated by vortex systems which develop on the stem and follow the line of the keel. The fluid at the windward hull surface is accelerated and induces a low pressure area which results in a net hydrodynamic side force. Good agreement was found between the CFD and towing tank test results, and the hypothesis that narrower V-shaped hulls would generate more side force when at leeway than a rounded hull was confirmed (Flay 2013).

The influence of the pressure distribution loses its impact towards the back of the hull producing a *yawing* moment which has to be balanced. Yawing (changing the heading from side to side of the direction of motion) can be controlled by steering paddles, and according to historical linguistics, these existed in Lapita times (Pawley and Pawley 1994).

Velocity Prediction Programs (VPP)

VPPs are a conventional mode of performance analysis in yacht design based on finding the equilibrium of forces and moments acting on a vessel, and predicting the lift and drag on sails and hull in any conditions of wind speed, heading and heel. Figure 10 is an example of preliminary VPP results modelled in the Yacht Research Unit (Boeck *et al*. 2012), a polar diagram showing boat speeds for canoes with U, V1 and V2 hulls, plotted radially against the true wind direction, including leeway, in a true wind speed of 6 metres per second (m/s), equivalent to 11.7 knots, which is a light to moderate breeze.

This example supports a general comparison of the advantages of different V-shaped hulls over U-shaped ones in terms of direction into the wind. Figure 10 shows that a U-shaped canoe of this configuration would reach its maximum speed of around 4.7 knots on a broad reach. At 90˚ to the wind it would be sailing at a speed of around 1.5 m/s, or 2.9 knots, and at 75˚ the speed reduces to 1.9 knots. A V1 canoe in the same wind conditions would be sailing at 2.8 m/s or 5.4 knots at 90˚ and still at 2.4 m/s or 4.6 knots at 75˚. The V1 canoe is almost as fast on a beam reach as on a broad reach and the V2 is better again. Speed quickly reduces for all three hull shapes when running directly downwind. Tacking downwind is generally preferable to

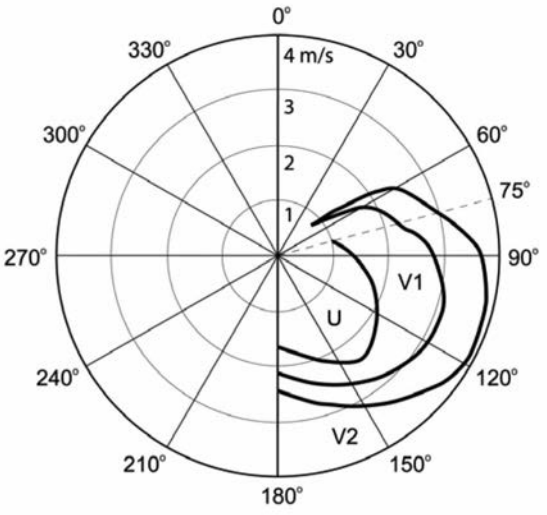

Figure 10. Polar plots of boat speed as a function of true wind direction (0-180°) for a true wind speed of 6 m/s (11.7 knots), for hull profiles U, V1 and V2.

running because of the larger driving force generated while broad reaching (Marchaj 1987:61), and also because sailing with waves coming from behind is uncomfortable and unstable, and there is a risk of a dangerous gybe (wind catching the sail from the wrong side).

The VPP results also show that increasing or decreasing the wind speed, increases or decreases the boat speed accordingly. However, the relative differences in boat speed by angle into the wind for U, V1 and V2 canoes are maintained at different wind speeds, and we can compare the performance of the three different canoes. Altering the experimental methodology would affect these results; however, our analysis was generally conservative. Historic Micronesian V2 canoes were clocked at speeds of 15-20 knots (Finney 2006), but in this study our interest is more in the simpler canoes of an earlier period in prehistory.

DISCUSSION

The Relative Age of Sail Forms in Remote Oceania

We selected Oceanic spritsails for testing in the wind tunnel because sails of this general form were widespread in marginal East Polynesia at the end of prehistory and, on that basis, could have been the earliest to reach central East Polynesia. However, the rig used on Lapita canoes 2000 years earlier is an open question. There are different theories about the relative age in Oceania of the three-spar lateen and the two-spar spritsail, and the wider distribution of the lateen has been taken to suggest it was the earlier form (Kirch 2000). Di Piazza *et al*. (2014:23) also consider on linguistic grounds that the spritsail could have been a later innovation somewhere in West Polynesia during the long pause before the settlement of East Polynesia.

On technological grounds, an alternative case can be made that the spritsail was the earlier form. A two-spar rig, with no standing mast, is more basic than a three-spar rig with a mast. Also, spritsails in East Polynesia were associated with canoes which changed direction by tacking, and single outrigger canoes had poor balance with the outrigger on the leeward tack. Elsewhere in Remote Oceania, single outrigger canoes which changed direction by shunting,[1] always kept the outrigger to windward and they were usually associated with lateen rigs. We see merit in Doran's (1981) theory that the third spar, or mast, of the Oceanic lateen functioned as a crane to move the rig from end to end during shunting.

Wind tunnel testing may confirm that the Oceanic lateen was generally more efficient than the spritsail. The three-spar rig also allows more control of the rake of the sail, and we have found that when sailing on a tight reach it is advantageous to increase the rake, which reduces the overturning moment while maintaining the driving force (Flay *et al*. n.d.). If shunting canoes with

lateen sails can be regarded as a more developed form than tacking canoes with spritsails, then they could have been an innovation or introduction that occurred after the Lapita period, somewhere in western Remote Oceania, which spread eventually and by stages into Fiji and West Polynesia late in prehistory (Haddon and Hornell 1997).

Irrespective of which of the two was earlier, a further case can be made that the Oceanic spritsail and Oceanic lateen were more similar to each other technologically and hence more closely connected historically, than either is to the lateen sail of the Indian Ocean. Both Oceanic lateen and spritsail have spars on both sides of the long axis of the sail (see Figure 2). In contrast, the Indian Ocean lateen lacks a spar on the lower side of the long axis of the sail; it is loose-footed, and its sailing characteristics have been found to be very different (Marchaj 1990).

Lapita voyaging

Archaeological outcomes inform us of the effectiveness of Lapita voyaging and linguistic reconstructions of a vocabulary of boats speak of elements of sailing present at the time (Pawley and Pawley 1994). Terms for sails and spars invoke driving force, and hulls invoke drag. The existence of some form of outrigger invokes an overturning moment *versus* a righting moment and sailing by reaching as well as running. Steering paddles invoke a yawing moment and the alignments of the side forces of sail and hull. One cannot be sure precisely what artefact forms are referred to in Austronesian proto-languages, but there is linguistic continuity.

Assuming Lapita canoes had U-shaped dug-out hulls and simple spritsails, our preliminary VPP results suggest they could beam reach, but were better adapted to broad reaching. We make no predictions here about boat speed, but suggest this level of technology was enough to sustain the Lapita expansion of the western Pacific. It would allow return journeys in seasonally alternating wind systems.

The current dating of Lapita sites allows an interval after settlement in Near Oceania by 1300 B.C., before expansion into Remote Oceania around 1000 B.C. (Sheppard *et al*. 2015). Some technological development of sailing canoes could have occurred in this interval, and there were probably advances in way-finding. Sailors who knew the night sky, and that its appearance changed when travelling north and south, but not when travelling east or west (when it is time that changes), could have eventually extended their range 200 nautical miles from the Solomons to Santa Cruz. They could sail across the latitude and return with seasonal winds under the same sky. Sailing north or south became safe when it was realised that one could return to a familiar sky. Such understanding was like an invention and it was evidently widely shared. From around 1000 B.C. many canoes crossed

a navigational threshold into Remote Oceania to both Western Micronesia and West Polynesia, within a very brief period of archaeological time.

Early East Polynesian voyaging

In East Polynesia the direct evidence of canoe hulls and appendages has recently improved. The remarkable find of a large section of a canoe hull with a sea turtle carved at its waterline, at Anaweka in New Zealand, dates around AD 1350–1400 (Johns *et al*. 2014), close to the settlement of marginal East Polynesia (Jacomb *et al*. 2014, Wilmshurst *et al*. 2011). This canoe had a sophisticated composite hull which approached a V1 profile (Flay *et al*. n.d.).

It has been suggested that the double canoe was an innovation during the long pause in West Polynesia, but we can now add hydrodynamic advances in hull form. Our preliminary VPP analysis suggests that return voyaging was feasible for early canoes of East Polynesia, of a type represented by the Anaweka *waka*, notwithstanding changes in prevailing winds during periods of climate change, and we suggest this level of technology was enough to sustain the rapid migration attested by archaeology. This is essentially a reaching model rather than a running model as our VPP results show the speed of all three canoe forms tested fell off when running directly downwind. The independent evidence of computer simulation supports a theory of return voyaging by demonstrating that one-way voyaging would result in an unsustainable loss of lives at sea in discovering isolated islands such as Easter Island and Hawai‘i (Irwin 1992).

Archaeological dating of East Polynesian colonisation has improved in the last decade but there are issues still to be resolved (Allen 2014). The theory that the islands of marginal East Polynesia were settled more or less simultaneously, within the limits of radiocarbon dating (Wilmshurst *et al*. 2011), has been taken "… to refute the proposition that there was a systematic strategy of exploratory sailing with respect to prevailing winds" (Anderson 2015: 3). However, the argument is actually that the strategy related to *seasonal variations* in prevailing winds (Irwin 1992). Moreover, different approaches to chronological analysis can suggest time-lags between the settlement of different islands, as recently proposed between Hawai‘i and New Zealand by Dye (2015). Such intervals would accommodate exploration by return voyaging, which our estimates of canoe performance suggest was feasible.

Voyaging after Colonisation

The diversity of canoes in Oceania at the time of European contact speaks of multiple strands of history possibly too complex to unravel. Over time, a range of hull profiles developed, generalised here as U, V1 and V2. There was also a development of construction methods from simple dugouts to complex planked canoes with internal frames, but there was an ecological dimension

to their historic distribution as planking often occurred on islands without large trees. Over time, sailing capability evidently developed, or declined, in different island groups. The early Anaweka *waka* shows that a more sophisticated sailing technology arrived in New Zealand than survived there. New Zealand offered very big trees and large and elaborate single canoes such as *waka taua* 'war canoes' developed; however, those without the stability of outrigger or double hull could only sail downwind (Irwin 2006). In both Hawai'i and the Marquesas voyaging continued in late prehistory within but not beyond the archipelagos, and historic canoes with spritsails had dug-out hulls described as U-shaped (Haddon and Hornell 1997). On Easter Island voyaging canoes were lost altogether and it is telling that many coastal *moai* statues faced introspectively inland, rather than out to sea.

In the historic period, V-shaped hull profiles persisted in some of the voyaging spheres of Oceania, consistent with the need for sailing performance adequate to sustain inter-island communication. For example, in central East Polynesia, the *pahi*, said to be a Tuamotuan canoe type in the Society Islands, had a V-shaped hull (Haddon and Hornell 1997). Further west, the voyaging sphere of Tonga, Samoa and Fiji was expanding at contact and both U-shaped and V-shaped sailing canoes were represented. The U-shaped canoes could well have managed inter-island passages with predictable seasonal wind shifts. The V-shaped canoes perhaps could have done rather better. In 1616 a *tongiaki*-style canoe was encountered at sea by Schouten and Le Maire, possibly on its way between Tonga and Samoa (van Spilbergen 1906), and others were seen at Niuatoputapu and Tafahi. A later description by Cook (Haddon and Hornell 1997) indicates the *tongiaki* had a V-shaped hull, although with a lateen rig that was cumbersome to tack; but some passages would not have required much tacking. In the Polynesian Outliers V-shaped canoes were recorded in Anuta and Tikopia. A traditional Tikopian canoe, *Rakeitonga,* gifted to Auckland War Memorial Museum in 1916, has a V1 form and is reported to have made return voyages to Anuta and Vanuatu. In wider Micronesia, the sustainability of long-term atoll occupation depended critically on continuing interisland communication and canoe design became most sophisticated there, with V2 hulls of asymmetric form which produced extra hydrodynamic lift. When first encountered by Europeans these were the fastest sailing craft in the world.

* * *

There is a longstanding interest in voyaging in Pacific prehistory. Recent developments include new information on climate change and sailing conditions (Goodwin *et al*. 2014), new statistical models that match the

dynamic nature of colonisation (Bell *et al*. 2015), accumulating evidence of interisland contact and trade (McAlister *et al*. 2013), and new archaeological discoveries of canoe remains (Johns *et al*. 2014). Theories about canoe capability invoke the science of sailing and we describe initial research on aerodynamic and hydrodynamic aspects of performance.

Evidence for climate change is particularly significant (Goodwin *et al*. 2014), but the conditions for sailing during prehistory and canoe sailing performance are independent variables and more information is needed about both. It is worth noting that while climate can change by the decade, weather can change by the day, and canoes react to changes in wind and waves in real time. Prevailing winds are not always constant and more clarity about seasonal variability of weather during times of change in prevailing winds would be welcome.

Between approximately 1300 BC and 1000 BC, sailing experience in Near Oceania led to innovations in ocean navigation, which opened routes into Remote Oceania. Our conclusions for sailing in the Lapita period are tentative without evidence of canoes or sails, however, our hypothesis is that voyaging canoes could beam reach and were well adapted to broad reaching. By negotiating seasonal weather strategically, return voyages between islands were possible, especially over shorter distances.

Our estimation of the performance of early East Polynesian canoe hulls is supported by archaeological evidence of the Anaweka *waka* (Johns *et al*. 2014), and our reconstruction of an early sail is informed by distributional evidence and ethnohistory. Preliminary VPP results suggest that during periods of adverse winds and climate change the ability of canoes to sail across the wind could accommodate return voyaging. As in the Lapita period, the performance of canoes running directly downwind was poor, and does not favour a downwind colonisation model.

With regard to the nature of colonisation our estimates of canoe technology suggest that a period of exploration and a strategic order of island settlement were feasible for East Polynesia. This would accord with accumulating archaeological evidence for planned migration, as in the case of New Zealand.

There is a further implication which concerns America—the successful settlement of East Polynesia put a suitable technology into place and brought America within range.

The study of Pacific sailing canoe performance is at an early stage and can be refined. This paper reports the first phase of testing at the University of Auckland and discusses the implications. A second phase of testing which more precisely relates to recent discoveries of early Maori canoes is in hand (Flay *et al*. n.d.).

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NOTE

1. A canoe changes direction by tacking by turning its bow through the no-go zone so the direction of the wind changes from one side to the other. In shunting the front of the sail is transferred to the other end of the boat, the canoe exchanges one end for the other, and the wind continues to come from the same side.

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ABSTRACT

We report on a collaboration between archaeology and the Yacht Research Unit at the University of Auckland to investigate the sailing characteristics of Pacific canoes, both ancient and modern. Archaeology provides a chronology for the colonisation of Pacific Islands, but one mystery that remains is how well the canoes could sail. We describe the first phase of testing reconstructed model hulls and sails. By combining aerodynamic and hydrodynamic information it was possible to compare the performance of three different kinds of canoe representing simple and more developed forms. We offer tentative suggestions about the sailing performance of canoes of the Lapita period and also conclude that canoes involved in the colonisation of East Polynesia were able to make return voyages between islands on passages that encountered adverse winds as well as fair ones.

Keywords: Pacific voyaging, colonisation, canoe performance, naval architecture, wind tunnel

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[1] Corresponding author: School of Social Science, Faculty of Arts, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand.
Email: g.irwin@auckland.ac.nz

[2] Yacht Research Unit, Faculty of Engineering, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand.

WORDS FOR CANOES: CONTINUITY AND CHANGE IN OCEANIC SAILING CRAFT

ANNE DI PIAZZA
Aix-Marseille Université
Centre national de la recherche scientifique (CNRS)
École des hautes études en sciences sociales (EHESS)
Centre de recherche et de documentation sur l'Océanie (CREDO)

Historically canoes are something of an enigma in the Pacific. They are extensively documented from the first contact period up to the present, but there is no widespread agreement pertaining to their design and technological innovations through time. Their few archaeological remains are not sufficiently informative, rendering such a topic challenging but, as developed below, historical linguistics can help to reconstruct Proto-Oceanic (POc), Proto-Central Pacific (PCP) and Proto-Polynesian (PPN) canoes. Pawley (2007: 26) has written:

> More than 20 terms for canoe parts and associated items are attributable to POc (Pawley and Pawley 1994). These include names for parts of a five-piece built-up hull, end pieces, projecting parts of the outrigger complex, platform, sail, boom of sail, steering oar, paddles, bailers, rollers for beaching and launching canoes, and anchors, indicating that POc speakers built substantial ocean-going outrigger canoes.

Such lexical evidence supplements the paucity of archaeological data of pre-contact canoes but more importantly allows relative dating of technological innovations. By tracing the histories of cognates and/or semantic fields related to the canoe complex, we can learn a great deal about continuity and change in maritime history. This idea is not new. Geraghty (1994), Lynch (1994), Osmond (2003), Osmond *et al.* (2003), Pawley (2007) and Pawley and Pawley (1994) have used historical linguistics to reconstruct aspects of the canoe complex and the maritime environment.

My approach combines observations on canoe technology with historical linguistics. Starting with the geographical distribution of the main types of sailing canoes in Remote Oceania at European contact, I selected technological traits that differentiate these types and that are marked by widespread terms, describing the rigging, steering devices and the way they change direction. Then, based on earlier work by historical linguists, I used the distribution of these lexical terms, as well as their reconstructed protoforms to analyse where and when new words appeared or shifts in meaning occurred to discuss the history of navigation.

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The shunting Oceanic lateen rigged canoe will be shown to be the vessel type of PCP speakers. Whether this canoe type was used by POc speakers is less clear. While the shunting manoeuvre is attested, no terms referring to a specific rig were found. The tacking Oceanic spritsail rigged canoe will be demonstrated to be a recent innovation attributed to Proto-Polynesian (PPN) speakers and was probably the vehicle used for the settlement of East Polynesia, some 800 years ago.

Although ocean-going double canoes are often thought of as the quintessential voyaging craft, they will not be discussed here since no specific shared terms differentiate their sailing rigs or manoeuvres from those of outriggers. The only term that marks them is 'doubled' as in Fijian *drua* (twin) and PPN **rua* (two) (Pawley 2007: 27). There is also no evidence for their existence during the early Oceanic settlement period, that is, during the time of POc.

TWO SCHOOLS OF NAVIGATION IN OCEANIA AND THEIR GEOGRAPHICAL DISTRIBUTIONS

From the beginning of European observations, from the 16th century on, we have a good picture of the geographical distribution of two schools of navigation, defined by their manner of coming about[1] (shunting versus tacking) and their sail rigs (Oceanic lateen versus Oceanic spritsail) (Doran 1981, Haddon and Hornell 1975, Neyret 1974). Shunting is generally associated with the three spar Oceanic lateen rig and is found throughout Micronesia, Western Polynesia and in scattered locations in Island Melanesia (Fig. 1). There the prevailing canoe type is a single outrigger whose rig is characterised by a triangular sail laced to two spars, a yard and a boom. Its apex is socketed at the bow of the hull and the yard is held up by a movable mast raked towards the bow. The entire rig is shifted from one end of the hull to the other when shunting, using the mast as a crane to carry the weight of the rig. Tacking is generally associated with the Oceanic spritsail rig. This rig is found throughout Eastern Polynesia and parts of West Polynesia (notably Samoa), on two Polynesian outliers, Anuta and Tikopia, and perhaps in Tonga.[2] This rig also uses a triangular sail, laced between two spars. The after spar is known as the sprit and the forward one is a functional mast stepped on the forward outrigger crossbeam, well back from the bow.

There are some exceptions to these generalisations. Shunting canoes with Oceanic spritsails were found on the east coast of New Caledonia, Ouvea in the Loyalties and on the Belep Islands to the north (Haddon and Hornell 1975, Neyret 1974), in northern and central Vanuatu (Di Piazza 2014), as well as in the Tuamotus. There was also an unusual double canoe type, the *tongiaki*, rigged with an Oceanic lateen sail that came about by tacking; this was known from Tonga, first described off the island of Niuatoputapu, and perhaps from Samoa.[3]

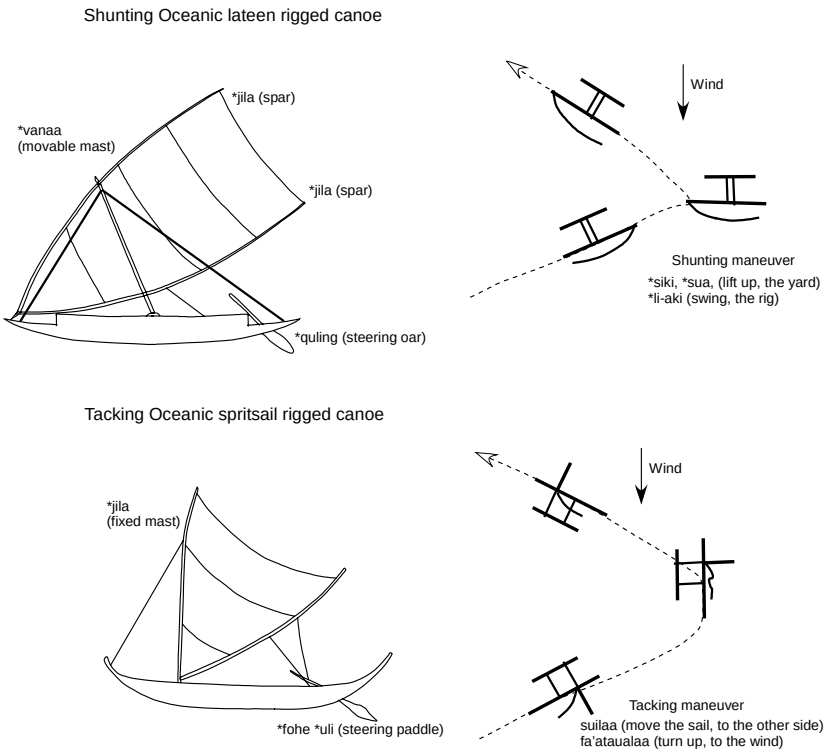

Figure 1. Reconstructed POc (*jila, *quliŋ), PCP (*vanaa, *tuku, *sua, *siki, *li-aki) and PPN (*fohe *ʔuli, *suati, suilā, faʻatauala) terms for canoe parts (modified after Fig. 2 in Di Piazza 2014).

DISTRIBUTION AND MEANINGS OF FOUR TRAITS THAT DISTINGUISH THE SHUNTING OCEANIC LATEEN FROM THE OCEANIC SPRITSAIL

Among technological traits that distinguish these two schools of navigation, four specific terms found in various Oceanic languages are here considered. They refer to:

- masts (movable versus fixed);
- stays (running fore and back-stays);
- steering devices (steering oars versus steering paddles);
- methods of coming about (shunting versus tacking).

Movable Mast Versus Fixed Mast

In a lateen rigged shunting canoe, the mast is stepped in a socket on the centre cross beam and is raked toward the forward part of the vessel. It is raised to vertical and raked toward the other end of the canoe during the manoeuvre using the fore and aft stays. In a spritsail rigged canoe the forward spar is a functional mast and it remains fixed in a vertical or nearly vertical position during the manoeuvre, but is generally lowered when the sail is struck.

Reflexes of **jila* and **vanaa* allow inferences about the two rig types. After Pawley and Pawley (1994: 351), reflexes of **vanaa* mean mast in PCP, although this protoform might be older since the word is present in Mota (northern Vanuatu). However, there the sense is somewhat different: "a boom with forked end stepped on the foot of the mast" (Pawley and Pawley 1994: 351). The POLLEX (Polynesian Lexicon) online database (Greenhill and Clark 2011) lists additional cognates for **vanaa* in both West and East Polynesia (see Appendix 1). I noted cognates for **vanaa* in New Caledonia (*pena* on Nakety and *pana* on Île des Pins), both meaning mast (Neyret 1974 [I]: 30) as well as on Efate in central Vanuatu where *fāla* means yard (Macdonald 1894: 29), although the latter reference may be unreliable. The New Caledonian forms may be Polynesian loans (Lynch pers. comm. 2015), and if so **vanaa* is therefore only reconstructible to PCP.

Wherever **vanaa* has been recorded as meaning 'mast' (Fiji, Tonga, Samoa, Niue, Tokelau, East Uvea, East Futuna and New Caledonia), the rig in use is the three spar Oceanic lateen, therefore a movable rather than a fixed mast.

Reflexes of **jila* have meanings that range from yard, to mast, to boom. Pawley and Pawley (1994: 350-51) noted that in POc **jila* refers to one of the spars supporting the sail, either the yard or the boom, with reflexes from the Admiralty Islands to Tonga. They further noted that **jila* in the sense of a fixed mast "... is confined to certain parts of Polynesia and this sense probably represents a post-PPN innovation" (Pawley and Pawley 1994: 351). Their parts of Polynesia include Samoa, Tikopia, Mangaia, Tahiti and New Zealand.

Looking further into the distribution of this word allows confirmation and clarification of their hypotheses (see Appendix 2). In the West (Tokelau, Tuvalu, Tonga, Samoa), **jila* designates the two spars laced to the sail but not to the third spar (the movable mast). While throughout East Polynesia (Cook Islands, Societies, Tuamotus, Hawai'i, New Zealand), in the Polynesian outlier of Tikopia, as well as in central and northern Vanuatu, where only the Oceanic spritsail is used, reflexes of **jila* refer to the forward spar (the mast).

This shift in meaning of **jila* from 'spar' (yard and/or boom) to 'mast' seems to reflect both a linguistic and technological innovation where the term for yard (the forward spar) of a lateen sail becomes the referent for the

functional mast of the spritsail rig, that is, the fixed forward spar that need not be raked when coming about. The distribution of these reflexes indicates that the innovation occurred before the settlement of East Polynesia, and probably after the Tongic/Samoic breakup. In Samoa (as well as Tonga, Tokelau, Tuvalu), **jila* (with qualifiers) refers to both the upper and lower spars of the lateen rig, for example in Samoan *tilatū* and *tilalalo* (Krämer 1995 [II]: 296).

The paired lexemes **vanaa* and **jila*, as movable 'mast' and 'yard(s)', date to at least PCP. In East Polynesia, the only places where they occur together, indeed the only places where **vanaa* occurs at all, are Tahiti and the Tuamotus. There *tira* (as throughout East Polynesia) is the functional 'mast' and *fanaa* the spar hoisted vertically against it. Seagoing canoes in those two groups (as well as those from Manihiki in the Cook Islands) appear to be the only Polynesian canoes that had a fixed mast independent from the sail assembly (Haddon and Hornell 1975 [I]: 79-91, 129-32, 186-89).

In all cases **jila* designates the most forward "stick" of both Oceanic lateens and spritsails. In the western regions **vanaa* is the spar that the **jila* is raised onto; in Tahiti and in the Tuamotus their functions seem to have been reversed and it is the *tila* that the *fanaa* is hoisted onto.

Stays (Fore and Back Running Stays)

On an Oceanic lateen canoe, the fore and aft stays are running, that is they are adjusted each time the canoe shunts. The forestay is slackened while the backstay is pulled. On tacking canoes, there is no backstay. It would interfere with the manoeuvre, but there is generally a "fixed" forestay. In both rigs, there are shrouds or lateral stays. On a tacking canoe these are fixed to the outrigger on one side and to a balance beam on the other. They need not be adjusted during the manoeuvre. On an Oceanic lateen rigged canoe, the shrouds are only attached on the outrigger (windward) side, the other side being left free for the swinging of the rig.

According to Pawley and Pawley (1994: 351), the PCP noun **tuku* means a running stay (Fiji, Tonga), a forestay (Samoa), a shroud (Tokelau) and may be cognate with PCP **tuku*, 'let go, slacken'. Apropos their first sense, it appears that in West Polynesia and Fiji *tuku* indicates the running fore and aft stays required to manoeuvre the Oceanic lateen sail when shunting (see Appendix 3). Qualifiers may be added to **tuku* to differentiate the forward and aft stays, for example Samoan *tu'umua, tu'umuli.* Such is also the case in Fiji and Pukapuka.[4]

In the second sense, as a verb 'to let go or slacken', we find it in Fiji (*tuku-ca*) with the meaning to release the stay or the halyard, in New Caledonia (*toukou*) 'to release the stay', in Efate (*tuku nalai*) 'to lower the sail' (see Appendix 3). These cognates seem to be older than PCP as they are found

in New Caledonia and Vanuatu, although borrowings from Polynesia cannot be ruled out. Releasing the forestay is the first step for shunting the Oceanic lateen sail, allowing a crewman to lift the tack of the sail out of its socket. The distribution of **tuku* suggests a long history for the shunting lateen, at least to PCP and perhaps to POc.

Steering Devices (Steering Paddles Versus Steering Oars)

On shunting lateen canoes, the steering oar is long and heavy and is held in place by some kind of a pivot, either a horizontal bar, a wooden fork and/or a rope fixed to the centre outrigger beam. In use, it rests against the off (downwind) side of the hull. The oar needs to be transferred to the other end of the deck during the manoeuvre. It may be unhooked and carried across by the helmsman or, when fixed with a cord, it may simply be dropped in the water where it floats to the new stern. Tacking spritsail canoes are steered by a relatively lightweight (steering) paddle, held in the hands and shifted from one side to the other during the manoeuvre.

According to Pawley and Pawley (1994: 352), **quli(n,ŋ)* 'steering oar' and 'to steer' are part of the Proto Malayo-Polynesian (PMP) sailing complex. In both senses it is found as far east as Fiji. In the Polynesian subgroup, PPN **fohe* 'paddle' followed by a qualifier designates a steering paddle as opposed to a steering oar. The qualifier is either a cognate of 'to steer' as in Samoa, Tonga, Hawai'i and the Tuamotus (thus **fohe* **ʔuli*) or of 'helmsman' as in Tahiti *(hoe fa'atere*), Anuta (*poe pakaterevaka*), New Zealand (*hoe whakatere*) and the Tuamotus (*hoe hakatere*) (see Appendix 4).

The semantic shift from **quli(n,ŋ)* to **fohe* **ʔuli* appears to be a PPN innovation. The western limit of the latter usage is in Tonga and Samoa, although it is not clear whether it applied to tacking or shunting canoes or both.

Methods of Coming About (Shunting Versus Tacking)

To come about by shunting, the canoe is turned broadside to the wind with its outrigger to windward then brought to a stop. The lower end of the forespar (the tack) is lifted or "uprooted" from its socket on the bow and the entire rig is carried or shifted from the bow to the stern (which now becomes the bow). The canoe now heads off "backward" in the other direction. To come about by tacking, the bow of the canoe is pivoted through the wind and the boom swings to the other side of the canoe (like western craft).

Several non-cognate terms seem to have been applied to different "stages" of the shunting manoeuvre. At least three of these words meaning 'to come about' appear to be related to the concept of 'uprooting' (*cavu*, **sua*, **li-aki*). According to Geraghty (1994: 69), *cavu* means both 'uprooting' and 'coming about' in Fijian. He further noted that in shunting a canoe, the foot of the yard

has to be lifted up, hence uprooted. One finds the same concept in Tonga and Samoa where *sua* has both meanings: coming about and uprooting (see Appendix 5). The use of **sua* to refer to uprooting the sail may be more widespread than these three Central Pacific examples since among Oceanic languages in general, POc **suar* carries the meaning of 'to turn over, to root up, to lever up, as soil with stick when weeding' (see POLLEX entries [Greenhill and Clark 2011]).

Another PPN lexeme, **li-aki*, has different meanings, among which some are clearly related to navigation. In Kiribati, *riaki* means to shunt and in Pukapuka it means to put up sail (Geraghty 1994: 69). Since KIR *riaki* was probably borrowed from one of the Samoic languages (SAM, TVL, TOK), it is likely that SAM *lia'i* meant 'to come about' (Geraghty 1994: 69). This specialised usage (see Appendix 5) may well derive from its more general meaning 'to swing or throw' or 'to uproot' widespread in West Polynesia (POLLEX [Greenhill and Clark 2011]). Both 'to swing' and 'to uproot' seem appropriate to describe the shunting manoeuvre, with the yard "swinging" from the masthead, while the tack is "uprooted" from the foredeck (see above).

Another POc word, **sigi* appears to have a similar usage where its general meaning 'to lift up' when applied to navigation signifies 'to come about'. This is found in West Uvea, Samoa and Tonga, although in the latter two cases the word for sail is added to the verb **sigi*. Thus Samoan *si'ilā* and Tongan *hiki lā* describe the action of lifting up the sail assembly when coming about (see Appendix 5).

Samoan is the sole language where three terms for coming about may well distinguish tacking (*suilā, fa'ataualā*) from shunting (*si'ilā,* see above) (Krämer 1995 [II]: 314). The morphological analysis of *suilā* is probably *sui* 'to substitute, to exchange, to change' and *lā* 'sail'. This is perhaps a reference to moving the sail from one side of the canoe to the other in tacking. *Taualā* means to 'luff, to turn up, to keep close to the wind'. When tacking, the canoe is effectively put as close to the wind as possible (in opposition to putting the wind on the beam when shunting).

Besides our four widespread technological terms (masts, stays, steering devices, methods of coming about), there are other more localised lexemes that inform us about the history of navigation. One such are the rails found on shunting canoes that connect each end of the hull to adjacent corners of the lee platform in Samoa and Fiji, which served as walkways during the shunt. Geraghty (1994: 64) noted that this rail is called *vavatā* in Samoa and *ivāvādā* in Fiji and that since "only in Fijian is the word morphologically analyzable... it is most likely that the term was coined in Fiji, and borrowed into Samoa". Another localised term refers to the platform or beam which extends from the side of the hull opposite the outrigger structure in tacking canoes, known by

reflexes of *suati* in Tikopia (Feinberg 1988: 63), Anuta (Feinberg 1988: 62), Samoa (Krämer 1995 [II]: 306) and Tuvalu[5] (Haddon and Hornell 1975 [I]: 303). It serves as a support for one or more crew members to counterbalance the forces on the outrigger float in tacking canoes. Analogous features are found on tacking outrigger canoes in Tahiti, as well as on the *tongiaki* double canoe where the beam extends outboard on both sides, although no word for these seem to have been recorded.

RECONSTRUCTING ANCESTRAL CANOES

Clearly, ancestral canoes cannot be said to have been preserved through lexemes in any simple or direct ways. Nevertheless, our body of four technological traits and their associated lexical terms allows correlations of canoes types to particular stages of Oceanic languages. The shunting Oceanic lateen rigged canoe is attributed to Proto-Central Pacific and the tacking Oceanic spritsail rigged canoe to Proto-Polynesian (Fig. 1). PCP vessels were fitted with three spars: a stick or mast (*v*anaa*) whose function was to hoist the sail, an upper and lower spar (**jila*) laced to the sail, as well as with running fore and aft stays (**tuku*) which helped to swing the rig. They were directed by specialised steering oars (**quli*) rather than paddles. To come about, their rig had to be uprooted (**sua*), the tack uplifted (**siki*) and the whole sail assembly swung (**li-aki*) aft. PPN canoes were steered with paddles (**fohe* *ʔ*uli*) rather than oars, had balance beams (**suati*) opposite the outrigger and tacked by moving the sail from one side to the other (*suilā*) or turning up (to the wind) (*fa'atauala*). After the breakup of PPN, canoes carried an Oceanic spritsail on a fixed mast (**tila*). Whether this innovation occurred earlier is unknown.

At European contact there were at least two more localised canoe types: (i) shunting canoes with Oceanic spritsails in parts of New Caledonia, Vanuatu and the Tuamotus; and (ii) tacking double canoes with Oceanic lateens (*tongiaki*) from Tonga, Niuatoputapu and perhaps Samoa. Among these poorly known types, the best extant vocabulary is that of Layard (n.d.) for the butterfly spritsail of central and northern Vanuatu (Di Piazza 2014). For Atchin, off the northern coast of Malakula, he noted that:

> The sides of the V [sail] are laced to bamboo spars ... respectively the 'outrigger [forward] spar' a-tsem, and the 'lee [aft] spar' tsorta. The rigging consists of six ropes, called talin na-mban 'sail ropes'. Of the three ropes on either spar, one, called nav, might well be termed 'stay' being made fast on the outrigger side..., and [one] on the lee side..., while the two others, rev-rev, acting as sheets, are made fast respectively to the fore and after thwarts. The steering paddle is called no-wosh na'ak wala, to come about ra tseme. (Layard n.d.: 8, 136b)

According to John Lynch (pers. comm. 2015), the term for 'forward spar' (*a-tsem*) is derived from POc **saman* 'outrigger float'. The other Atchin words for canoe parts, such as stays, steering paddle and coming about, are not cognate with PCP lexemes. While the larger canoes of this type always shunt, smaller ones can also tack (Di Piazza 2014). This fact along with the peculiar way the sail is handled might explain why Atchin canoe lexicon is so different.

While detailed reconstruction is possible for the PCP stage onward, the only terms that allow inferences about the rig in use by POc speakers are 'spar' (**jila*) and 'steering oar' (**quliŋ*). The latter indicates that Lapita canoes were probably shunting. Since the shunting Oceanic lugsail is the only rig known from Manus to the Trobriands, it may well be the best model for an early Lapita canoe. Whatever the case, we are on firmer ground 300 years and 3,000 km further away at the eastern end of Lapita (PCP), where shunting Oceanic lateen sails are attested.

* * *

Technological development is often portrayed as a linear process, for which it is assumed that progress is a matter of a more advanced technology replacing a simpler and older one. This is probably what has led certain authors to hypothesise that the "primitive" two spar (spritsail) rig is older than the three spar Oceanic lateen rig. Similarly, that the "simple" tacking manoeuvre precedes the shunting manoeuvre. Yet the history of our reconstructed canoes suggests otherwise. PCP navigators appear to have been using shunting lateen rigged canoes. And only later on, in West Polynesia (Tonga or Samoa), a new rig, the Oceanic spritsail and its associated tacking manoeuvre was invented. This invention presumably took place during the long pause, before East Polynesian settlement some 800 years ago.

The long coexistence of these two navigational traditions in Samoa (and probably Tonga) right up to European contact, suggests that the new technology was not replacing the old, nor did it necessarily derive from the old. Only a few terms seem to be interchangeable between the two types, and when they were (**jila*, **vanaa*, **quli*), it was with new meanings, emphasising the discontinuity between these two traditions.

NOTES

1. "Coming about" is here used as a generic term to refer to changing direction by either tacking (that is turning the bow through the wind as in Western craft) or shunting. In shunting, the sail along with the spars is carried to the opposite end of the boat. The bow becomes the stern and the boat sails in the other direction.

2. Sources are rare on Tonga. There tacking canoes rigged with an Oceanic spritsail are known only from a sketch and two aquatints based on it by John Webber from Cook's third voyage (Dodd 1972: 21, 134).
3. According to Haddon and Hornell (1975 [I]: 241), the Samoan *va'a tele* was similar to the Tongan *tongiaki*, although very little is known about it. The peculiarities of the *tongiaki* consisted of the absence of a halyard with the yard resting directly on the head of the mast, the tack suspended by ropes between the hulls and a mast stayed to a long crossbeam.
4. For Pukapuka, the terminology for 'stay' is consistent with the Oceanic lateen rig but the only description known dates to the 1930s, when a European rig was in use (Macgregor 1935). In Samoa, *tu'u* is associated with the lateen rigged *'alia* canoe (Krämer 1995 [II]: 291-96). The author knows of no vernacular data referring specifically to stays on Samoan spritsail rigged canoes.
5. After Haddon and Hornell (1975 [I]: 303), the word *tuati* was remembered by Tuvaluans, although its meaning had been forgotten. Since balance beams are apparently specific to tacking canoes, it may be that such canoes were once known there.

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APPENDICES

Abbreviations

ADM	Admiralty Islands
CNV	Central Northern Vanuatu
EFU	East Futuna
EUV	East Uvea
FIJ	Fiji
KAP	Kapingamarangi
KIR	Kiribati
KWN	Kwamera (Tanna)
LEN, WSN, LEN, SWT	North Tanna, Whitesands, Lenakel, South-West Tanna
MANG	Mangaia
MARQ	Marquesas
NC	New Caledonia
NUK	Nukumanu
NZ	New Zealand
PCP	Proto-Central Pacific
POc	Proto-Oceanic
PPN	Proto-Polynesian
PUK	Pukapuka
RARO	Rarotonga
ROT	Rotuma
SAM	Samoa
TAH	Tahiti
TIK	Tikopia
TOK	Tokelau
TONG	Tonga
TUA	Tuamotu
TUV	Tuvalu
WFU	West Futuna
WO	Western Oceanic
WUV	West Uvea

*Appendix 1: ?PEO *pana, PCP *vanaa*

MOTA *pane*, the boom (Codrington and Palmer 1896: 2); *pane/i*, boom with forked end stepped on the foot of the mast (Pawley and Pawley 1994: 351)
EFATE *fāla*, a ship's yards (because they are fixed across or on the mast) (Macdonald 1894: 29)
NC (Nakéty) *pena*, mât; (Ile des Pins) *pana*, mât (Neyret 1974 [I]: 30)
WFU *fana,* mainmast (POLLEX [Greenhill and Clark 2011])
WUV *fanaa,* mât (POLLEX [Greenhill and Clark 2011])
FIJ *i-vanaa,* mast (Pawley and Pawley 1994: 351)
SAM *fanaa,* mast (Pawley and Pawley 1994: 351, POLLEX [Greenhill and Clark 2011])
TONG *fanaa,* mast (Pawley and Pawley 1994: 351, POLLEX [Greenhill and Clark 2011])
EUV *fanaa,* mast (POLLEX [Greenhill and Clark 2011])
EFU *fanaa,* mast (POLLEX [Greenhill and Clark 2011])
NIUE *fanaa*, mast (POLLEX [Greenhill and Clark 2011])
TOK *fanaa,* mast (Pawley and Pawley 1994: 351, (POLLEX [Greenhill and Clark 2011])
TUA *fana,* yard (Emory 1975:138); *fanaa* yard of sea-going canoe (POLLEX [Greenhill and Clark 2011])
TAH *fana,* vergue (POLLEX [Greenhill and Clark 2011])

*Appendix 2: POC *jila, PPN *tila*

ADM Seimat s*il*, boom of a sail, Ninigo s*il*, booms of triangular sail, Penchal *cil*, sheet of sail, Lou *e/sil* horizontal support for sail (Pawley and Pawley 1994: 350)
WO Tuam *na/sila*, yard or boom of sail (Pawley and Pawley 1994: 350)
TAKUU *tila,* gaff of a canoe sail (POLLEX [Greenhill and Clark 2011])
CNV Mota *pane sila*, projecting boom of a sail, Paamese *a/sil*, mast (Pawley and Pawley 1994: 350)
EFATE ? (Neyret's list is not clearly attributed to any particular language) *tira tok*, vergue servant de mât, *tiré viséik*, gui (Neyret 1974 [I]: 36); *tere*, the mast (of a canoe or ship) (Macdonald 1894:197), SOUTH EFATE *na/tir*, mast (Lynch pers. comm. 2015)
EMAE *tira*, mast (POLLEX [Greenhill and Clark 2011])
IFIRA-MELE *tira*, mast (POLLEX [Greenhill and Clark 2011])
NTN,WSN,LEN,SWT *tila*, mast (Lynch 1994)
KWM *tira*, mast (Lynch 1994)
NGUNA *tira*, mast (POLLEX [Greenhill and Clark 2011])
FIJ *sila*, sheet of a sail (Pawley and Pawley 1994: 350); (Lau) *karikari sila*, lower sail spar (Gillet *et al*. 1993: 80)
SAM *tila,* mast, yardarm, sprit; spar of sail, mast (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011]))

TIK *tira,* mast or spar of sailing canoe (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011])
SIKAIANA *tila,* mast (POLLEX [Greenhill and Clark 2011])
TONG *sila,* yard, for a sail to hang from, as a verb, shorten the sheet of a sail (Pawley and Pawley 1994: 350); *jilalal*o, the lower sprit or yard in a canoe; *jilatuu*, the upper sprit or yard in a canoe (Rabone 1845)
WUV *tila,* mât (POLLEX [Greenhill and Clark 2011])
NUK *tila,* yard (POLLEX [Greenhill and Clark 2011])
EUV *tila toka*, mât dressé (Neyret 1974 [I]: 36)
EFU *tila,* yardarm (POLLEX [Greenhill and Clark 2011])
PUK *tila,* yard of sail, mast (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011])
MANG *tira,* mast (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011])
RARO *tira*, mast (POLLEX [Greenhill and Clark 2011])
MANIHIKI *tira*, mast (Haddon and Hornell 1975 [I]: 194)
TONGAREVA *tira*, mast (Haddon and Hornell 1975 [I]: 194), *tila,* mast (POLLEX [Greenhill and Clark 2011])
AITUTAKI *tira*, mast (Buck 1927: 270)
TOK *tila lalo*, mast boom, *tila lunga*, mast yard (Haddon and Hornell 1975 [I]: 251)
TUV *tila tu,* yard (Haddon and Hornell 1975 [I]: 303); *tila*, mast (POLLEX [Greenhill and Clark 2011]). Note that an upper sprit is a forward spar (or mast) and not a boom
TAH *tira,* mast (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011]))
TUA *tira,* mast, yardarm (Emory 1975: 138, (POLLEX [Greenhill and Clark 2011])
HAW *kia*, mast, the base of the mast (Holmes 1981: 175)
NZ/MAORI *tira tuu,* yard of a sail, upper sprit, mast of a canoe (Pawley and Pawley 1994: 350, (POLLEX [Greenhill and Clark 2011]). Note that an upper sprit is a forward spar (or mast) and not a boom; *tiratu*, *titoko* (Haddon and Hornell 1975 [I]: 212)

*Appendix 3: PCP *tuku*

EFATE *tuku nalai*, lower the sail (of a canoe) (MacDonald 1894: 205)
MOTA *tug*, to loosen, slacken, untie (Codrington and Palmer 1896: 228)
MALIGO *tig,* to loosen, untie (Codrington and Palmer 1896: 217)
NC (Ile des Pins) *toukou,* laisser filer l'étai; (Nakéty) *toukou*, laisser filer l'étai (Neyret 1974 [I]: 30)
KAP *tuku*, lower sail (POLLEX [Greenhill and Clark 2011])
FIJI *tuku-ca,* to let go, to slack a rope; in the Bau dialect this word is chiefly used of slacking the stay, in tacking a canoe, or of slacking the haulyard [halyard] (Hazlewood 1872: 138); (Lau) *tuku*, stay (Gillet *et al*. 1993: 39); *tuku*, running stays (Pawley and Pawley 1994: 351), *uthu i mua,* running stays which form respectively forestay and backstay of mast (Haddon and Hornell 1975 [I]: 336).
SAM *tu'u,* stay; *tu'umua,* forestay; *tu'umuli,* aft stay (Krämer 1995 [II]: Figs 29, 293, 295); *tuu*, to set free, to let go (Pratt 1862: 212).

TONG *tuku,* rope attached to the top of a *kalia* mast (Churchward 1959: 508); *tuku,* running fore and backstays of mast, also as a verb to slacken or to let go (Haddon and Hornell 1975 [I]: 273, Pawley and Pawley 1994: 351); *tukulolo*, lower (sail) (Collocott 1925: 207).
EUV *toukou,* laisser filer l'étai (Neyret 1974 [I]: 30). *ʔuli*
TOK *tuku*, guy rope of traditional sail, fastened to the outrigger (Pawley and Pawley 1994: 351)
PUK *tukuku mua,* forestay; *tukuku muli*, after stay (Haddon and Hornell 1975 [I]: 253).

*Appendix 4: POC *quliŋ, PPN *ʔuli*

ADM Lou (Manus) *kuli/p,* steering oar (Pawley and Pawley 1994: 351)
WO Kiriwina *kuliga,* steering oar; Molima *kuliga,* steering oar, to steer; Tami *gul,* steering paddle; Gedaged *ulu/m,* rudder, steering; Yabem *ŋa/goliŋ,* rudder (Pawley and Pawley 1994: 352)
MOTA *turwose,* steering paddle (Codrington and Palmer 1896: 2)
LUANGIUA *hoe ulu*, steering paddle (POLLEX [Greenhill and Clark 2011])
FIJ *uli*, steering oar, to steer (Pawley and Pawley 1994: 351, (POLLEX [Greenhill and Clark 2011])
TONG *fohe ʻuli*, rudder, steering oar (Pawley and Pawley 1994: 351)
SAM *foe/uli*, rudder (Pawley and Pawley 1994: 351)
MARQ Both terms *ui/uki* and *hoe* are found for steering oar (Dordillon 1857: 168, 425, 426). Whether they used in compound remains in question.
NZ/MAORI *hoe whakatere*, *hoe whakahaere*, steering oar (Best 1976)
TUA *uri hoe*, steering paddle (Emory 1975: 184, citing Stimson 1932: 195), *hoe hakatere* (Emory 1975: 167)
TAH *hoe faʻatere*, gouvernail (Académie Tahitienne 1999)
ANUTA *poe pakaterevaka*, steering paddle (Feinberg 1988: 195)
HAW *hoe uli,* steering paddle (Handy 1932: 173)

*Appendix 5 : PCP *sua, PPN *li-aki, POC *siki*

ROT *sua*, to tack about, change from one tack to another; *ua*, to lever up (Churchward 1959: 523)
SAM *sua*, to tack (of a boat or a ship), to plough up; *suasua,* to root up (Pratt 1862)
TON *hua*, to tack, to row, to skudd, to root or turn up the earth (Rabone 1845)

SAM *liaʻi,* to root up, to pull up (Pratt 1862)
TOK *liaki,* uproot, swing, throw (POLLEX [Greenhill and Clark 2011])
TUV *liaki,* shake, swing (Geraghty 1994: 69)
KIR *riaki*, to tack (Geraghty 1994: 69)
PUK *liaki*, put up sail (mentioned as borrowed in (POLLEX [Greenhill and Clark 2011])

WUV *siki*, faire des bordées (POLLEX [Greenhill and Clark 2011])
SAM *siʻilā*, put about (Pratt 1862)
TOK *hiki*, to lift (a canoe) (POLLEX [Greenhill and Clark 2011])
TONG *higgi la*, tack about; *higgi*, to raise, to lift, to heave (Mariner 1817: 404)

ABSTRACT

This article aims to reconstruct prehistoric Oceanic canoes by analysing four technological traits and their associated lexical terms: masts (movable versus fixed), stays (fore and back running stays), steering devices (steering paddle versus steering oars) and method of coming about (shunting versus tacking). By tracing the histories of cognates and/or semantic fields related to these terms, the study demonstrates that the shunting manoeuvre was known at the Proto-Oceanic stage, but no specific rig type can be reconstructed for that time period. The canoe of the Proto Central Pacific speakers used the shunting Oceanic lateen rig. The tacking Oceanic spritsail rigged canoe was a later Proto Polynesian innovation and served for the settlement of East Polynesia.

Keywords: Oceanic canoes, historical linguistics, maritime history, Oceanic lateen, Oceanic spritsail

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[1] Correspondence: Aix-Marseille Université, CNRS, EHESS, CREDO-UMR 7308, 13003 Marseille, France. Email: anne.dipiazza@pacific-credo.fr

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