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# Tupaia's Wind Positioning System: (Re)Modelling Ancestral Polynesian Voyaging\*

LARS ECKSTEIN 

## ABSTRACT

This essay reconstructs a complex 'wind positioning system' which the Ra'iātean *tahu'a* Tupaia shared with James Cook and select officers of his crew in 1769. It sets an array of scattered traces in the colonial archive in conversation with the more recent teachings of Te Aliko Koloso Kaveia of Taumako. The essay systematically compiles and connects evidence that Tupaia's *rua mata'i* and Kaveia's *te nohoanga te matangi* offered related cognitive models for navigation. Attention will be given to the ways in which signature wind positions are tied to astronomical events involving sun, moon, and star positions; how wind and astronomy provide ritualized calendrics and seasonality for voyaging; how knowledge of complex swell patterns further calibrates a multi-variable tool kit; how detailed accounts of specific island-to-island voyaging paths are built into the system; and finally how such particularities also involve primordial cosmogonic axes of (island) migration in Tahitian traditions.

**Keywords:** James Cook, Koloso Kaveia, navigation, *rua mata'i*, Tahiti, Taumako, Tupaia, wind positioning system

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*Acknowledgements:* This project is indebted to previous archival work conducted in collaboration with my colleague Anja Schwarz and an array of both Western and Oceanian scholars who shared their knowledge with us in the process of researching Tupaia's Map. The new research on Tupaia's *rua mata'i* again relied on the generosity of friends. For approaching an understanding of the Taumakoan *te nohoanga te matangi*, I am primarily indebted to Mimi George, as well as to Luke

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## INTRODUCTION: TUPAIA'S MAP AND THE QUESTION OF ANCESTRAL POLYNESIAN VOYAGING

Sometime in August 1769, James Cook, the English commander of HMS *Endeavour* that circumnavigated the planet between 1768 and 1771, and the Ra'iātean *tahu'a*,<sup>1</sup> senior 'ariori and initiated master navigator Tupaia, embarked on a joint project: the drawing of a map of the Polynesian sea of islands. Tupaia's Map is the justly famous outcome of an encounter between two legendary navigators; and it is the outcome of a meeting of two very different ways of navigational world-making. The ways in which both navigators and their wayfinding capacities have been recorded in history, however, is dramatically lopsided. Cook's achievements have become staple food in history books across the planet. Tupaia's achievements, including his integral role on the *Endeavour*, have only more recently come to be more fully acknowledged and he is still widely unknown outside Oceania. Who was Tupaia?

After a raid from Porapora on his native Ra'iātea in the Leeward Society Islands in the early 1760s, Tupaia was living in Tahitian exile when the first British ship, Samuel Wallis's HMS *Dolphin*, set anchor at Matavai Bay for about a month in June and July 1767. As *tahu'a* of the Teva clan of Papara, he conducted much of the diplomacy for the chiefly family that ensued after Wallis's lethal bombardment of Tahitian fleets and the Matavai shoreline. When Cook's *Endeavour* arrived in Tahiti two years later, Tupaia was in a much more precarious political situation. Between the visits of Wallis and Cook, the Teva clan had been crushed in a bloody civil war. Just having lost his social standing and titles for a second time, Tupaia strategically set himself up as an advisor for the British, doubtlessly to build new alliances and gain new political options. When the *Endeavour* set sail again from Tahiti in July 1769 after three months at Matavai, he decided to join its crew, together with a young disciple. Both died of an infectious disease in December 1770 in Batavia, today's Jakarta, during the return voyage of the *Endeavour*.<sup>2</sup> How much Tupaia was respected by Cook already in Tahiti is evidenced by the fact that Cook let Tupaia navigate his precious ship to the Leeward Society Islands and pilot it around the reefs of Huahine, Ra'iātea, Taha'a, and Porapora. When leaving Ra'iātea again on 9 August 1769, Tupaia offered to lead Cook on an extended passage westward, on ancestral paths that would have taken the *Endeavour* to the Southern Cook Islands and presumably on to Samoa/Tonga. However, Cook refused, being on strict orders to go

Vaikawi and Betty Bosi. I learned Tahitian astronomy from Libor Teanonui Prokop, who also, together with Merehau Anastas, greatly helped decoding the wind names in Tupaia's system. Thanks to the journal editors for allowing the publication of an(other) excessively long paper. I am grateful for the instructive comments of my anonymous readers, and to Bronwen Douglas for her meticulous copy editing. This essay is for my family: Djaynab, Zoë, Marley, and Noemi.

<sup>1</sup> For terms in Tahitian, I generally follow the spelling conventions (including the 'eta) of the Fare Vāna'a/Académie Tahitienne. I use the 'okina in Hawaiian terms.

<sup>2</sup> Anne Salmond, *The Trial of the Cannibal Dog: Captain Cook in the South Seas* (London: Penguin, 2005); idem, *Aphrodite's Island: The European Discovery of Tahiti* (Berkeley, Los Angeles, and London: University of California Press, 2010), chs 2–10; Joan Druett, *Tupaia: The Remarkable Story of Captain Cook's Polynesian Navigator* (Santa Barbara, CA: Praeger, 2011).



FIGURE 1. Tupaia, 'Tupaia's Map' (1770), British Library, London, Add MS 21593.C, © British Library Board.

straight south to find the legendary great southern continent. This is the moment when the project of Tupaia's Map began.

Beyond Tupaia and Cook, several officers like Cook's ship's master Robert Molyneux and one of his master's mates, Richard Pickersgill, were also part of this project, as well as gentleman naturalist Joseph Banks and perhaps other scientists. The final result of their collaboration has survived as a fair copy in the Banks papers in the British Library in London, where it was rediscovered in the 1950s by Cook's biographer John Beaglehole (Figure 1).<sup>3</sup> Ever since, it has been at the centre of debates in Western sciences regarding the capacities and extent of ancestral Polynesian targeted voyaging. Intriguingly, to the best of my knowledge, Oceanian communities (who trust their oral voyaging traditions) never took an excessive interest in Tupaia's Map. It became iconic, however, in those knowledge traditions (in which I, too, have been trained) in which black-and-white archival evidence is still considered the gold standard for making solid historical claims. And yet, Tupaia's Map posed a mystery, for two related reasons. First, the identity of most of the islands that it depicts could not be clearly ascertained, partly because a lot of the island names Tupaia used are no longer familiar and partly because the Europeans wrote them down as they heard them, in often garbled transcriptions. Second and more important, the positions of those islands that could be identified simply made no sense in the framework of a Western map: how would it be possible, for instance, that when islands in the Society Group such as Tahiti and Ra'iātea are placed in the

<sup>3</sup> Tupaia, 'Tupaia's Map' (1770), British Library, London, BL Add MS 21593.C.

map's centre, that islands in the Austral Group such as Ra'ivavae range to the northwest, or islands in the Marquesas to the southeast? Tupaia's Map thus served both in the arguments of those who infamously questioned the capacities of ancestral Polynesian voyaging,<sup>4</sup> and those who argued in its support.<sup>5</sup>

In the early 2010s, my colleague Anja Schwarz and I began our own collaborative research into Tupaia's Map. Building on previous efforts to understand its underlying logic by Finney,<sup>6</sup> Turnbull,<sup>7</sup> and Di Piazza and Pearthree,<sup>8</sup> among others, we both systematically re-evaluated all the archival evidence in Western archives that we could find and learned about ancestral Oceanian navigation, primarily relying on the work of David Lewis.<sup>9</sup> Trained in postcolonial literary and cultural studies, our approach had been to understand the map as the result of a complex knowledge transaction between two very different ways of being in, relating to, organizing, and representing the world. Also, we suspected that Tupaia's Map was probably not a singular representation, but the ultimately narrative result of a complex process of such transactions, which we attempted to retrace across the evidence in all available journals and ship logs from the *Endeavour* voyage. In these transactions, it was Tupaia, rather than Cook and his men, who 'crossed the beach', to use Greg Denning's metaphor,<sup>10</sup> by attempting to translate his own traditions into a very foreign

<sup>4</sup> Most notably Andrew Sharp, especially in *Ancient Voyagers in the Pacific* (Wellington: Polynesian Society, 1956).

<sup>5</sup> Most notably Greg Denning, David Lewis, and Ben Finney; e.g. G.M. Denning, 'The Geographical Knowledge of the Polynesians and the Nature of Inter-Island Contact', in *Polynesian Navigation: A Symposium on Andrew Sharp's Theory of Accidental Voyages*, ed. Jack Golson (Wellington: Polynesian Society, 1962), 102–53; David Lewis, *We, the Navigators: The Ancient Art of Landfinding in the Pacific* (2nd ed. Honolulu: University of Hawai'i Press, 1994 [1972]); Ben Finney, e.g. in 'Nautical Cartography and Traditional Navigation in Oceania', in *The History of Cartography*, vol. 2, book 3, *Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies*, eds David Woodward and G. Malcolm Lewis (Chicago: University of Chicago Press, 1998), 443–94.

<sup>6</sup> E.g. Ben Finney, 'Nautical Cartography'.

<sup>7</sup> E.g. David Turnbull, 'Reframing Science and Other Knowledge Traditions', *Futures* 29, no. 6 (1997): 551–62; idem, 'Cook and Tupaia, a Tale of Cartographic "Méconnaissance"', in *Science and Exploration in the Pacific: European Voyages to the Southern Oceans in the 18th Century*, ed. Margarette Lincoln (Suffolk: Boydell Press, 1998), 117–31; idem, *Masons, Tricksters, and Cartographers: Comparative Studies in the Sociology of Scientific and Indigenous Knowledge* (London and New York: Routledge, 2003), 133–64; idem, 'Trails and Tales: Multiple Stories of Human Movement and Modernity', in *Arctic Geopolitics and Autonomy*, ed. Michael Bravo and Nicola Triscott (Ostfildern: Hatje Cantz, 2010), 71–88.

<sup>8</sup> Anne Di Piazza and Erik Pearthree, 'A New Reading of Tupaia's Chart', *Journal of the Polynesian Society* 116, no. 3 (2007): 321–40; Anne Di Piazza, 'A Reconstruction of a Tahitian Star Compass Based on Tupaia's "Chart for the Society Islands with Otaheite in the Center"', *Journal of the Polynesian Society* 119, no. 4 (2010): 377–92.

<sup>9</sup> Lewis, *We, the Navigators*.

<sup>10</sup> Greg Denning, *Islands and Beaches: Discourses on a Silent Land, Marquesas, 1774–1880* (Carlton, VIC: Melbourne University Press, 1980); Greg Denning, *Beach Crossings: Voyaging Across Time, Cultures and Self* (Carlton, VIC: Miegunyah Press, 2004).

representational form. The main question to solve the mystery of Tupaia's Map, it transpired, was to understand the translation devices that Tupaia would have employed.

In the four weeks he had sailed with Cook by August 15, Tupaia must have observed two crucial things. First, that every day at noon, the Europeans took bearings of the sun which reliably pointed to the north. Cook did so for various reasons: measuring the height of the sun above the horizon with a sextant was crucial for Cook to know his latitude; the exact time of the sun at its highest position was needed to calibrate the hourglass; the ship's position at noon time was also essential when mapping coastlines using the triangulation method, etc. Second, Tupaia must have learned that to conceptualize the bearings of islands and other targets, Cook primarily used the compass (rather than, for instance, the stars, sun positions, or swell patterns) and expressed them in the clockwise angular distance from a bearing to the north.

With this in mind, Tupaia's Map becomes legible when considering three things. First, that the Europeans set it up for Tupaia following Western cartographic conventions, and first drew the islands that they already knew in the Society Group (and Rurutu in the Australs) in a Western-style map projection.<sup>11</sup> Second, that when taking over, Tupaia chose to abandon the cartographic model that was set up for him and instead drew island-to-island voyaging paths. Most of these he had earlier recited for Robert Molyneux, who set them down in his log,<sup>12</sup> and Tupaia rather systematically worked his way through these sequences in the drawing process. Such voyaging sequences can basically begin anywhere on the chart, and it is essential to know which islands on Tupaia's Map are connected on a path, and which are not. Third, these paths were not drawn randomly, and this is where Tupaia's ingenious translation device comes in: Tupaia also provided the rough compass bearings for the passages he drew for Cook. He did so by requesting the word *avatea*, signifying 'the sun at noon' in Tahitian, in the centre of the map where the cardinal axes pre-drawn by the Europeans cross. This is where Cook's compass, in the logic of Tupaia's Map, would point to from any of the islands on the paths he drew, and thus provide direction to the next target with astounding precision.<sup>13</sup>

<sup>11</sup> This is evidenced by the copy of a first draft of Tupaia's Map that Richard Pickersgill kept and gave to Johann Reinhold and Georg Forster, Cook's naturalists on the second voyage, as well as by an island list copied by the Forsters from that first draft map. See Georg Forster, 'Copy of a Chart Made by a Native of O'Taheitee, Named Tupaia, Containing about 45° of Longitude' (1776), Stadtarchiv Braunschweig, H III 16–87; and Johann Reinhold Forster, 'Insularium Maris Pacifici or a Catalogue of the Isles in the South-Sea with the Names of the Natives', in 'Vocabularies of the Language spoken in the Isles of the South-Sea & of the various Dialects which have an Affinity to it; with some Observations for the better Understanding of them' (1774), Staatsbibliothek zu Berlin, MS Orient Oct. 62, 6–7.

<sup>12</sup> Robert Molyneux, 'Master's Log' (26 August 1768–20 October 1769), National Archives Kew, London, Adm 55/39, 61v.

<sup>13</sup> See Lars Eckstein and Anja Schwarz, 'The Making of Tupaia's Map: A Story of the Extent and Mastery of Polynesian Navigation, Competing Systems of Wayfinding on James Cook's Endeavour, and the Invention of an Ingenious Cartographic System', *Journal of Pacific History* 54, no. 1

Tupaia's Map, then, really turns out to be the black-and-white evidence of Society Islander voyaging knowledge at the time of Cook that extended at least from Rotuma in the West to Samoa and Tonga, from Tonga to the Southern Cook Islands, from there to the Northern Cooks as well as to the Austral chain, from Mangareva to Pitcairn and beyond, through the Tuamotus, and finally to the Marquesas and all the way to O'ahu in Hawai'i. What is important to understand and to emphasize, however, is that Tupaia's Map is an exceptional achievement of translation from Polynesian worldings into the framework of a European conceptual form. *Tupaia's Map is not an expression or representation of Polynesian ways of modelling navigation and voyaging.*

What then would have been the ways in which Tupaia modelled ancestral navigation, before he translated some of the most important voyaging paths of his tradition into the very different model of a map that was set up for him? This is a question that Anja Schwarz and I had set aside in our research on Tupaia's Map, partly because we felt that we have neither the training nor the title to address this question. At the same time, it seems crucial to a fuller and less one-sided understanding of the knowledge transactions on board the *Endeavour*. In 2019, Anne Salmond directed us to Marianne 'Mimi' George and her work with the Vaka Taumako Project. This was our somewhat belated introduction to what is, to my knowledge, the only contemporary Polynesian voyaging tradition that remained in practice until Te Aliko Koloso Kaveia's death in 2009. Despite the severe interruptions of imperial capitalism and the colonizing mission, it endured under the guidance of an experienced master, and his teachings continue to be applied by his descendants in building new traditional vessels and attaining mastery at sea. It is not that we had not come across the Santa Cruz Islands and some of their voyaging protagonists before, primarily in the accounts of David Lewis of Tevake of Nifiloli. But it has been in our correspondences and later meetings with Mimi George that the relevance of Kaveia's guidance for better understanding the traces of Tupaia's teachings in the *Endeavour* archive began to resonate. Learning from the Vaka Taumako Project allowed us to see things in the archive that we had missed before. This particularly pertains to the Taumakoan *te nohoanga te matangi*, or wind positioning system, that serves as a complex model of knowledge to plan and undertake targeted voyaging. The foundational layer of the model consists of equidistant wind positions that are placed on the horizon around the voyager in clockwise progression. It is only when more fully understanding the encompassing significance of *te nohoanga te matangi* as taught by Kaveia that the potential significance of a 1769 entry in Robert Molyneux's ship log began to stand out: a seemingly inconspicuous list of 'Otaheite names for the Winds according to Tobia' (Figure 2).<sup>14</sup>

(2019): 1–95; idem, 'Corrections: An Update to "The Making of Tupaia's Map"', *Journal of Pacific History* 58, no. 1 (2023): 64–80; as well as Lars Eckstein, 'Hawaiki According to Tupaia: Glimpses of Knowing Home in Precolonial Remote Oceania', *Zeitschrift für Anglistik und Amerikanistik* 71, no. 1 (2023): 55–69.

<sup>14</sup> Molyneux, 'Otaheite Names for the Winds according to Tobia' (1768–9), in 'Master's Log', 62r.

*Otaheite names for the Winds according to Tobia.*

North .....	<i>Toomootoomarōā</i>	1111 <i>Morāiera whannōā</i>
NE .....	<i>Morāihētō</i>	1111 <i>Morāitewiriri.</i>
N .....	<i>Morāiphaiete</i>	West <i>Towiraaw</i>
ENE .....	<i>Morāichawroo</i>	1111 <i>Ewharōā</i>
East .....	<i>Morāimona</i>	1111 <i>Mowepuwhāle</i>
SE .....	<i>Morāimoetai</i>	1111 <i>Moweraowarōo</i>
South .....	<i>Morāiwhaitū</i>	1111 <i>Mowahōā. —</i>

FIGURE 2. Robert Molyneux, 'Otaheite names for the winds according to Tobia', in 'Master's Log' (1768–9), National Archives Kew, London, Adm 55/39.

In this essay, I shall propose that what Tupaia shared with Molyneux is in fact the foundational layer of a complex navigational model that is best referred to as a wind positioning system or, in Tahitian, *rua mata'i*. The core experiment of this essay is to compare the Taumakoan *te nohoanga te matangi*, taught by Kaveia and publicized at his request by George, with the Ra'iātean *rua mata'i* which Tupaia shared with Cook's crew, as best as it can be reconstructed from the available archival traces. I believe that this exercise is vital to rethinking ancestral Oceanian voyaging far beyond Taumako and Tahiti, given that historical wind positioning systems have been documented in places as far apart as Anuta, Tikopia, Vanuatu, the Marianas, Tokelau, Fiji, the Southern and Northern Cook Islands, the Tuamotus, the Marquesas, or Aotearoa New Zealand.<sup>15</sup> In the following, I set out with a more general introduction to wind positioning systems before trying to establish the actual wind positions in Tupaia's model. The next two sections then explore how, based on Kaveia's teachings, we might conceive the ontology of Tupaia's wind positioning system and the ways in which it relates to and conceives the role of ancestral presences. This allows me to explore at some length the interrelations between wind positions and astronomical events and the possible seasonality and calendrics structuring Tupaia's model. I discuss the relevance of swell patterns, as well as the voyaging paths that are built into Tupaia's *rua mata'i*. In the last section, I turn to the concept of a primordial cosmic axis along which islands may swim or drift, expressed in the concept of *hiti*, which brings me full circle again to Tupaia's Map.

I write this essay mostly from Berlin, Germany, in full knowledge that I cannot claim ownership of the Oceanian knowledges that it draws upon or on the knowledge it may ultimately produce. I have embarked upon this project understanding that Tupaia had chosen to impart his knowledge of ancestral

<sup>15</sup> E.g. Cathy Conboy Pyrek and Richard Feinberg, 'The Vaeakau-Taumako Wind Compass as Part of a "Navigational Toolkit"', *Structure and Dynamics: eJournal of Anthropological and Related Sciences* 9, no. 1 (2016): 41–69. Thanks to Chris Ballard and Michael Koch for pointing me to wind systems from Vanuatu and the Marquesas respectively.

voyaging with *pōpa'ā*, in this case with the strangers aboard the *Endeavour*, for reasons we can only speculate about, both by drawing the map of his Polynesian sea of islands and by sharing the foundational outline of his *rua mata'i*. From the historical records, it is evident that Cook and his crew only partially understood or accepted Tupaia's gifts, and it remains unclear how much they returned in kind. The least that Western sciences as heirs of the imperial Enlightenment inaugurated by Bougainville's and Cook's voyages can do, I suppose, is belatedly to appreciate and understand as best as possible what Tupaia had to offer, in a spirit of epistemic decolonization.

## POLYNESIAN WIND POSITIONING SYSTEMS

What, then, are wind positioning systems of the kind which Tupaia apparently cared to teach the *Endeavour* crew? Oceanian wind positioning models have been designed for different purposes. Some applications are land-based. Others, such as Kaveia's or Tupaia's systems, were primarily designed for navigating ocean spaces. Different systems have addressed different scales of voyaging activity, ranging from inner-archipelagic travel to the range of ocean space covered by Tupaia's Map, which extends across much of the South Pacific and into the North Pacific. This again is complicated by the fact that characteristic Pacific winds change across different regions. This is true also of the latitudinal corridor in which all islands on Tupaia's Map (with the exception of O'ahu in Hawai'i) are located, even if the signature winds tend to be relatively stable in this geographical region (that is, between around 8° S in the Marquesas and 27° S in Rapa Iti, ranging from Rotuma in the W to at least the Pitcairn Group in the E).<sup>16</sup> But wind, weather, and climate have also changed in time, as have Oceanian cultures. Across Polynesian cultural spaces, the names and relationships of wind positions to other phenomena therefore vary in different places. A case in point is the westerly *to'erau* wind. In the system taught by Kaveia in Taumako, in the eastern Solomons, *te tokelau* marks a NWern bearing (Figure 3),<sup>17</sup> just like in systems recorded from the Southern and Northern Cooks in the 19th century, where *tokerau* tends to be housed in the NW (Figure 4).<sup>18</sup> In the Society Islands, *to'erau* is often situated N. In Tupaia's wind positioning system, however, *to'erau* clearly designates a westerly system. This corresponds with Spaniard José de Andía y Varela's list of 16 wind positions shared by the Makatean navigator

<sup>16</sup> Here and in the following, I use capitalized abbreviations for cardinal points and wind directions.

<sup>17</sup> Daniel Jackson after Marianne George, 'Te Nohoanga Te Matangi – the Thirty-two Named Positions and Four Pairs', in Marianne George, 'Polynesian Navigation and *Te Lapa* – "The Flashing"', *Time and Mind: The Journal of Archaeology, Consciousness and Culture* 5, no. 2 (2012): 145, Figure 3.

<sup>18</sup> 'Cook Islands Wind Compass (after Gill 1876)', in David Lewis, *We, the Navigators*, 113, Figure 19; W. Wyatt Gill, *Myths and Songs from the South Pacific* (London: Henry S. King, 1876), 320. See also Ernest Beaglehole and Pearl Beaglehole, *Ethnology of Pukapuka* (Honolulu: Bernice P. Bishop Museum, 1938), 21–2.

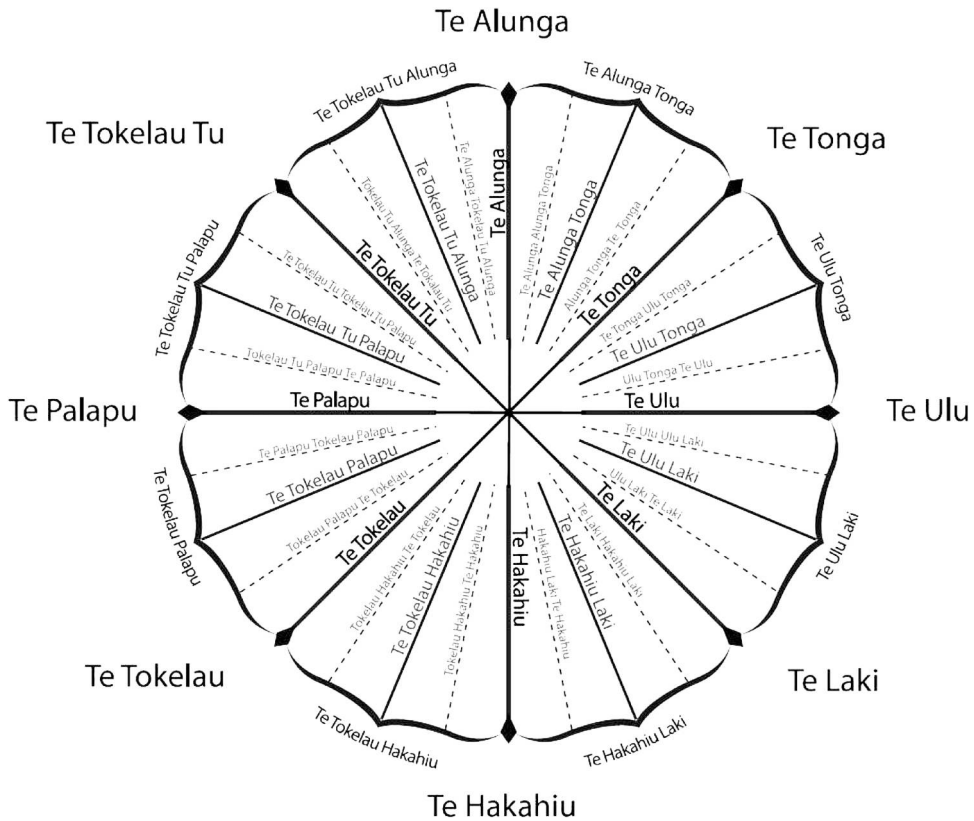


FIGURE 3. Daniel Jackson after Mimi George, ‘*Te Nohoanga Te Matangi* – the thirty-two named positions and four pairs’, in Marianne George, ‘Polynesian Navigation and *Te Lapa* – “The Flashing”’ (2012).

Puhoro with the crew of the *Jupiter* in the Society Islands only five years later, in 1774, which also locates ‘Etoerau’ due W (Figure 5).<sup>19</sup>

Beyond *to’erau* and a handful of other wind names, the convergence between Puhoro’s 1774 and Tupaia’s 1769 *rua mata’i* is limited. Still, Andía y Varela’s contextual information is valuable to begin to better understand Tupaia’s model. It is vital in this context that Puhoro explained that Tahitians ‘divide the horizon into sixteen parts, taking for the cardinal points those at which the sun rises and sets’.<sup>20</sup> In Kaveia’s teachings of the Taumakoan *te nohoanga te matangi*, wind positions are conceptualized as oppositional pairs, marking 32 positions equidistant from each other around the horizon (see Figure 3).<sup>21</sup> The Taumakoan *te nohoanga te matangi* shows

<sup>19</sup> José de Andía y Varela, ‘Relación del viaje hecho a la Isla de Amat [Tahití], y sus adyacentes a bordo de la Fragata “La Aguila”, bajo el comando de Domingo de Bonachea’ (1774), 172r, Archivo del Museo Naval, Madrid, AMN 0145 Ms. 0190/007.

<sup>20</sup> Andía y Varela in B.G. Corney, *The Quest and Occupation of Tahiti by Emissaries of Spain during the Years 1772–1776* (London: Hakluyt Society, 1913–19), vol. 2, 284.

<sup>21</sup> George, ‘Polynesian Navigation’, 135–74.

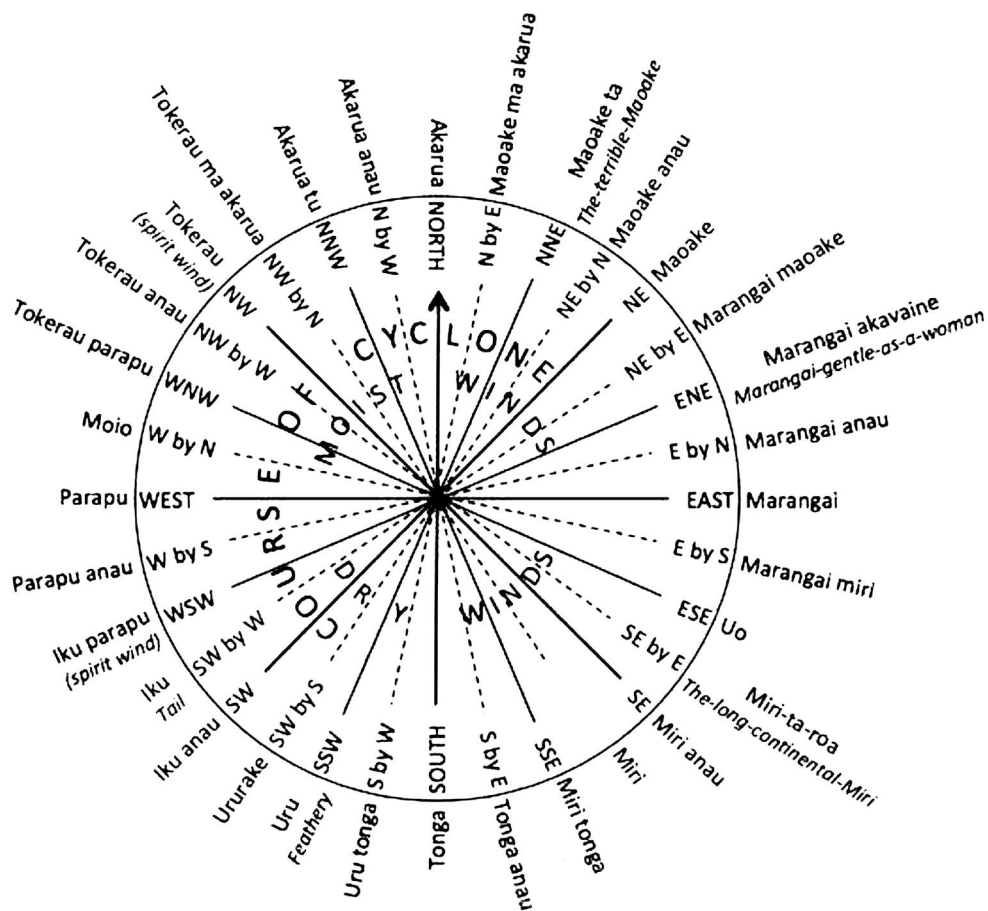


FIGURE 4. ‘Cook Islands wind compass (after Gill 1876)’, in David Lewis, *We, the Navigators* (1994).

32 named positions. In Mimi George’s account (personal communication), Kaveia taught wind positions in stages: in the first stage, he established 8 major named positions and sectors around the horizon and explained how to name the 24 in-between positions, using a neighbour-combining naming system. In a second stage, he explained how each of the eight major positions is tied to the one opposite it around the horizon, thus forming four basic pairs. Kaveia confirmed to George that all 32 wind positions in the model have a partner and thus make up 16 pairs – but Kaveia did not elaborate on sub-positions of the basic four pairs until he was, in a third stage of teaching, describing wind positions that asterisms rise and set in, as well as ‘special winds’ that move between positions in certain patterns.

Given Puhoro’s instruction of 16 positions and Kaveia’s insistence on wind pairs, it is likely that the *rua mata’i* recorded by Molyneux (see Figure 2) is incomplete: for it only names and marks 14 wind positions, in uneven distribution. We may thus assume that up to 18 further wind positions Tupaia knew were not captured in Molyneux’s records, or else that Tupaia’s *rua mata’i* indeed operated without exclusively binary wind pairs. In a

Este	-----	Εμαααα
Ε:νορδεστε	-----	Εαπιη
Νορδεστε	-----	Εταυγααα
Νορνορδεστε	-----	Εφαααα
Νορτε	-----	Εαοφαα
Νορ νονορτε	-----	Μοεγιο
Νορο εστε	-----	Αμμεαα
Ο:ενορο εστε	-----	Εταφοαα
Ο:εστε	-----	Ετοεαα
Οεσ:νδοεστε	-----	Εκαπαα
Οδουεστε	-----	Εκααα
Οο:νδο εστε	-----	Ενι:τιυαα
Ουα	-----	Ευαμυα
Ουα:νυεστε	-----	Εραγενια
Ουεστε	-----	Μαααα
Εσ:νυεστε	-----	Ευαααα

FIGURE 5. José de Andía y Varela, [List of 16 wind positions recorded from the Makatean navigator Puhoro], in ‘Relación del viaje hecho a la Isla de Amat [Tahití]’ (1774), Archivo del Museo Naval, Madrid, AMN 0145 Ms. 0190/007.

model similarly lacking the logic of oppositional wind pairs, the Tahitian wind positioning system recorded from Marau Ta’aroa by Craighill Handy shows 23 named wind positions (Figure 6).<sup>22</sup> What is important to note here is that the question of possibly incomplete pairs in Tupaia’s system only applies to minor wind positions and does not extend to what are the major houses providing the primary orientation. In Kaveia’s teachings, the primary structure of *te nohoanga te matangi* consists of ‘four pairs that make up the primary eight positions’ (*te alunga – te kahaiu; te papalu – te ulu; te tokelau tu – te laki; te tokelau – te tonga*; see Figure 3). In Tupaia’s system, too, the corresponding signature winds, offering a ‘basic orientation grid’,<sup>23</sup> are all present, dividing the horizon into eight major sectors. A set of special winds which sit in or move through the eight major sectors are detailed for the hurricane season (this is for westerly and northerly positions), but not for the more stable trade-wind patterns (see Figure 10).

There is strong evidence to support the notion that the *rua mata’i* Tupaia shared with Molyneux, like Kaveia’s system, relates to long-distance ocean voyaging. Many of the wind names bear direct references to distinct qualities of open-ocean phenomena such as swells, currents, or waterspouts. But more importantly, Molyneux recorded his list of ‘Otaheite names for the Winds according to Tobia’ in his journal right after recording the composite list of islands Tupaia dictated or

<sup>22</sup> [Marau Ta’aroa], ‘Chart of Wind Names’, in E.S. Craighill Handy, *Houses, Boats, and Fishing in the Society Islands* (Honolulu: Bernice P. Bishop Museum, 1932), 67, Figure 14.

<sup>23</sup> George, ‘Polynesian Navigation’, 145.

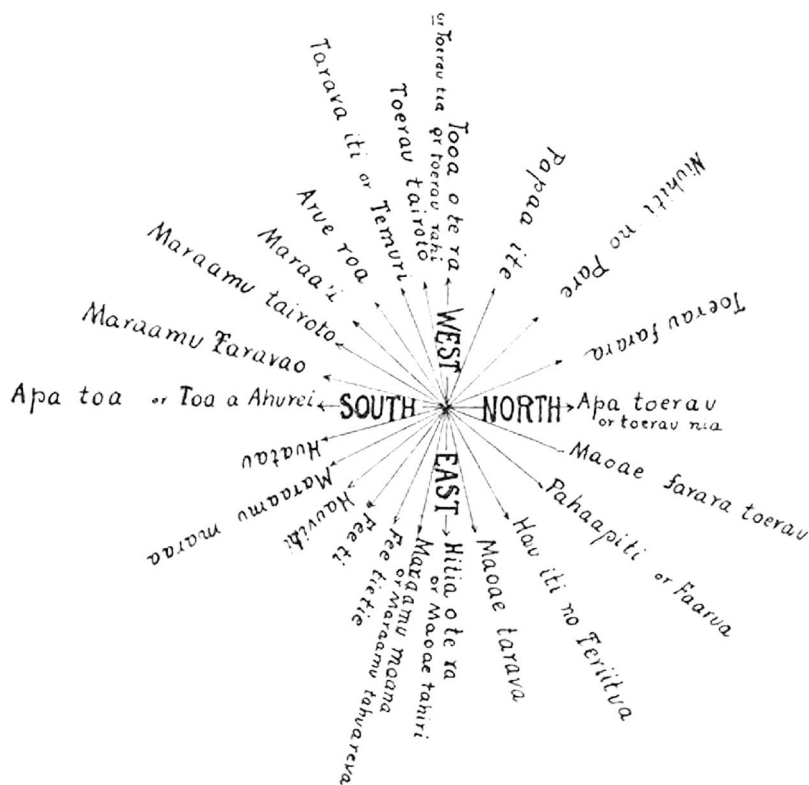


FIGURE 6. [Marau Ta'aroa], 'Chart of wind names', in E.S. Craighill Handy, *Houses, Boats, and Fishing in the Society Islands* (1932).

chanted for him, which later played a key role in the drawing of Tupaia's Map. Molyneux framed these as follows: 'Tobia's Office as Priest has not hinder'd him from travelling which he is very fond of... Towbia has seen many of these Islands & has a number more on Tradition that are not here mention'd'.<sup>24</sup> It is very likely, therefore, that the recording of Tupaia's *rua mata'i* formed part of the same conversations about Polynesian geography, voyaging, and migration on board the *Endeavour* which also contributed to the making of Tupaia's Map of Oceania.

*Rua mata'i* are cognitive systems which do not merely passively record and organize winds. This is expressed in the Taumakoan phrase *te nohoanga te matangi*, the conceptual term Kaveia used in teaching his own wind positioning system. As George explains, *nohoanga* denotes the 'positioning', 'seating', or 'housing' of *te matangi/te mata'i*, 'the wind'. *Rua* in Tahitian cosmogony denotes an opening on the level of the horizon, enabling a connection that is both material and spiritual. *Rua mata'i/matangi*, like *te nohoanga te matangi*, is thus expressive of an essentially active relation between the voyager and specific winds. It is expressive not of a passively recording 'compass', but of a cognitive system or mental model in which human agents interact with and actively influence or effect the 'position' of winds around

<sup>24</sup> Molyneux, 'Master's Log', 61v.

the horizon.<sup>25</sup> The term ‘wind compass’ habitually used in Western literature is therefore misleading. In English, I follow George in using ‘wind positioning system’ as the most appropriate translation of *te nohoanga te matangi* or *rua mata’i*.

Kaveia’s teachings correspond closely with William Gill’s account of the most comprehensive central Polynesian ‘rua matangi’ recorded in Mangaia in the early second half of the 19th century ‘from the lips of the ancient priests’.<sup>26</sup> The Mangaian model details, like its Taumakoan counterpart, 32 wind positions (see Figure 4). Both the Mangaian and the Taumakoan systems conceptualize the annual seasonal progression of the winds in a clockwise movement around the horizon, from the trade-wind season to the hurricane season and back. In both systems, the winds are perceived to be controlled by the deified ancestor Raka/Lata and his children. Initiated descendants of Raka/Lata (Rātā in Tahitian) can therefore establish relations to, and ultimately ‘call’ winds to desired positions (under specific circumstances and seasonal conditions).<sup>27</sup> Kaveia’s teachings and Gill’s annotations also agree on the fact that the foundational orientation or ‘head’ of the wind positions is in the E.<sup>28</sup> In the Mangaian system, it houses the *marangai* wind, in Taumako *te alunga*, literally ‘the pillow’.

#### THE WIND POSITIONS IN TUPAIA’S *RUA MATA’I*

Clearly identifying any of the winds in Tupaia’s *rua mata’i* is a challenge in more than one respect. The first is linguistic. As in the preceding list of island names in Molyneux’s journal, identification is complicated by the fact that Molyneux transcribed Tupaia’s Tahitian in a rather intuitive English phonology that is not always consistent. In the journal, both the list of island-to-island voyaging paths and the ‘names for the Winds according to Tobia’ are inserted between the journal entries for the three-month stay in Matavai Bay in Tahiti and the departure for the Leeward Society Islands on 14 July 1769. We cannot conclude from this, however, that 13 July was the date of the recording of the wind names; rather, it looks as if the entries in this section were retrospectively inserted. What can be assumed, though, is that Molyneux and Tupaia had already spent substantial time together when they discussed winds and ancestral voyaging and that Molyneux also had a better command of Tahitian than most other officers, given that he had already met Tupaia in his capacity as master’s mate on Wallis’s *Dolphin* during the first European visit to Tahiti in 1767. Molyneux’s transcriptions are, overall, relatively reliable, while his phonological practice can be approximately systematized in comparative perspective, not least between his records of island and wind names.

The second challenge in identifying Tupaia’s wind positions is that historical records of wind names in Society Islander tradition are relatively scarce while, as indicated above, not only do wind positions shift within any local tradition, but

<sup>25</sup> George, ‘Polynesian Navigation’, 144.

<sup>26</sup> Gill, *Myths and Songs*, 319.

<sup>27</sup> *Ibid.*, 321; Marianne George, dir., *We, the Voyagers: Lata’s Children (Matou Nga MakuPuna o Lata)*, Part 1: *Our Vaka* and Part 2: *Our Moana* (Vaka Taumako Project, 2020), Part 2.

<sup>28</sup> Gill, *Myths and Songs*, 320; George, ‘Polynesian Navigation’, 145.

wind names also vary across time and space. There is relatively little congruence between wind names across the various central Polynesian wind positioning systems that have been recorded over the past 250 years. The attempt to identify the wind positions in Tupaia's model as reliably as possible in the following therefore draws on a range of different sources. This includes other historical wind positioning systems in the region, especially those recorded by Andía y Varela in the Tuamotus/Tahiti in the 18th century, Gill in Mangaia in the 19th century, and Handy in Tahiti in the early 20th century.<sup>29</sup> For Puhoro's system, Andía y Varela's manuscripts are more reliable than B.G. Corney's early-20th-century translation.<sup>30</sup> Further sources include the seminal online dictionary of Fare Vāna'a/Académie Tahitienne;<sup>31</sup> John Davies's classic *A Tahitian and English Dictionary*;<sup>32</sup> historical journals such as William Anderson's contributions to the narrative of Cook's third voyage;<sup>33</sup> Jacques-Antoine Moerenhout's *Voyages aux îles du Grand Océan*;<sup>34</sup> missionary records of ancestral traditions containing information on winds, like Teuira Henry's edition of John Muggridge Orsmond's manuscripts in *Ancient Tahiti* and Tyerman and Bennet's *Journal of Voyages and Travels*;<sup>35</sup> early ethnographic accounts such as Pierre-Adolphe Lesson's *Les Polynésiens*;<sup>36</sup> and the work of the late Jean-Claude Teriierooiterai.<sup>37</sup> Given the dynamic change of wind positions in local traditions, most credit is given to wind positions recorded close to Tupaia's time.

I turn now to Molyneux's recording of Tupaia's wind positions (see Figure 2). Rather than beginning with the wind blowing from the north and thus following the logic of the Western compass which evidently guided Molyneux's conceptual understanding, I begin with a cluster of winds that share the designation *mara'ai*. *Mara'ai*, for

<sup>29</sup> Andía y Varela, 'Relación del viaje', 172r; Gill, *Myths and Songs*, 320; [Marau Ta'arua], 'Chart of Wind Names'.

<sup>30</sup> Andía y Varela in Corney, *The Quest and Occupation of Tahiti*, vol. 2, 184–6. However, I consistently use Corney's translation when quoting Andía's contextualizations.

<sup>31</sup> Fare Vāna'a/Académie Tahitienne, *Dictionnaire en ligne*, <https://farevanaa.pf/dictionnaire.php>

<sup>32</sup> [John Davies], *A Tahitian and English Dictionary, with Introductory Remarks on the Polynesian Language, and a Short Grammar of the Tahitian Dialect* (Tahiti: London Missionary Society Press, 1851).

<sup>33</sup> William Anderson in James Cook and James King, *A Voyage to the Pacific Ocean ... Performed under the direction of Captains Cook, Clerke, and Gore, in His Majesty's ships the Resolution and Discovery, in the years 1776, 1777, 1778, 1779, and 1780* (London: G. Nicol and T. Cadell, 1784), 3 vols.

<sup>34</sup> Jacques-Antoine Moerenhout, *Voyages aux îles du Grand Océan* (Paris: Bertrand, 1837), 2 vols.

<sup>35</sup> Teuira Henry, *Ancient Tahiti, Based on Material Recorded by J.M. Orsmond* (Honolulu: Bernice P. Bishop Museum, 1928); Daniel Tyerman and George Bennet, *Journal of Voyages and Travels by the Rev. Daniel Tyerman and George Bennet, Esq., Deputed from the London Missionary Society, to Visit their Various Stations in the South Sea islands, China, India, &c., between the years 1821 and 1829* (Boston: Crocker and Brewster, 1832), 3 vols.

<sup>36</sup> Pierre-Adolphe Lesson, *Les Polynésiens : Leur origine, leurs migrations, leur langage*, ed. Ludovic Martinet (Paris: Ernest Leroux, 1880–4), 4 vols.

<sup>37</sup> Jean-Claude Teriierooiterai, 'Mythes, astronomie, découpage du temps et navigation traditionnelle: L'héritage océanien contenu dans les mots de la langue tahitienne'. PhD thesis, Université de la Polynésie française, Tahiti, 2013.

Tupaia, seems to have served as a conceptual frame for wind positions in the long trade-wind season. Altogether, seven houses fall under the category of *mara'ai*, ranging from the NE to the WSW. Each *mara'ai* marks a different position in the seasonal progression of winds and is qualified by a different characteristic.

*Mara'ai pāha'apiti (M: Moraiphaietee): housed in the NE*

*Pāha'apiti* does not emerge very clearly from Molyneux's transcription, yet is the likely wind designated here. It corresponds with the Tahitian system recorded by Handy, which also places 'Pahaapiti' in the NE.<sup>38</sup> Without the *pā* (signifying the force of its blowing), it resonates, for instance, with Andía y Varela's account of Pohoru's 'Eapiti' (located ENE).<sup>39</sup> Henry translated 'Ha'apiti' in the chant 'The Birth of Winds' as 'North-wind-with-two-currents'.<sup>40</sup> Tyerman and Bennet recorded 'a gusty wind, with heavy blasts, and rain, from whatever quarter, *haapiti*', while Lesson noted about the *ha'apiti*: 'the NE wind, ... blowing occasionally with much force; the atmosphere is then often clouded and it rains; but when [it] is moderate, the skies are clear and untroubled'.<sup>41</sup>

*Mara'ai hū'aru? (M: Moraiahawroo): housed in the ENE*

The most likely interpretation of this wind name is to read it as *mara'ai hū'aru*.<sup>42</sup> This resonates with Puhoro's system as recorded by Andía y Varela, where the wind position following 'Eapiti' (*haapiti*) in the ENE in clockwise progression is 'Etaguaru' (*e tauhū'aru*).<sup>43</sup> *E tau* is 'the season [of]', *hū'aru*. This wind position seems no longer to appear in any system recorded after Tupaia's and Puhoro's time. Davies translated *hū'aru* as 'the white froth of the sea'.<sup>44</sup> *Mara'ai hū'aru* ('*mara'ai* of the white sea foam') would thus speak of a particular seasonal quality of the ocean in the early progression of the trades.

*Mara'ai moana (M: Moraimona): housed in the E*

Adapting Kaveia's teachings of the Taumakoan *te nohoanga te matangi* as fundamentally oriented to the E, *mara'ai moana* would mark the position where the 'head' rests in

<sup>38</sup> [Marau Ta'aroa], 'Chart of Wind Names'.

<sup>39</sup> Andía y Varela, 'Relación del viaje', 172r.

<sup>40</sup> Henry, *Ancient Tahiti*, 364.

<sup>41</sup> Tyerman and Bennet, *Journal of Voyages and Travels*, vol. 1, 214; Lesson, *Les Polynésiens*, vol. 2, 311, my translation.

<sup>42</sup> Molyneux's transcription initially suggests *mara'ai haurū*, which would denote a calm wind (see *hau* in Fare Vāna'a, *Dictionnaire en ligne*) essentially unsuitable for voyaging. There seem to be no historical records of such a wind, though, and it would not match the typical seasonal progression of wind patterns in the trade-wind season.

<sup>43</sup> Andía y Varela, 'Relación del viaje', 172r.

<sup>44</sup> Davies, *A Tahitian and English Dictionary*, 112.

Tupaia's system, correspondingly defined by 'the signature position from which the trade winds blow early in the trade wind season'.<sup>45</sup> *Moana* ([open, deep, blue] ocean) expresses the essential quality of this *mara'ai* for open-ocean voyaging. In the ancestral chant 'The Birth of Winds', the attribution of *moana* qualifies the wind as 'deep and vast', bringing clear skies.<sup>46</sup>

*Mara'ai maita'i* (*M: Moraimoetai*): housed in the SE

*Maita'i* simply translates to 'very good', which in the context of *rua mata'i* would have designated the ultimate settling position of a wind, here the trades.<sup>47</sup> In the latitudinal corridor in which all the voyaging paths Tupaia translated on to his chart of Oceania are situated (with the exception of the route to Hawai'i), the trades reliably settle in a SEern position when the season progresses. *Mara'ai maita'i* thus designates the unmarked trade-wind position. It corresponds very well with Puhoro's 1774 model, which also locates 'Maray' in the SE.<sup>48</sup>

*Mara'ai fe'etī* (*M: Moraiwhaiete*): housed in the S

Molyneux's transcription rather clearly suggests *mara'ai fe'etī*. Both Lesson and Davies document *fe'etī* as a southerly wind in Tahitian traditions.<sup>49</sup> Lesson noted, moreover, that *fe'etī* is another name for the *mara'amu*, the signature south wind in Tahitian traditions, which features prominently in the chant 'The Birth of Winds'.<sup>50</sup>

*Mara'ai arafenua* (*M: Moraiarawhannooa*): housed in the SW

Literally, 'path from the land', *arafenua* is also positioned in the SW by Tyerman and Bennet in their records from Huahine. Lesson describes it as 'strong' and Davies as a 'high wind from the westward'.<sup>51</sup>

<sup>45</sup> George, 'Polynesian Navigation', 145.

<sup>46</sup> Henry, *Ancient Tahiti*, 364.

<sup>47</sup> Libor Teonui Prokop, personal communication.

<sup>48</sup> Mimi George explained to me in personal communications that, in the context of Taumako, not all winds blowing from the corresponding signature house of *te tonga*, or between *te alunga* and *te tonga* (where the winds may sit for months) are indeed 'very good' for sailing, as they may be too strong and currents are ripping. See also George, 'Polynesian Navigation', 149.

<sup>49</sup> Lesson, *Les Polynésiens*, vol. 2, 311; Davies, *A Tahitian and English Dictionary*, 85. The Tahitian system recorded by Handy in the 19th century locates 'Fee ti' in the SE. [Marau Ta'aroa], 'Chart of Wind Names'.

<sup>50</sup> Lesson, *Les Polynésiens*, vol. 2, 311; Henry, *Ancient Tahiti*, 364.

<sup>51</sup> Tyerman and Bennet, *Journal of Voyages and Travels*, vol. 1, 214; Lesson, *Les Polynésiens*, vol. 2, 312; Davies, *A Tahitian and English Dictionary*, 32. In Puhoro's system, 'Eragenia' is located SSE. Andía y Varela, 'Relación del viaje', 172r.

Mara'ai tōriri (M: *Moraitowrerre*): housed in the WSW

Molyneux's transcription is rather unambiguous. In Tahitian, *tōriri* signifies a drizzle, or very fine type of rain.<sup>52</sup> *Mara'ai tōriri*, then, is literally the 'mara'ai of the drizzling rain'. This wind does not seem to appear in any other historical record. In Tupaia's *rua mata'i*, it designates the last *mara'ai* position in the yearly cycle and, like in Kaveia's *te nohoanga te matangi*, marks the ultimate end of the trade wind with the beginning of the hurricane season, as announced by that particular quality of rainfall.

To'erau (M: *Towiraow*): housed in the W

*To'erau* is ambiguous in Society Islander traditions. While it often signifies plain 'north' (see the corresponding entry in Fare Vāna'a), the wind positions *to'erau* designated in the historical sources actually range 'from north to west'.<sup>53</sup> Davies registered it as 'a westerly, or north-westerly wind',<sup>54</sup> while Moerenhout positioned it due W.<sup>55</sup> During Cook's third voyage in 1777, Anderson noted:

when the sun is nearly vertical, that is, in December and January, the winds and weather are both very variable; but it frequently blows from West North West, or North West. This wind is what they call *Toerou*; and is generally attended by dark, cloudy weather, and frequently by rain. It sometimes blows strong, though generally moderate; but seldom lasts longer than five or six days without interruption.<sup>56</sup>

Puhoro's model as recorded by Andía y Varela, like Tupaia's, locates 'Etoerau' in the W.<sup>57</sup> In Tupaia's *rua mata'i*, *to'erau* seems to have designated the signature position of westerly systems.

Fa'arua (M: *Ezharrooa*): housed in the WNW

*Fa'arua* literally translates to a wind with 'two valleys' or 'double swell'. In Tahitian traditions, it is best known as an alternative designation for the *pāha'apiti*, housed, as in Tupaia's system, in the NE.<sup>58</sup> The *fa'arua* in Tupaia's *rua mata'i*, however, is clearly a

<sup>52</sup> E.g. Davies, *A Tahitian and English Dictionary*, 281.

<sup>53</sup> Tyerman and Bennet, *Journal of Voyages and Travels*, vol. 1, 214.

<sup>54</sup> Davies, *A Tahitian and English Dictionary*, 276; cf. Lesson, *Les Polynésiens*, vol. 2, 312.

<sup>55</sup> Moerenhout, *Voyages aux îles du Grand Océan*, vol. 2, 182.

<sup>56</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

<sup>57</sup> Andía y Varela, 'Relación del viaje', 172r.

<sup>58</sup> [Marau Ta'arua], 'Chart of Wind Names'; see also Davies, *A Tahitian and English Dictionary*, 76.

different wind, qualifying a westerly system that marks the transition from the *to'erau* to cyclonic positions. This is confirmed by Anderson, who remarked that 'the *Farooa*' is a violent wind which 'often succeeds the *Toerou*'.<sup>59</sup> Lesson recorded 'Ohiuhiu fa'arua, the name given to a NW wind which rises slowly' between the *to'erau* and the *pāfaite*.<sup>60</sup>

*Maoa'e pāfaite (M: Mowepawhaete): housed in the NW*

Across the historical records (including the systems recorded by Andía y Varela, Gill, and Handy), the *maoa'e* is typically assigned various positions during the trade-wind season, ranging from NE to SE. In Tupaia's model, however, this appellation marks three cyclonic, northwesterly positions. *Maoa'e pāfaite* literally translates as the 'maoa'e of ocean spouts', or 'vortex' wind. The *pāfaite* is widely recorded in Society Islander traditions. While in Puhoro's system, 'Paofaeti' is housed in the N,<sup>61</sup> most other sources agree very well with Tupaia's positioning of the wind in the NW.<sup>62</sup>

*Maoa'e aruaru?<sup>2</sup> (M: Moweraowarrou): housed in the NWbN*

Molyneux's transcription of the second *maoa'e* position in Tupaia's system suggests *maoa'e aruaru*. There are no Polynesian winds in the surviving records that resonate closely. *Aruaru*, however, signifies to be 'following',<sup>63</sup> which makes sense for a *maoa'e* position in close proximity to and following suit upon the tempestuous *pāfaite*.<sup>64</sup>

*Maoa'e hu'a?<sup>2</sup> (M: Mowahooa): housed in the NNW*

This is the last in the cluster of three *maoa'e* positions which mark the progression of northwesterly systems in the cyclone season. There seem to be no wind names in the historical records that directly correspond to the entry. The most likely signification of

<sup>59</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

<sup>60</sup> Lesson, *Les Polynésiens*, vol. 2, 312, my translation.

<sup>61</sup> Andía y Varela, 'Relación del viaje', 172r.

<sup>62</sup> Henry, *Ancient Tahiti*, 364; Davies, *A Tahitian and English Dictionary*, 179; Lesson, *Les Polynésiens*, vol. 2, 312.

<sup>63</sup> Fare Vāna'a, *Dictionnaire en ligne*; see also Davies, *A Tahitian and English Dictionary*, 40.

<sup>64</sup> Another possible interpretation is to follow Corney's adaptation of Andía y Varela's records, listing 'Arueroa' for the NW position. Andía y Varela in Corney, *The Quest and Occupation of Tahiti*, vol. 2, 285. This, however, stretches Molyneux's transcription and does not emerge clearly from Andía y Varela's manuscripts, where the spelling is 'Aruerta'; see Figure 5). Tahitian traditions, moreover, agree on *arueroa* as a SW wind; see Davies, *A Tahitian and English Dictionary*, 40; [Marau Ta'arua], 'Chart of Wind Names'.

*hu'a* that resonates in the context of navigation is 'a spray of the sea' that seems to qualify this wind.<sup>65</sup>

Tumutumuroa (*M: Toomootoomooroa*): housed in the *N*

Molyneux's transcription is unmistakable here. There seems to be no other record of this wind name in Polynesian traditions. However, there are contextual traces: literally, *tumutumuroa* translates to 'distant origin' or 'great foundation', and thus clearly has cosmogonic and genealogical resonances. In her discussion of chants and legends about 'incarnations of gods and spirits', which extends to winds, Henry remarked that 'The Huatau (North-wind) was from Ta'aroa, the Great-foundation'.<sup>66</sup> *Tumutumuroa* may thus be another name, version, or annotation of the *huatau*, which Davies recorded as 'a strong north wind'.<sup>67</sup>

Mohiotū (*M: Mowheootoo*): housed in the *NNE*

This wind name corresponds well with Puhoro's account of the *mohio* ('Moegio' in Andía y Varela's transcription).<sup>68</sup> The qualifier 'tū' typically signifies the settling of the wind in the progressing season, which may account for the shift from Puhoro's location of the *mohio* in the NNW to Tupaia's *mohiotū* in the NNE (as in the positions of *te tokelau* [NW] and *te tokelau tu* [NE] in Kaveia's system, see Figure 3). Teriierooiterai commented that, while the *mohio* wind has disappeared from Tahitian models, it still features as *mo'io* in the *rua matangi* of Mangaia (see Figure 4).<sup>69</sup>

Not all these winds have the same ontological weight. Like in Kaveia's model, Tupaia's system, too, would have consisted of primary winds and minor, less stable wind systems. The major winds mark the foundational axes of the system and consist of four pairs marking the eight major wind positions or *rua* around the horizon. This emerges also from the most significant (if short) genealogical chant about Tahitian winds recorded in Henry's *Ancient Tahiti*. Unfortunately, there is

<sup>65</sup> Davies, *A Tahitian and English Dictionary*, 111. *Hu'a* may also designate smallness or, without the glottal stop (*hua*), can mean female genitals, possibly qualifying this *maoa'e*. Fare Vāna'a, *Dictionnaire en ligne*.

<sup>66</sup> Henry, *Ancient Tahiti*, 393.

<sup>67</sup> Davies, *A Tahitian and English Dictionary*, 112. Other winds, too, are linked to deified ancestral presences in this context which is, however, land- rather than ocean-based. 'The Mara'amu-moana (Trade-wind)', Henry noted, 'came from the gods as a messenger of peace in the land'; the 'Fa'arua, or Tumurua came from Te-fatutiri (The-lord-of-thunder)'; and the 'To'erau (North-westerly) wind brought rain from the god Tumuruperupe (Cause-of-verdure) ... for times of peace'. Henry, *Ancient Tahiti*, 393–4.

<sup>68</sup> Andía y Varela, 'Relación del viaje', 172r.

<sup>69</sup> Teriierooiterai, 'Mythes, astronomie', 131.

no indication when, where, or from whom 'The Birth of Winds' originated. It goes as follows:

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*O Ra-ta'iri te metua tane, o Te-muri te metua vahine, fanau maira ta raua matahiapo, o Maa'a'e-ra'i-aneane, ei ari'i no te mau mata'i atoa.*

Ra-ta'iri ... was the father, Te-muri ... was the mother, and there was born their firstborn, Maa'a'e-ra'i-aneane ... , which became king over all the other winds.

*He'e te tua, o Pafa'ite; he'e te tua, o Mara'amu; he'e te tua, o Ha'apiti, oia o Fa'arua; a he'e te tua o Toerau, e mara'i-moana maira.*

There followed Pafa'ite ... ; then came Mara'amu ... ; then the boisterous Ha'apiti or Fa'arua ... ; and afterwards came Toerau – mara'i-moana [of the clear skies].<sup>70</sup>

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The firstborn wind in the chant of creation and 'king over all the other winds', 'Maa'a'e-ra'i-aneane' does not appear in any central Polynesian wind system. This makes sense, as 'aneane' signifies that it does not descend to the surface of the earth. *Maa'a'e ra'i aneane*, in other words, is a celestial wind in Tahitian traditions, tied to the upper realms of the sky from which only its siblings in the genealogy of winds descend.<sup>71</sup> The first wind to do so is *pāfai*, the cyclonic vortex wind blowing from the NW, forcing open the first primordial wind axis between the *rua* of *pāfai* and the oppositional opening, *mara'ai maita'i*, the stable southeasterly trade-wind position. The second wind to descend is *mara'amu*, a south wind in Tahitian traditions which in Tupaia's system assumes the name of *mara'ai fe'eti*. It establishes the second primordial axis between the *rua* of *mara'ai fe'eti* in the S, and the opening of *tumutumuroa*, or *huatau* in the N. The third axis in the genealogy of winds is then opened by the northeasterly *ha'apiti*, featuring as *mara'ai pāha'apiti* in Tupaia's system. It draws towards the house of *mara'ai arafenua* in the SW. And the fourth axis in the genealogy of the winds, finally, is established by the westerly *to'erau*. Here, the chant explicitly links the *rua* of *to'erau* with its opposite easterly *rua*, that of *mara'ai moana*, the signature position of the early trade winds where, in Mangaian, Taumakoan, and presumably also Tahitian traditions, the 'head' of the navigator rests.

The four primordial wind axes thus mark eight primary sectors around the horizon which serve as the primary grid of orientation. These sectors may then be further detailed by special winds that are important in navigational practice during different voyaging seasons. What is remarkable in Tupaia's model in this context is that during the core trade-wind season, when wind systems are stable for days and sometimes weeks on end without much variation – this is between the positions of *mara'ai moana* (in the E) and *mara'ai arafenua* (in the SW) – there appear no special or minor winds. Special winds in Tupaia's system are instead recorded for the in-between seasons and the cyclone season in particular when attending to wind

<sup>70</sup> Henry, *Ancient Tahiti*, 364.

<sup>71</sup> Libor Teonui Prokop, personal communications.

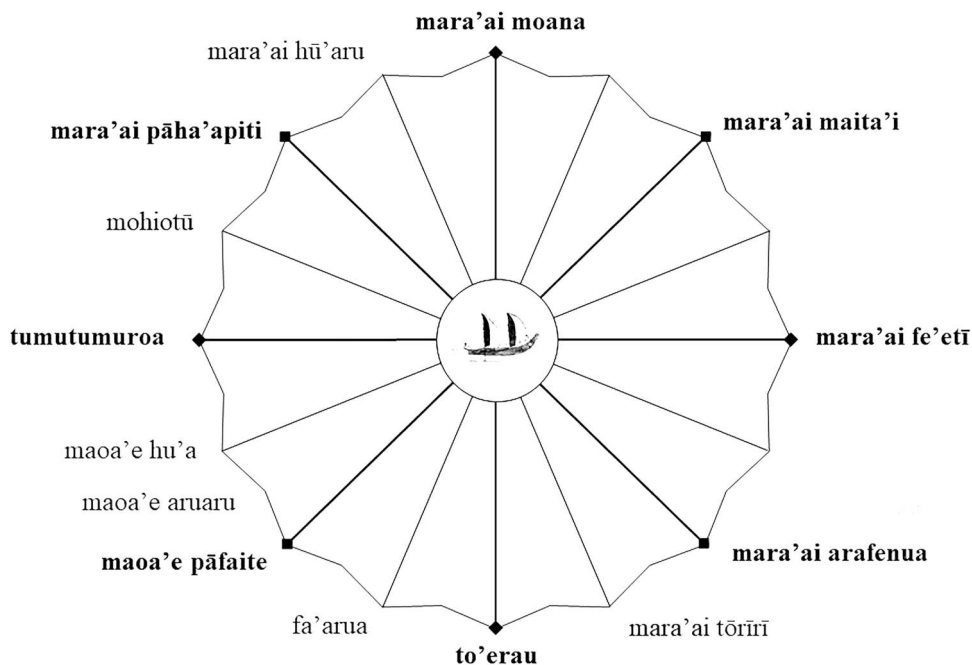


FIGURE 7. Lars Eckstein, 'Wind positions in Tupaia's *rua mata'i* (E on top): likely wind names in modern Tahitian transcription' (2025).

changes would have been particularly important for ancestral voyagers. The particular quality of rain of the transitional *marai to'iriri*, for instance, would have announced the arrival of more stable westerly *to'erau* systems, the signature wind for eastbound voyaging. *Fa'arua*, in turn, is clearly an indicator for the transition from the *to'erau* to cyclonic systems and signs of its arrival (changing wind directions and two competing swell trains) would have called for seeking immediate shelter. Anderson noted that the *fa'arua* 'blows down houses and trees ... but it is only of short duration'.<sup>72</sup> Similarly, the two *maoa'e* positions following the violent *pafaite* would have detailed the progression of cyclonic northwesterly systems and presumably their suitability for shorter voyages when *pafaite* gives way to more moderate *maoa'e* winds which follow (*aruaru*) and bring a particular quality of sea spray (*hu'a*). The particular quality of the ocean expressed by *marai hu'aru* (sea foam) would have announced the transition to the early settling position of the trades in the east in the season of *marai moana*, etc.

Roughly modelled on the graphs George and Kaveia developed together for the Taumakoan *te nohoanga te matangi*, I have visualized the basic outline of Tupaia's wind positioning system with wind names in modern Tahitian transcription (Figure 7).<sup>73</sup>

<sup>72</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

<sup>73</sup> Lars Eckstein, 'Wind positions in Tupaia's *rua mata'i* (E on top): likely wind names in modern Tahitian transcription' (2025).

TUPAIA'S *RUA MATA'I* AND KAVEIA'S *TE NOHOANGA TE MATANGI*

How might we begin to understand the ontological and epistemological complexities of Tupaia's wind positioning system and speculate about the ways in which Tupaia might have used it as a conceptual tool in navigational practice? To begin with, I argue that Tupaia's Polynesian wind positioning system is only indirectly related to the so-called star compass models which serve as the principal conceptual tool for navigation in the various Polynesian voyaging revivals. This observation should in no way discredit the modern star-based models used by Polynesian voyaging societies, which have proven to be profoundly effective in the voyaging revivals since the 1970s. They are all variations, in one way or the other, of Nainoa Thompson's system of star bearings, which he developed in collaboration with Will Kyselka in the Bishop Museum planetarium, as advised by Ben Finney and tested on successive voyages of the double-hull replica vessel *Hōkūle'a*. For the 1976 maiden passage of *Hōkūle'a* from Hawai'i to Tahiti, Thompson and his crew were famously trained in using their star system by master navigator Mau Pailug of Satawal. However, there is no direct relation of the Polynesian Voyaging Society star compass to central Polynesian traditions. In order to better understand the ontological validity and conceptual complexities of Tupaia's *rua mata'i*, it is more promising, therefore, to bring the archival evidence around Tupaia's navigational knowledge in conversation with the living Polynesian traditions of Taumako in the Santa Cruz Group of Solomon Islands in the Western Pacific.

David Lewis documented a version of the Taumakoan wind model in the late 1960s when sailing with the aged master navigator Tevake of Nifiloli, without, however, commenting much on the role of winds in his path-breaking *We, the Navigators* of 1972. In 2007 and 2008, Richard Feinberg conducted several months of fieldwork among the Taumakoan community and published articles, latterly with Cathy Conboy Pyrek, on their wind positioning system.<sup>74</sup> I take the lead in my approach, however, from the fact that in 1993, Paramount Chief Kaveia requested the anthropologist and sailor Mimi George to become principal investigator in the Vaka Taumako Project, which from 1996 systematically documented local vessel constructions and the *te nohoanga te matangi* system to preserve its life for future generations. Under Kaveia's direction, George and the Taumakoan community built and sailed the first *te puke* after more than 16 years of intermission. When Kaveia died in 2009, the project continued with a core team of his descendants. George and her collaborators produced two award-winning documentary films directed by a team of Taumako and Pacific Traditions Society volunteers, titled *We, the Voyagers: Part 1, Our Vaka*; and Part 2, *Our Moana*, to which this essay is greatly indebted.<sup>75</sup> George also wrote about Kaveia's teachings of *te nohoanga te matangi* in several academic publications, most importantly for this discussion in 'Experiencing *Mana* as Wind' and

<sup>74</sup> E.g. Richard Feinberg, 'Multiple Models of Space and Movement on Taumako, a Polynesian Island in the Southeastern Solomons', *Ethos* 42, no. 3 (2014): 302–31; Pyrek and Feinberg, 'The Vaeakau-Taumako Wind Compass'.

<sup>75</sup> George, dir., *We, the Voyagers*.

‘Polynesian Navigation and Te Lapa – “The Flashing”’.<sup>76</sup> My discussion of the relations between Tupaia’s *rua mata’i* and Kaveia’s *te nohoanga te matangi* will draw, too, on a series of personal exchanges over the past years with Mimi George and Luke Vaikawi, Kaveia’s grandson.

There are fundamental lessons to be learned from Kaveia’s teachings about wind positioning systems. To begin with, wind is the foundational category in an integrated cognitive model that is calibrated by a range of further interrelated elements and variables. This insight counters the reservation of Western scholarship against ‘wind compasses’ more generally, often arguing that wind is far too instable, impermanent, and imprecise a phenomenon to be attributed to specific cardinal positions around the horizon.<sup>77</sup> As George explained, wind positions denote sectors, in addition to singular bearings, and any position of a distinct wind in a given sector will do in navigational practice. The positions and sectors themselves are stabilized by the observation of interrelated phenomena, first and foremost astronomical: the houses of seasonal winds are tied to specific positions where the sun rises and sets throughout the yearly calendar, as well as to the positions of the moon, planets, stars, and the appearance and disappearance of specific asterisms. Key astronomic events establish detailed calendrics in the seasonal progression of a wind positioning system which also structures distinct seasons for distinct island-to-island voyaging paths. Wind positions, moreover, are intimately correlated with seasonal currents and swell patterns, which are themselves produced by signature winds, as well as with specific weather phenomena and changes in the migratory patterns of sea fauna, bird life, and other ancestral relations. In Kaveia’s model ancestors may even emit flashing lights from target islands travelling on the ocean surface toward the voyager for guidance, called *te lapa* in Taumakoan tradition.<sup>78</sup>

Wind positioning systems, this is to say, are complex integrated models which do not conceive of the winds in isolation, but as existing with and operating in relation to a host of other natural phenomena that voyagers relate to, more often than not, as ancestral presences. Not all of these are recorded or resonate in the surviving colonial records around Tupaia, or in Society Islander traditions more generally. There are, however, hints and traces which allow speculation about a range of concrete relations between Tupaia’s *rua mata’i* and Kaveia’s *te nohoanga te matangi*. These are discussed in detail in the following sections.

First, however, it is important to acknowledge and emphasize the sheer difference between what genealogies and histories suggest about ancestral Oceanian ways of being in and knowing the world, on the one hand, and the dualist philosophies of the modern sciences as shaped by the joint trajectories of the Enlightenment, capitalism, and imperial colonialism, on the other. As Anne Salmond noted about ancient Tahitian traditions:

<sup>76</sup> Marianne ‘Mimi’ George, ‘Experiencing *Mana* as Ancestral Wind-Work’, *Time and Mind: The Journal of Archaeology, Consciousness and Culture* 11, no. 4 (2018): 385–407; idem, ‘Polynesian Navigation’.

<sup>77</sup> E.g. Lewis, *We, the Navigators*, 133.

<sup>78</sup> George, ‘Polynesian Navigation’; George, dir., *We, the Voyagers*.

land and sea, plants and animals, stars and winds, canoes, god's houses and people were all linked together in one vast kin network. Particular beings could appear in the everyday world in different guises – Ta'aroa as an ancestor, a canoe or a god house; islands as fish; stars as ancestors, pillars or canoes sailing through the sky; whales and sharks as manifestations of ancestors. Two hundred years later, it is difficult to grasp the kind of reality that underpins these accounts.<sup>79</sup>

There is no easy access to precolonial ways of being and knowing, not least from my own position of writing. Still, in order to begin speculating about the conceptual complexities of Tupaia's *rua mata'i*, it is vital to unlearn some of the lessons that Western sciences have engrained as self-evident in their various academic disciplines and to accept the worldings of Oceanian traditions as profoundly scientific in their own right. In Salmond's words again, in 'most Western accounts of Polynesian navigation ... ontological refusals fundamentally distort our understandings of how the ancestors of Polynesian people were able to explore and settle the Pacific Ocean'.<sup>80</sup>

Kaveia's teachings are immensely instructive here. The key challenge for Western sciences is to accept that Kaveia's *te nohoanga te matangi* conceives of the voyager as being in reciprocal relation with a world of ancestral presences, which may manifest themselves as a wind, star, bird, shark, or other being. Navigational knowledge, in such a world, is essentially embodied and performative. Within this system, not only passive, but also active relations with ancestral presences are possible through the performance of appropriate rituals by initiated practitioners of *mana*. As George elaborated:

in many Pacific cultures there are different ontological realms (for instance *te po*, the ancestral realm ...) in which reality manifests itself differently from ordinary, everyday life. When relationships with ancestors are activated, the everyday world and the ancestral realm are linked, and this is associated with flows of *mana* as ancestral power.<sup>81</sup>

Traditional knowledge in Taumako centres on the first voyager and deified ancestor Lata, who is conceived of as being at the centre of *te nohoanga te matangi*. The relation of Taumakoan spiritual leaders to the ancestral presence of Lata allows them to perform what George calls 'wind and weather work'. Thus, George observed how Kaveia could temporarily stop heavy rain from falling.<sup>82</sup> And she reported with her Taumakoan film team that Kaveia successfully practised *mana* that affected wind: 'Kaveia did not try to stop strong winds

<sup>79</sup> Anne Salmond, 'Star Canoes, Voyaging Worlds', *Interdisciplinary Science Reviews* 46, no. 3 (2021): 268.

<sup>80</sup> *Ibid.*, 270.

<sup>81</sup> George, 'Experiencing *Mana*', 386.

<sup>82</sup> *Ibid.*, 401.

during a stable season. But early or late in the season or between seasons, he called the wind to a desired position, and within three days, it came to sit right there'.<sup>83</sup>

There is strong evidence that this kind of 'wind and weather work' persisted across Polynesia and was an integral part of the functioning of wind positioning systems. Closer to Tupaia's home, a very similar type of wind work was reported by Gill in the context of the Mangaian wind model, which likewise features Raka/Lata at its centre. Mangaian *tahunga* apparently used a calabash to model the 32 wind positions of the *rua matangi*: 'The vast concave above was symbolized by the interior of a calabash, in the lower part of which a series of small apertures was made to correspond with the various wind-holes at the edge of the horizon'. Whilst Taumakoan wind and weather workers practise *mana* using ritual wooden sticks, Mangaian *tahunga* operated by manipulating the openings in the calabash. Gill described the process thus:

Each hole was stopped up with cloth. Should the wind be unfavourable for a grand expedition, the chief priest began his incantation by withdrawing the plug from the aperture through which the unpropitious wind was supposed to blow. Rebuking this wind, he stopped up the hole, and advanced through all the intermediate apertures, moving plug by plug, until the desired wind-hole was reached. This was left open, as a gentle hint to the children of Raka that the priest wished the wind to blow steadily from that quarter.<sup>84</sup>

In Tupaia's world, too, voyagers would have understood their relation to wind and weather as reciprocal, as a relationship in which initiated practitioners of *mana* and the winds as ancestral presences had agency to affect each other. Irrespective of how we relate to this proposition within our own academic frameworks, I argue that it must be taken seriously when attempting to better understand how ancestral Polynesian voyagers like Tupaia conceived of their place in and relation to the world in navigational practice.

### THE ONTOLOGICAL MODEL OF TUPAIA'S *RUA MATA'I*

From the historical sources, we cannot assume that the deified ancestor at the centre of Tupaia's *rua mata'i* is Lata/Raka's Tahitian namesake Rātā.<sup>85</sup> Instead, both Joseph Banks and his draftsman Sydney Parkinson independently reported that Tupaia had

<sup>83</sup> George, dir., *We, the Voyagers*, Part 2.

<sup>84</sup> Gill, *Myths and Songs*, 321.

<sup>85</sup> However, Rātā features prominently in Society Islander traditions, most notably as the cultural hero, canoe builder, and master navigator who sailed his vessel *va'a iama* from Tahiti via Mangarēva to the Pitcairn Group where he, according to legend, rescued the remains of his kin from the insides of a giant *Tridacna*. See Henry, *Ancient Tahiti*, 468–95.

frequently invoked Tāne since their joint departure from Tahiti in July 1769, in ritual performances presumably quite similar to the wind work in which Kolosa Kaveia reached out to Lata, or Mangaian *tahunga* called upon Raka. Tāne, in Society Islander traditions, is known as one of the oldest and most senior deified ancestors who is intimately connected to the waters, weather, and wind. As a cosmic traveller inhabiting the tenth sky, which also houses *vaiora a tāne* ('the living waters of Tāne', the Milky Way), and whose celestial voyages in the canoe *fa'atere apu* mirror the voyaging paths of the seas, Tāne is present in specific asterisms. He is also known to appear regularly on earth in the form of messengers, such as sharks or specific white as well as red birds.<sup>86</sup> Most importantly for this discussion, Tāne is known to control the weather and winds. In the legend of 'Tane's Voyage and Struggle with Atea', he boasts: 'This is I, Tane of the living waters! ... I have wind, all the head winds; I have wind, all the inner winds; I have wind, all the winds from behind!'<sup>87</sup>

It makes good sense, then, that Tupaia addressed Tāne in ritual wind work when navigating the *Endeavour* on Cook's behalf from Tahiti to the Leeward Society Islands in July 1769. On the day after their departure from Tahiti, Sydney Parkinson observed:

Toobaiah praying in the afternoon, in the stern-windows, called out, with much fervor, O Tane, ara mai, matai, ora mai matai; which is to say, Tane (the god of his Morai) send to me, or come to me with a fair wind; but his prayer proving ineffectual, he said, Wooreede waow, I am angry. However, he told us that we should have wind when the sun arrived at the meridian, and so it happened, though we did not impute to him the gift of prophecy or foresight.<sup>88</sup>

Joseph Banks independently reported the same events:

Calm all last night, this morn hazey so that no land is seen; light breezes and calms succeeding each other all morn. Our Indian often prayd to *Tane* for a wind and as often boasted to me of the success of his prayers, which I plainly saw he never began till he saw a breeze so near the ship that it generally reachd her before his prayer was finishd. At sunset a pleasant breeze.<sup>89</sup>

While clearly neither Parkinson nor certainly Banks could accept the propositions of Tupaia's active wind work (and in more or less respectful ways express what Salmond might call their 'ontological refusal'), Banks in particular also documented his admiration for the accuracy of Tahitian weather and wind predictions

<sup>86</sup> Henry, *Ancient Tahiti*, 368–9.

<sup>87</sup> *Ibid.*, 455.

<sup>88</sup> Sydney Parkinson, *A Journal of a Voyage to the South Seas* (London: Caliban Books, 1984 [1773]), 67.

<sup>89</sup> Joseph Banks, *The Endeavour Journal of Joseph Banks 1768–1771*, ed. J.C. Beaglehole (Sydney: Public Library of New South Wales in association with Angus and Robertson, 1962), vol. 1, 314.

and stressed their importance for voyaging. In his 1769 prose account of the ‘Manners and Customs of South Sea Islands’, he acknowledged:

The people excell much in predicting the weather, a circumstance of great use to them in their short voyages from Island to Island. They have many various ways of doing this but one only that I know of which I never heard of being practisd by Europæans, that is foretelling the quarter of the heavens from whence the wind shall blow by observing the Milky Way, which is generally bent in an arch either one way or the other: this arch they conceive as already acted upon by the wind, which is the cause of its curving, and say that if the same curve continues a whole night the wind predicted by it seldom fails to come some time in the next day; and in this as well as their other predictions we found them indeed not infallible but far more clever than Europæans.<sup>90</sup>

The passage is remarkable in a number of ways. It is a rare case in which Banks openly declared that Society Islanders hold knowledge that not only eludes the analytical capacities of Western sciences, but is effectively superior (‘far more clever’) to European modelling (here, of wind and weather). It acknowledges a plurality of Pacific Islander scientific methods (‘many various ways of doing this’) that he, Banks, had no access to or understanding of. Finally, the method of predicting wind directions by observing the arch of the Milky Way as ‘already acted upon by the wind’ supports an understanding of Tupaia’s *rua mata’i* as an integrated, holistic cognitive model in which the winds are intimately related to a range of other, here astronomical, presences and phenomena. It is relevant in this context that in Tahitian traditions the Milky Way is *vaïora a tāne*, ‘the living waters of Tāne’, in which the deified ancestor sails his canoe *fa’atere apu* on the very winds that ‘act upon’ the ocean of the night sky. This is to stress again that, for Tupaia, a highly sophisticated knowledge of astronomy and meteorology would not have contradicted, but really started from the basic premise of encompassing ancestral relations.

If we accept, unlike Banks and Parkinson, the notion that senior *tahu’a* like Tupaia were indeed *mana* practitioners ‘that can and do control wind, and that ancestors are agents that help people control, or modify, winds that people desire or need’,<sup>91</sup> how might this contribute to a better understanding of the ontological model of Tupaia’s *rua mata’i*?

Building on and transferring from Kaveia’s teachings of the Taumakoan *te nohoanga te matangi*, it is reasonable to speculate that in Tupaia’s *rua mata’i*, Tāne assumes Lata’s place at the centre of the integrated model of wind positions. Kaveia’s teachings thus help to essentially animate Tupaia’s wind positioning system, as visualized in Figure 7, and fill it with ancestral presence. More than that, the surviving accounts and performed knowledge of Taumako may suggest

<sup>90</sup> Ibid., vol. 1, 368.

<sup>91</sup> George, ‘Experiencing *Mana*’, 388.

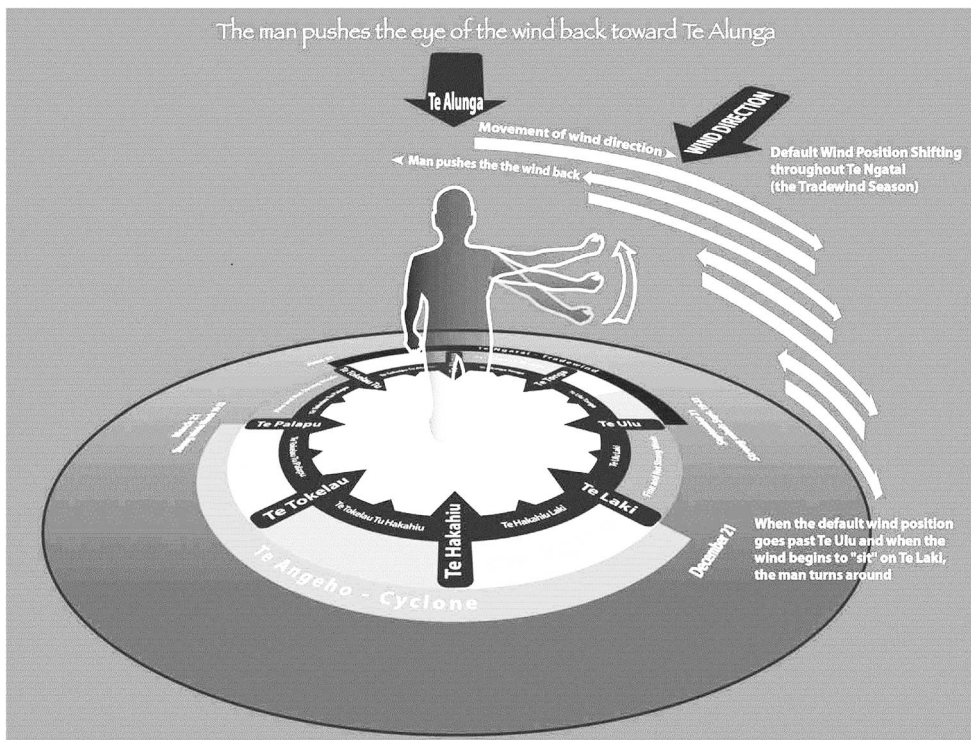


FIGURE 8. Daniel Jackson after Mimi George, ‘Diagram of Lata pushing the eye of the wind back with reference to eight primary positions and two seasons (cyclone and trade-wind) of *Te Nohoanga Te Matangi*’, in Marianne ‘Mimi’ George, ‘Experiencing *Mana* as Ancestral Wind-Work’ (2018).

how actually to conceive the ways in which Tāne’s agency was modelled into Tupaia’s system.

This is how Kaveia conceptualized the presence of Lata in his own wind positioning system, as visualized and narrated by George (Figure 8):<sup>92</sup>

early in the trade-wind season, the eye of the wind (the position that the wind blows from) stabilizes when ‘sitting down’ (*noholalo*) on the *TeAlunga* position. As a weather system passes through Lata’s position, the position that the eye of the wind sits on moves clockwise, such as to *TeTonga* and/or to *TeUlu*. Each time this happens, Lata extends a right arm and pushes it counterclockwise, back to *TeAlunga*. But as the trade-wind season progresses, Lata is unable to push it all the way back to *TeAlunga* and the stabilized/default position becomes *TeTonga*. Lata keeps pushing it back, but eventually the eye of the

<sup>92</sup> Daniel Jackson after Mimi George, ‘Diagram of Lata pushing the eye of the wind back with reference to eight primary positions and two seasons (cyclone and trade-wind) of *Te Nohoanga Te Matangi*’, in George, ‘Experiencing *Mana*’, 392, Figure 3.

wind will not be pushed back to the *TeTonga* position. Lata keeps trying, but eventually the eye of the wind moves past *TeUlu*.<sup>93</sup>

What Kaveia offered here is essentially an animated ‘mechanical model of how wind, weather systems, and seasons work’.<sup>94</sup> We cannot assume a perfect symmetry of wind dynamics or behaviours across the Western and the Central Pacific, from Santa Cruz to the Society Islands, and must reckon with variations between different Polynesian traditions and their ontological modelling. However, to assume that Kaveia’s most basic lessons also apply to Tupaia’s tradition is a move supported, for instance, by the fact that Gill’s account of the Mangaian *rua matangi*,<sup>95</sup> which is much closer to Tupaia’s home, strongly converges with Kaveia’s accounts of Lata’s/Raka’s central presence.

If Tupaia’s *rua mata’i* follows a similar conceptual logic, it can be assumed that Tupaia too, when invoking Tāne, conceived that his deified ancestor methodologically worked on the winds in calm and measured movements at the centre of the cognitive model. The signature position of the early trade-wind season to which passing weather systems needed to be ‘pushed back’, for Tupaia, would clearly be *marā’ai moana*; that of the progressing season, *marā’ai maita’i*. Toward the end of the trade-wind season, Tāne, too, would eventually need to give in to the pressure of weather systems increasingly moving past the southerly house of *marā’ai fe’etī*. And when the winds begin to sit in the house of *marā’ai arafenua*, *tahu’a* of the Society Islands would also have conceived that Tāne changes his position, and turns clockwise by 180 degrees.

Here is how Mimi George continued to recount Kaveia’s teachings about Lata:

the trade-wind season is over when the eye of the wind sits in *TeLaki*. Then Lata turns 180 degrees around clockwise, and begins to do the same thing. The eye of the wind begins the cyclone season by sitting briefly in *TeHakahiLaki*, then stabilizes in *TeTokelau*. Lata keeps pushing it back, but gradually the reset position moves past *TePalapu*. Then it is the end of the cyclone season and Lata turns 180 degrees around again. The eye of the wind sits briefly in *TokelauTuAlunga* and then stabilizes at *TeAlunga*. As always, it moves clockwise as weather

<sup>93</sup> George, ‘Experiencing *Mana*’, 390–1.

<sup>94</sup> *Ibid.*, 391. The mega-systems George referred to are independently constituted concentrations of high or low barometric pressure that cause wind to move in a clockwise or counter-clockwise direction (high pressure systems move clockwise in the northern hemisphere and counter-clockwise in the southern hemisphere). The interactions of such systems can increase the strength of the winds. Between about 10 to 20 degrees from the equator, cyclonic storms move westward and recurve toward the poles during the summer season, while trade winds blow from late spring until the winter equinox. But nearness to land, especially large islands and continents, changes the systemic behaviours and seasonal variations of winds.

<sup>95</sup> Gill, *Myths and Songs*, 319–20.

systems pass through, and Lata is ready to start pushing the wind back to *TeAlunga*.<sup>96</sup>

When talking about westerly wind systems during the tropical Southern Pacific cyclone season, regional variation between Taumako and the Society Islands is more pronounced than for the rather stable trade patterns. We might assume that, in Tupaia's model, the end of the trade-wind season, and thus possibly Tāne's 'turning point' too, is *mara'ai arafenua*. Identifying more clearly defined 'reset position[s]' during the cyclone season between *to'erau*, *fa'arua*, the three *maoa'e* positions, and *tumuturoa* in Tupaia's model is ultimately speculative. As in many other Polynesian contexts, *to'erau* is the most prominent westerly system in Society Islander traditions and linked to eastbound voyaging. It is thus likely to mark, as in Kaveia's teachings, the signature wind position in the cyclone season that is challenged by various tempestuous systems (*fa'arua* and *maoa'e*) passing through. Finally, Tāne's second 'turning point' in Tupaia's model seems to be indicated by the transition from the northerly *mohiotū* to the first *mara'ai* (trade wind) position in the new season, *mara'ai ha'apiti*.

The details of Tāne's movements at the centre of Tupaia's system ultimately remain hypothetical in the absence of more reliable archival evidence and oral tradition in the Society Islands. Overall, though, Kaveia's teachings strongly suggest that the ontology of Tupaia's wind positioning system, too, must have been fundamentally different from disenchanting Western dualistic scientific models of wind and weather. And yet, its core epistemic function is again very relatable, in the sense that it offers a profoundly scientific way to organize, relate, and intricately model natural phenomena in a complex world for very pragmatic purposes. It is vital to understand that, in this sense, Tupaia's *rua mata'i* would not have been representational, that it was not attempting to 'map' a realistic model of the seasonal distribution of wind directions, which are evidently much messier and more variable, especially during the cyclone season. Rather, following Kaveia's teachings, it would have been a cognitive device Tupaia ritually used to model the signature positions of wind systems for navigational practice; as a tool kit that categorizes and systematizes knowledge to forecast wind and weather and that conceptually allows for reciprocal engagement based on foundational ancestral relations. I assume that Tupaia, when invoking Tāne as in the 'prayers' documented by Parkinson and Banks, performed what George refers to as active wind work. And following the knowledge traditions of Taumako, this wind work itself presumably drew on a highly sophisticated astronomy which correlates the movements of the winds with the movements of the sun, the moon, planets, stars, and stellar formations from the minute Pleiades to the vast Milky Way.

## WIND POSITIONS AND ASTRONOMY IN TUPAIA'S *RUA MATA'I*

The most generous praise anyone in Cook's crew had for Tupaia's knowledge of navigation and astronomy is recorded in John Marra's journal of the voyage of the

<sup>96</sup> George, 'Experiencing Mana', 391.

*Resolution* in 1772–5. Marra was an Irish seaman who seems to have run from a Dutch ship in Batavia and joined the *Endeavour*'s crew just over a month after Tupaia's death – so what he knew about Tupaia he must have learned from other crew members of varying ranks (including also on Cook's second voyage on which he served as a gunner's mate). This is what he wrote about Tupaia and ancestral Polynesian navigation:

As their whole art of navigation depends upon their minutely observing the motions of the heavenly bodies, it is astonishing with what exactness their navigators can describe the motions and changes of those luminaries. There was not a star in their hemisphere fixt or erratic but Toobia could give a name to [and] tell when and where it would appear and disappear.<sup>97</sup>

The importance of Marra's account is that, while there are detailed notations of the Tahitian lunar calendar, as well as solar positions, in the colonial records, there are hardly any accounts of the names or qualities of stars and planets in the surviving journals and vocabulary lists from the *Endeavour* voyage. These, it seems, Tupaia chose not to share with any of the senior officers or scientists for reasons that remain speculative. Next to Banks's statement quoted above, Marra's account is thus an important testimony to Tupaia's encompassing astronomical knowledge and a powerful reminder of the partiality and incompleteness of the European archive.

What is even more crucial in the context of Tupaia's *rua mata'i*, however, and mostly ignored in critical discussions, is how Marra did not so much emphasize the importance of Tupaia's astronomy in the context of navigational wayfinding. Rather, his focus is clearly on the very relation of astronomy to wind positions and weather. He continued:

what was still more wonderful, [Tupaia] could foretell from the aspect of the heavens the changes of the wind, and the alterations of the weather, several days before they happened. By this intelligence he had been enabled to visit most of the islands for many degrees round that of which he was a native. By the sun they steer in the day, and by the stars they steer in the night; and by their skill in presaging the weather, they can without danger lengthen or shorten their voyage as appearances are for or against them.<sup>98</sup>

Marra's account is key to my argument and the most powerful archival trace to legitimize the core experiment of this essay: the exploration of convergences between Kaveia's *te nohoanga te matangi* and Tupaia's *rua mata'i*. I turn now to the

<sup>97</sup> [John Marra], *Journal of the Resolution's Voyage: in 1772, 1773, 1774, and 1775 ...* (London: F. Newbery, 1775), 217.

<sup>98</sup> *Ibid.*

question of how much else is in the *Endeavour* archive to support Marra's claim about the pervasive link between wind, weather, and astronomy in Tahitian navigation.

The most detailed account of Tahitian astronomy in this context pertains to the moon. Both Banks and his fellow naturalist Daniel Solander listed the 13 names of Tahitian moons in the yearly cycle, as well as the 29 names for moons in each lunar month.<sup>99</sup> However, there are no accounts in the Society Islands that I am aware of, or in the Santa Cruz Islands for that matter, of moon positions corresponding directly to wind or weather, other than known wind and sea behaviours in neap and spring tides. It seems rather that the role of the moon interrelated with other astronomic events by providing nuanced calendrics in Tupaia's *rua mata'i*, which I discuss in the following section.

For the sun, the close relation between sun positions and wind modelling is far better documented. According to George, Kaveia stressed that it was key for Lata to observe how 'the sun rises and sets between four main wind positions' when modelling *te nohoanga te matangi*. The position of certain seasonal winds in this context crucially corresponds with the seasonal position of the rising or setting sun on the horizon, so that for example, 'the wind sits in Te Alunga when the sun rises at the wind position Te Alunga'. It is on these grounds, in George's account, that 'Taumako people say the wind follows the sun'.<sup>100</sup>

There is some evidence that Tupaia discussed sun positions in relation to wind positions when sharing information about ancestral navigational world-making with his European interlocutors. The most revealing document, perhaps, is Solander's entry on 'Winds' in the same notebook that also records the Tahitian lunar calendar.<sup>101</sup> It lists four names under this rubric and relates them to the four principal cardinal directions. However, only the first two names, for north and south, refer to winds, as the heading promised: 'Opatoerao', *apato'erau*, literally the quarter or direction of the *to'erau* (here: north) wind; and 'Oapatoa', *apato'a*, the quarter of the *to'a* (south) wind. The names listed for east and west are 'Tehitia-otera', *te hiti'a o te rā*, the appearance of the sun on the horizon, and 'Tetoa-otera', *te tō'o'a o te rā*, the setting of the sun. Rather than assuming a category mistake in Solander's notebook, it seems much more likely that Tupaia indeed discussed sun positions and wind positions together.

What is intriguing in this context is that variations of Tupaia's terms for north, east, south, and west as recorded by Solander also eventually found their way onto (Banks's fair copy of) Tupaia's Map of the Polynesian sea of islands (see Figure 1): here, they appear as 'Opatoerow', 'Ohetooterera', 'Opatoa', and 'Toottera', marking the cardinal directions. In contrast, the first draft of Tupaia's Map (which was in the possession of Molyneux's mate Richard Pickersgill and later copied by

<sup>99</sup> Joseph Banks, 'Vocabularies of the Languages of Tahiti, New Zealand, Savu, Prince's Island, Samarang, Sulu, Madagascar, the Mandingos, the Eskimos, Malabar and Peru' ([1780]), SOAS, University of London, MS 12156, 43; Joseph Banks [Daniel Solander], 'Observationes de Otaheite &ct.' (1769), SOAS, University of London, MS 12892, 9, 10.

<sup>100</sup> George, dir., *We, the Voyagers*, Part 2.

<sup>101</sup> Banks [Solander], 'Observationes', 13.

Georg and Johann Reinhold Forster during Cook's second voyage) only marks one sun position located in the centre of the chart, namely that of *avatea*, the sun at noon-time in its highest position in the astronomical meridian (suggesting that the other positions were only retrospectively added, presumably in Aotearoa New Zealand).<sup>102</sup> In our work on Tupaia's Map, Anja Schwarz and I argued that Tupaia used the concept of *avatea* as a key translation device between his own system of navigational wayfinding and the European cartographic model that was set up for him.<sup>103</sup> The relevance of the *avatea* sun in ancestral Polynesian navigational practice and wind positioning – if any – is more difficult to make out, as opposed to the varying rising and setting positions of the sun in annual progression. We argued that Tupaia's choice of *avatea* as a cartographic translation device was primarily a gesture toward his European interlocutors, for whom the sun in its highest position was absolutely crucial in their own world-making and navigational practice. The ritual importance of noontime astronomy on European ships is also important to keep in mind in view of an astonishing discovery by the Tahitian ethno-astronomer Libor Teanomui Prokop that underscores Tupaia's superior knowledge of the stars.

Prokop's discovery starts from a curious short entry in James Cook's journal for 1 March 1770. At that time, the *Endeavour* was far from Tupaia's native islands, near Cape Saunders to the southeast of the South Island of Aotearoa New Zealand. Cook noted on this day: 'The New Moon made her appears last night and Tupia told us that this is New Years day at the Island, on which account we paid him the proper comp<sup>t</sup>'.<sup>104</sup> By 'Island', Cook here clearly referred to Tahiti. And by 'New Years day', Cook must have recorded that Tupaia attempted to teach the concept of *matari'i i ni'a* to his European interlocutors.

In Society Islander traditions, the year is divided into two seasons: the season of abundance, *matari'i i ni'a*, and the season of scarcity, *matari'i i raro*.<sup>105</sup> Their commencement is ritually marked by the events of the appearance and the disappearance of *matari'i* (the Pleiades) in the night sky after sunset, likewise referred to as *matari'i i ni'a* (*ni'a* signifying 'above', as well as 'east') and *matari'i i raro* (*raro* signifying 'below', or 'west'). *Matari'i i raro* occurs around 18 May in the Society Islands; *matari'i i ni'a*, the first appearance of the Pleiades above the eastern horizon at dusk, is typically celebrated around 20 November each year. While versions of *matari'i* celebrations are common across the Polynesian sea of islands, they take on a particular cosmogonic significance in the Society Group, because in Society Islander tradition both events mark the annual moments after sunset when the universe is in perfect balance.

<sup>102</sup> Georg Forster, 'Copy of a Chart'.

<sup>103</sup> Eckstein and Schwarz, 'The Making of Tupaia's Map', 27–39.

<sup>104</sup> See the entries for 1 March 1770 in James Cook, 'Official Copy of Journal Kept by Captain James Cook' [Admiralty MS] (27 May 1768–10 July 1771), National Archives Kew, London, Adm 55/40, 121; idem, 'Journal of H.M.S. Endeavour, 1768–1771' [Canberra MS], National Library of Australia, Canberra, MS, <http://nla.gov.au/nla.obj-228958440>, 1; idem, *The Voyage of the Endeavour 1768–1771*, vol. 1, *The Journals of Captain James Cook on his Voyages of Discovery*, ed. J.C. Beaglehole (Cambridge and London: Hakluyt Society, 1955), 259.

<sup>105</sup> Henry, *Ancient Tahiti*, 332.

Tahitian cosmogony conceives of the skies as being held up by ten pillars whose function is adopted by various signature stars.<sup>106</sup> The three main pillars of creation in this context are *'ana mua* (front pillar), *'ana muri* (back pillar), and *'ana roto* (middle pillar). The function of *'ana mua* is typically ascribed to Antares in Scorpio; that of *'ana muri* to Aldebaran in Taurus; the role of *'ana roto* may be performed by Spica in Virgo in the southern skies and by Regulus in Leo in the northern. It is the positions of these *'ana* that calibrate and ultimately time the exact moments of *matari'i i ni'a* and *matari'i i raro*. At the event of *matari'i i raro*, the disappearance of the Pleiades in the western sky at dusk (always at about 45 minutes after sunset), *'ana muri* (Aldebaran) is just about to set beneath the horizon in the west, chasing *matari'i* (and the sun); *'ana mua* (Antares) has just risen above the horizon in the east, while *'ana roto* (here: Regulus) is in the exact meridian overhead. In the moment of *matari'i i raro*, this is to say, the three major pillars of cosmic creation, front, middle, and back, are in perfect symmetry in the night sky at dusk.

For the celebration of *matari'i i ni'a* marking, in Cook's words, 'New Years day on the Island', the skies are inverse. At the moment of the first appearance of the Pleiades in the eastern sky at about 45 minutes after sunset, *'ana muri* (Aldebaran) has just risen above the horizon in the east, chasing *matari'i*; and *'ana mua* (Antares) is just about to set beneath the horizon in the west. Instead of *'ana roto*, *taurua nui faatere va'a*, literally 'the great directional star of the navigator', Fomalhaut in Southern Fish (Piscis Austrinus), crosses the meridian overhead.

What does any of this have to do with Tupaia's astronomical knowledge? Prokop's research resolved an evident mystery. For why would Tupaia have told Cook and his men that the skies are that of *matari'i i ni'a* on 27 February (as recorded by Cook on 1 March, and accounting for their previous crossing of the dateline)? Why, if the ritual astronomical cluster of *matari'i i ni'a* in 1769, as marked by the symmetrical co-presence of Aldebaran, Antares, and Fomalhaut at dusk, would actually have fallen on 20 November, almost three months earlier? Rather than assuming that Tupaia was at fault, we must again assume his astronomical brilliance. For amazingly, the mystery resolves if we assume that Tupaia imparted his observation about the *matari'i i ni'a* sky in the context of *avatea*, the moment in which Cook and his men habitually did their own astronomical measurements of the sun (followed, especially in the circumnavigation of Aotearoa New Zealand, by triangulating measurements of the coastline which crucially rested on knowing the *Endeavour's* exact position at the moment of noon time).

This is Prokop's astonishing discovery: at the exact moment of *avatea* on 27 February 1770, the constellation of the (midday) sky over Tahiti was *exactly* that of the very moment of *matari'i i ni'a* on 20 November 1769, about 45 minutes after sunset – the Pleiades about four fingers above the eastern horizon, Aldebaran just risen, Antares just about to set, Fomalhaut exactly in the meridian.

Given the conceptual importance of *avatea* in Tupaia's and Cook's previous efforts to draw a map of the Polynesian sea of islands together, the likelihood of the perfect convergence of the *avatea* sky on 27 February and of the *matari'i i ni'a* sky on 20

<sup>106</sup> See especially 'The Birth of Heavenly Bodies', in Henry, *Ancient Tahiti*, 361–2.

November being accidental is basically zero. What might this tell us about Tupaia's astronomical knowledge and ultimately his *rua mata'i*? Among other things, Prokop's research underscores that the ancestral Tahitian moon calendar (*tārena tahito*) will have played a key role for Tupaia in keeping track of astronomical events (here, the appearance of what Cook referred to as the 'new moon', the first visible sickle named *hirohiti* in *tārena tahito*, indicating the signature constellation of *matari'i i ni'a* at the moment of *avatea*). But perhaps most importantly, Prokop's discovery supports the fact that Polynesian master navigators like Tupaia knew not only the names and positions of stars that are visible in the night sky, but also of stars that are not, and he made active use of them in navigational practice. This applies both to the position of stars in daylight and to stars that are below the horizon at night. Here, then, is another significant correspondence between what can be gleaned from the minimal archival traces of Tupaia's knowledge of stars and star paths and Kaveia's teachings of the Taumakoan *te nohoanga te matangi*.

Kaveia insisted that his first ancestor, Lata, 'steered by partner stars'. In George's account, 'Lata did not only steer by stars that are visible above the horizon, Lata knew how to steer by partner stars which are not visible because they are under the horizon'.<sup>107</sup> The signature example in Kaveia's teachings that closely relates to Tahitian cosmogony, as outlined in the context of *matari'i*, is the relation between *salo lavo*, a Taumakoan name for Antares in Scorpio, and *sino*, a Taumakoan name for Aldebaran in Taurus.<sup>108</sup> A voyaging path from Taumako to the Reef Islands, for instance, should ideally be undertaken in the season when *salo lavo* provides direction in the western night sky (in front of the voyager). This happens in the knowledge that *salo lavo*'s partner star *sino* travels (backwards) on the same path below the horizon and will rise right behind the voyager as *salo lavo* and the constellation of Scorpio (called 'Maui's fishhook' in different Polynesian contexts) has set and is no longer available as a directional marker.<sup>109</sup>

Present-day Taumakoan traditions still record a substantial number of partner stars rising and setting in different wind positions around the horizon that are useful for navigation on specific voyaging paths (Figure 9).<sup>110</sup> If Marra can be trusted, it is likely that a much larger number of star pairs were operative in Tupaia's own system. What is key in this context is again the correlation between star paths and winds in the holistic modelling of *te nohoanga te matangi/rua mata'i*. According to Kaveia, 'stars are useful for navigation when they rise and set in certain wind positions'. Wind positioning models, accordingly, always conceive of 'a leading star that has one end in the wind position in which it rises and the other end in the wind position in which it sets', operating on the understanding that 'when particular stars rise and set, certain winds and weather happen'.<sup>111</sup>

<sup>107</sup> George, dir., *We, the Voyagers*, Part 2.

<sup>108</sup> *Sino* is also used for Sirius, the body of the bird asterism *manu*, in Taumakoan traditions.

<sup>109</sup> George, 'Polynesian Navigation', 149.

<sup>110</sup> Daniel Jackson after Mimi George, '*Te Nohoanga Te Matangi* showing asterisms useful for navigation', in George, 'Polynesian Navigation', 149, Figure 6.

<sup>111</sup> George, dir., *We, the Voyagers*, Part 2.



stable *to'erau* winds in Tupaia's system. Rising in the wind position of *mara'ai moana*, it sets at 270° W, and thus squarely in the house of *to'erau* in the morning.

I assume that all signature *taurua* and *'ana* of the Tahitian astronomic tradition, as reconstructed by the likes of Teriierooiterai and Prokop, would have been integrated into the holistic model of Tupaia's *rua mata'i* in a similar way.<sup>112</sup> This would have involved detailed information about the seasons in which they are in the sky, their partners, their rising and setting in particular wind positions, the corresponding wind and weather that they typically bring, and, based on all this, their qualification as directional markers for specific seasonal voyaging paths. This brings us to the importance of seasonality and calendrics in Kaveia's and Tupaia's systems.

### SEASONALITY AND CALENDRICS IN TUPAIA'S *RUA MATA'I*

The two seasons of the Tahitian calendar, *matari'i i ni'a* (the season of abundance beginning around November 20 with the *matari'i i ni'a* celebrations) and *matari'i i raro* (the season of scarcity beginning around 18 May), roughly coincide with the hurricane season and the trade-wind season, respectively, in the latitudinal corridor of the South Pacific in which the Society Islands, Taumako, as well as all islands Tupaia recited and drew for Cook (with the exception of O'ahu) are located. Given the eminent ritual significance of the two annual *matari'i* celebrations in Society Islander traditions, I propose that they would have been an integral element of Tupaia's *rua mata'i* and that they were associated with specific wind positions. Assigning these positions is ultimately speculative in the absence of living traditions and any conclusive archival material. Yet, in order to visualize a more composite model of Tupaia's *rua mata'i*, I still venture to suggest possible interrelations between select wind positions and key astronomical events (Figure 10).<sup>113</sup> Rather than making claims to historicity, these should be read as invitations to further complement a complex model. With this in mind, I believe that the most plausible link is between *matari'i i raro* and the first *mara'ai* position in the yearly cycle, which is *mara'ai pāha'apiti* in the NE. Following the Taumakoan principle of oppositional wind pairs, the house of *matari'i i ni'a* would then fall to the penultimate *mara'ai* in the system, that is, *mara'ai arafenua*. The two *matari'i* celebrations thus also tie in with the ritual 'turning

<sup>112</sup> Teriierooiterai, 'Mythes, astronomie'; Libor Teaonui Prokop, 'Nomenclature des objets célestes du ciel polynésien' (2013), personal manuscript. These *taurua* and *'ana* include, ordered by their declination: *taurua ha'apāra'a manu* (Deneb Cygni), *taurua nui o mere* (Betelgeuse, also *'ana iva* [north]), *taurua o mere* (Rigel), *taurua/'ana heuheu po* (Alphard), *taurua nui amo aha* (Sirius), *rua o mere* (Capricorn [star path]), *taurua nui faatere va'a* (Fomalhaut), *taurua i hiti apato'a* (Canopus), *tau hā* (Southern Cross); as well as *'ana ni'a* (Polaris), *'ana tipu* (Dubhe and Mizar ?), *'ana varu* (Capella); *'ana tahu'a ta'ata metua te tupu mavae* (Arcturus); *'ana roto* (Regulus [north], Spica [south]), *'ana tahu'a vahine e to'a te manava* (Procyon), *'ana muri* (Zubeneschamali [south]), and *'ana iva* (Procyon [south]).

<sup>113</sup> Lars Eckstein, 'Tupaia's wind positioning system, showing likely calendrics and seasons' (2025).

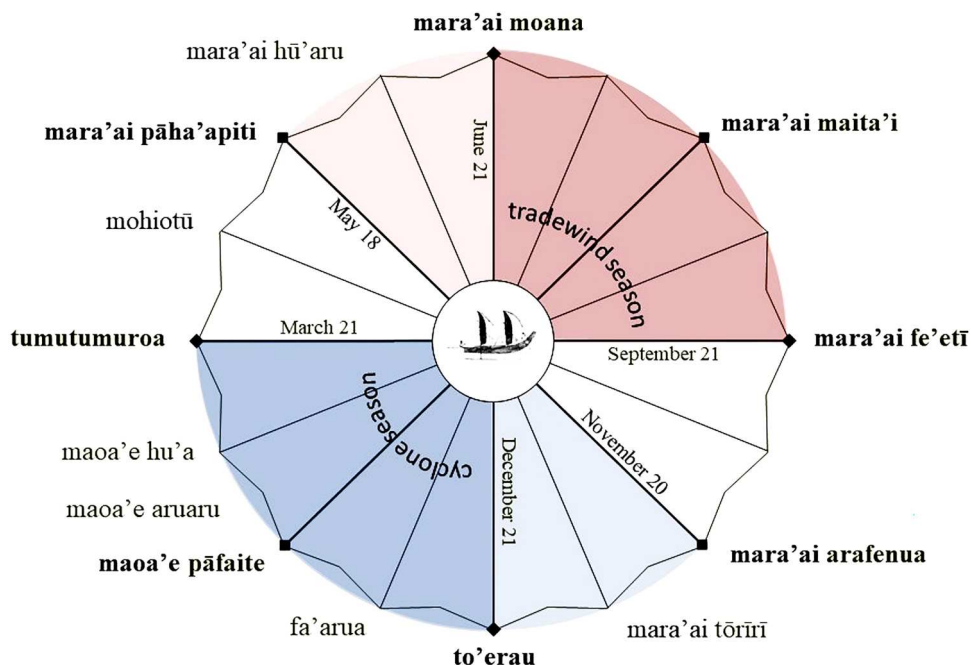


FIGURE 10. Lars Eckstein, 'Tupaia's *rua mata'i*, showing likely calendrics and seasons' (2025).

points' of Tāne, marked by wind systems pushing past *marā'ai pāha'apiti* (around *matari'i i raro*) and past *marā'ai arafenua* (around *matari'i i ni'a*).

The most characteristic periods of the trade-wind and hurricane seasons, in turn, would have been framed by specific solar positions. In Kaveia's teachings of *te nohoanga te matangi*, it is the signature azimuth positions of the sun that provide the basic orientation. George notes that 'in the Solomons, in the southern hemisphere, most trade winds blow between the winter solstice and the spring equinox [and] from cyclonic wind positions between summer solstice and autumn equinox'.<sup>114</sup> With minor variations, this is true for the entire latitudinal corridor of Tupaia's (Southern) Polynesian sea of islands as drawn on his chart for the *Endeavour* crew. In Kaveia's model, the June and December solstices are tied to the occurrence of *te tokelau tu* and *te laki* winds respectively, while the March and September equinoxes are affiliated with the northerly *te palapu* and the southerly *te ulu* (Figure 11).<sup>115</sup> It is important to note in this context that complex models such as *te nohoanga te matangi* operate on various scales: a macro scale which follows the clockwise movement of wind positions from season to season; and micro scales, which allow modelling and prediction of distinct wind patterns during special seasonal events. According to Mimi George (personal conversation), the equinoxes are a salient example, conceived as a five-day period rather than a singular event, which frequently bring typical wind-

<sup>114</sup> George, dir., *We, the Voyagers*, Part 2.

<sup>115</sup> Daniel Jackson after Mimi George, 'Te Nohoanga Te Matangi showing calendrics and seasons', in George, 'Polynesian Navigation', 146, Figure 4.

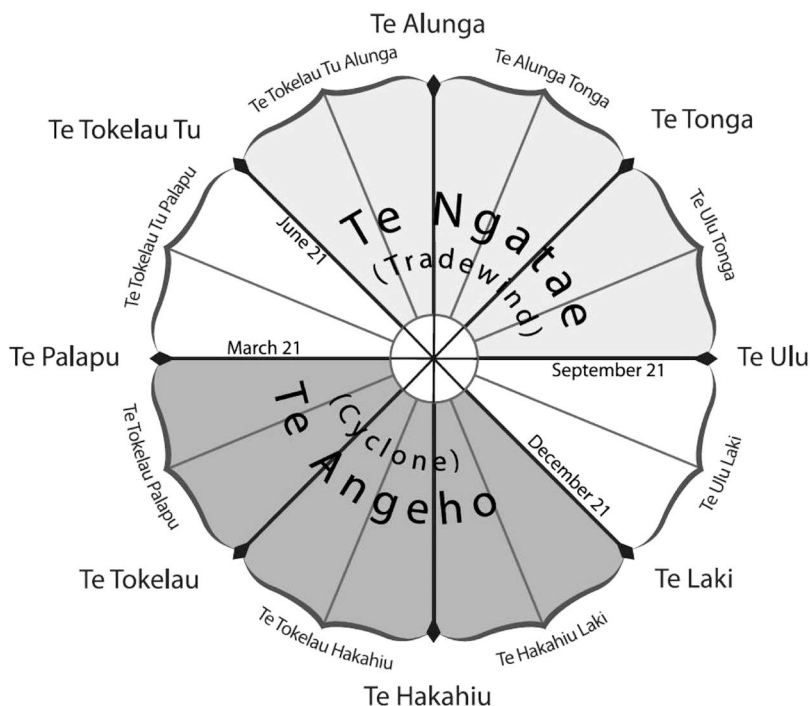


FIGURE 11. Daniel Jackson after Mimi George, ‘*Te Nohoanga Te Matangi* showing calendrics and seasons’, in Marianne George, ‘Polynesian Navigation and *Te Lapa* – “The Flashing”’ (2012).

backing patterns. *Te palapu*, the signature wind to go south in Taumakoan traditions, for instance, is associated specifically with the period of the March equinox.

It can reasonably be assumed that, in its modelling of seasons and seasonal voyaging, the sun played a very similar part in Tupaia’s system. What remains speculative, again, is which wind positions the equinoxes and solstices are affiliated with more specifically. In the absence of living traditions, reliable historical wind data, and better archival indicators, it makes sense to follow the Taumakoan model for the equinoxes by assigning the northerly *tumutumuroa* or *huatau* to the March equinox (*rua ti’a*) and the southerly *mara’ai fe’eti* to the September equinox. The solstices are slightly less straightforward. One lead, however, is Anderson’s comment in 1777 that the *to’erau* occurs ‘when the sun is nearly vertical, that is, in December and January’.<sup>116</sup> This would support a model that associates the December solstice (*rua maoro*, roughly one lunar cycle after *matariki i ni’a* which marks the beginning of westerly systems arriving from the SW) with the *to’erau*. If *rua maoro* was indeed linked to the typical occurrence of the more stable spells of *to’erau*, then the opposite house of *mara’ai moana*, marking the settling position of the early trade winds in the season of *matariki i ni’a*, could be affiliated with the June solstice (*rua poto*) (see Figure 10). It needs to be stressed again that, unlike Kaveia’s associations of sun and wind

<sup>116</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

positions which draw on living traditions, these proposed affiliations in Tupaia's model remain hypothetical.

Whatever winds they were historically affiliated with, what can be said with conviction is that the shifting azimuth positions of the rising and setting sun in Tupaia's model must have correlated closely with the azimuth positions of stars and stellar constellations as outlined above. These, together with the lunar calendar, would have provided the fine-tuning for calibrating astronomy and wind in the progressing seasons. The sophistication of Tahitian astronomy in this context can only be gleaned from the ethnographic and historical research conducted by Teriierooiterai and the encompassing work of Prokop (shared in personal communications). Within the scope of this essay, it is impossible to do this sophistication justice in all its complexity and dimensions. To provide only some of the most pertinent examples: in Tahiti, the solar azimuth of the equinoxes (at 90° rising and 270° setting) is, as already indicated, identical with the rising and setting positions of *taurua nui o mere ma* (Orion's belt); the rising and setting *matari'i* (Pleiades, 64°/296°) limit the sun's positions in the north (*rua poto* at 65°/295°); while the positions of rising and setting *'ana mua* (Antares, 118°/242°) mark the southern frontier of the sun (*rua maoro* at 114°/246°). *'Ana muri* (Aldebaran 73°/287°) rises and sets just below the solar azimuth positions at *matari'i i raro* (69°/291°). Given the importance of *avatea* (the sun in the astronomical meridian) in Tupaia's efforts to translate his navigational knowledge into the conventions of Western mapmaking, it is likely that the zenith position of the sun over Tahiti (on 10 November and 1 February respectively) also played a role for the seasonal modelling. This occurs (at -17°33, the latitude of Tahiti) when the rising and setting azimuths of the sun (108°/252°) correlate with *taurua nui amo aha* (Sirius, 107°/253°). In similar ways, further alignments of rising and setting sun and star positions would have marked a very nuanced progression of the seasons, always set in relation to its signature winds.

In Kaveia's teachings of *te nohoanga te matangi*, the correlation of signature wind positions with astronomical events and their typical seasonality and calendrics is key when planning a voyage. Specific voyaging routes depend on the occurrence of specific winds. We must assume, therefore, that in Tupaia's world, too, voyaging was not only profoundly ritualised, but also tied to very distinct voyaging seasons. In my understanding, this is one of the main reasons for Tupaia's indignation when Cook chose a straight southern course upon leaving Ra'iātea on 9 August 1769, under strict orders by the Admiralty to find the legendary great southern continent. Tupaia's disapproval of this course clearly transpires in Cook's diary entry for 15 August, when the *Endeavour* was at anchor in Rurutu in the Austral Group. Cook noted:

Sence we have left Ulietea [Ra'iātea] ~~Tobia~~ Tupia hath been very disireous for us to steer to the westward and tells us if we will but go that way we shall meet with plenty of Islands the most of them he himself hath been at.<sup>117</sup>

<sup>117</sup> Cook, 'Journal of H.M.S. Endeavour' [Canberra MS], 108r.

Tupaia's *rua mata'i* may help us to understand why Tupaia might have attempted to dissuade Cook so insistently from his southerly course and instead to honour and follow the paths indicated by the ritual voyaging season: Cook's 15 August, for Tupaia, would have translated into the height of the season of *matarī'i i raro*, indicated by 'ana mua (Antares) crossing the meridian at dusk and *tauruā nui faatere va'a* ('the great directional star of the navigator', Fomalhaut) rising in the very house of the signature wind of the season, *mara'ai maita'i*. In Tupaia's logic, the season of *mara'ai maita'i* would have been tied to westbound passages from the Society Islands. Cook's continued journal entry suggests that Tupaia had in mind to lead the *Endeavour* from Ra'iātea past the Nga Pu Toru chain (Ma'uke, Miti'āro, and 'Ātiu) to Rarotonga in the Southern Cooks and from there, presumably, to Samoa/Tonga. Cook reported that, according to Tupaia, this composite passage would have taken '10 or 12 days' in a traditional *pahi*, which 'sails much faster than this Ship [the *Endeavour*]'. The return voyage, however, would have taken '30 or more'.<sup>118</sup> Clearly, Tupaia must have implied that going back would not only have meant taking a different route (probably along the Austral chain to Ra'ivavae before heading north again), but also waiting for a different voyaging season bringing the necessary winds that allowed for the much more challenging eastbound passage.<sup>119</sup>

From a postscript to his 'Description of the Islands, Ulietea, Otaha, and Bolabola', which Cook repeatedly reworked, we know that Cook took a special interest in 'westerly winds' that are intricately related, of course, with questions of the first settlement of Oceania and the maintenance of long-distance relations of kinship and trade across the region. Cook must have discussed this with Tupaia on several occasions, including in August 1769 when the project of Tupaia's Map began, and in early February 1770, in Tōtaranui in Aotearoa New Zealand, when they discussed and reworked the chart once more in the presence of a senior Māori chief the British referred to as 'Topaa'. The Admiralty MS of Cook's journal contains the final and longest entry on westerly winds:

Tupia tells us that during the months of Nov. Dec. and Jan. Westerly winds with rain prevail and as the inhabitants of the Islands know very well how to make the proper use of the winds there will be no difficulty arise in Trading or Sailing from Island to Island even tho they lie in an East and West direction.<sup>120</sup>

<sup>118</sup> Ibid.

<sup>119</sup> Evidence for the circular nature of ancestral Polynesian voyaging, making use of different voyaging seasons, is also offered in a letter by Johann Reinhold Forster to his publisher. Forster noted that Tupaia's 'father' undertook 'a three-month voyage, until he came to a large country which, to judge from all the circumstances, must be New Guinea; but he needed 9 months for the return journey'. Johann Reinhold Forster to Johann Spener, 24 February 1772, in David Paisey, 'Letters by Johann Reinhold Forster about Captain Cook's First Voyage and the Preparations for the Second: Translated from German', *Terrae Incognitae* 43, no. 2 (2011): 118–9.

<sup>120</sup> Cook, 'Official Copy of Journal' [Admiralty MS], 121.

Months	Lunar
2 ta'a	Aug. 1769
Huliema	
Othali	Stormy. Rainy.
Tetai	Yam's <sup>English?</sup> planted.
Oalehu	
Oāhou	hot.
Pipirhi	Spanish Ships there.
Anunu	Apr.
Manu	Wine begins to ripen. The Endeavour came
Paroromoa	
Paroromurhi	Syl.
Mulihā	Muti Cod.
Ohiya	

FIGURE 12. [Daniel Solander], [Lunar months as recorded from Tupaia in August 1769], in Joseph Banks [Daniel Solander], 'Observationes de Otaheite &c'. (1769), SOAS, University of London, MS 12892.

As always in the complex transactions between European and Polynesian worldings, this passage is in need of conceptual (re)translation. It is quite clear that Tupaia would have imparted this information by referring to lunar, not calendric months. Fortunately, Solander's 'Observationes de Otaheite' contain an annotated manuscript page which records the months of the Tahitian lunar year as his European interlocutors understood them from Tupaia (Figure 12).<sup>121</sup> The list begins with the lunar month of *ta'a'oa* linked to August 1769, suggesting that it was indeed part of the complex conversations about Tahitian temporal, but also navigational orientation which started after the *Endeavour* had left Ra'iātea. In the logic of this list, the lunar months Tupaia would have actually talked about as 'Nov. Dec. and Jan.' were *teta'i* (Tetai), *rehu* (Oalehū), and *fa'ahu* (Oāhou).<sup>122</sup> In the lunar year of 1769, the first moon of *teta'i* actually fell on 29 November, and the last moon of *fa'ahu* in 1770 on 22 February. In his corresponding account of

<sup>121</sup> [Daniel Solander], [Lunar months as recorded from Tupaia in August 1769], in Banks [Solander], 'Observationes', 9.

<sup>122</sup> Cf. Henry, *Ancient Tahiti*, 333–4.

13 Tahitian lunar months recorded in 1818, Pomare II likewise attributed *teta'i* to 'December', *rehu* to 'between December and January', and *fa'ahu* to 'between January and February'.<sup>123</sup> What Tupaia would have thus imparted, really, is a voyaging period ranging between late November and mid- to late February. Put differently, in Tupaia's *rua mata'i*, westerly winds that are suitable for eastbound voyaging seem to be conceptually tied to the first half of *matari'i i ni'a*, roughly until 'ana *muri* (Aldebaran) crosses the meridian at dusk and 'ana *roto* (Regulus) rises in the early night sky in the east. This period would have been associated with the wind positions of *mara'ai arafenua*, *mara'ai tōriri*, and, most importantly, *to'erau*, its signature house. The *fa'aru*a as well as the first *maoa'e* positions of the cyclone season are likely to have designated more violent cyclonic patterns that should be avoided when voyaging.

### SWELL PATTERNS IN TUPAIA'S *RUA MATA'I*

What I hope to have established by now is that, like the Taumakoan *te nohoanga te matangi*, Tupaia's *rua mata'i* would have served as what George called a 'complex and redundant system' in which the 'various elements ... are complementary – such as wind and swells, seasonal phenomena and celestial events, swell patterns, bird and sea animal behaviors, and the routes between islands that one would sail to'.<sup>124</sup> The 'routes between islands' taught by Kaveia in the context of the Taumakoan *te nohoanga te matangi* mainly remain within the Santa Cruz archipelago; however, its circuit of navigation had once been far more extensive than that. There are traditions, for instance, which include passages to and from the ancestral voyaging hub of Rotuma in the east (personal communication by Luke Vaikawi), which would have connected the Santa Cruz Islands with the vast voyaging circuit as recited and ultimately drawn by Tupaia.<sup>125</sup> Kaveia's system accurately details the wind positions between which specific voyages can be made swiftly and safely. In light of what has been developed so far, these positions not only define the direction, strength, and particular quality of expected winds. They also crucially indicate the most promising voyaging season for undertaking the passage, as marked by specific sun and star positions. The astute observation of these astronomical events, moreover, in combination with other phenomena (such as, in Tupaia's account, the particular curve of *vaiora a tāne*, the Milky Way), not only allows for the prediction and, possibly, alteration of upcoming wind and weather phenomena; it also serves to know the seasonal positions of (both visible and invisible) directional stars and asterisms.

In the logic of Kaveia's *te nohoanga te matangi*, a passage from Taumako to the Reef Islands bearing to the WSW, for instance, is advisable when the wind begins to

<sup>123</sup> Henry, *Ancient Tahiti*, 333.

<sup>124</sup> George, 'Polynesian Navigation', 147–9.

<sup>125</sup> Spanish navigator Pedro Fernández de Quirós noted that in 1606, Te Alikī Tumai of Taumako 'indicated the direction of no fewer than seventy islands that he knew'. Lewis, *We, the Navigators*, 38.



by observing and feeling the angle and impact of swells on the hulls of voyaging canoes, experienced voyagers may keep a course in overcast weather conditions when the sun and directional stars are no longer available as markers.<sup>127</sup> In a much more sophisticated and nuanced way, master navigators like Kaveia also knew and understood the complex patterns that are created by multiple swell trains. This pertains both to how swell trains are refracted by islands set on a distinct voyaging path, how they are reflected from islands, and how to expertly use these phenomena in navigational praxis. The intersective doubling of opposing swells, for instance, may create what George translated as an oval ‘fence’ around the borders of the path between two islands which may guide experienced navigators on their passage.<sup>128</sup>

Unfortunately, there are no archival traces of any conversations Tupaia had with Cook or any of his officers about the use of swells in ancestral navigation. That Tupaia would have mastered the art of navigating by swells can be inferred, however, from Andía y Varela’s annotations of the wind positioning system shared by Puhoro in the Society Islands in 1774, only five years after Tupaia sailed with Cook. Andía y Varela explained thus the workings of Puhoro’s system when planning a concrete voyaging path: ‘When setting out from port the helmsman reckons with the horizon thus partitioned, counting from E, or the point where the sun rises; he knows the direction in which his destination bears’. Counting, in Puhoro’s model of 16 wind positions placed equidistantly around the horizon, would have meant proceeding clockwise from where the ‘head’ rests in the system (here, the house of *maoake*), to the house in which the target island lies (see [Figure 5](#)). These positions are then correlated with the direction of the prevailing wind and swell patterns. Andía y Varela continued: ‘He sees, also, whether he has the wind aft, or on one or other beam, or on the quarter, or is close-hauled: he knows, further, whether there is a following sea, a head sea, a beam sea, or if it is on the bow or the quarter’.<sup>129</sup> Only once a navigator used the wind positioning system, also referred to by George as a ‘vehicle-centered’ ‘trip planner’,<sup>130</sup> to thus calibrate the main variables for a specific voyage, can the passage be undertaken safely: ‘He proceeds out of port with a knowledge of these [conditions], heads his vessel according to his calculation, and aided by the signs the sea and wind afford him, does his best to keep steadily on his course’.<sup>131</sup> That swells were crucial in Society Islander traditions while navigating open waters (and would have been for Tupaia, too), is then given particular emphasis in Andía y Varela’s continuing account, detailing the complex relation between swells and winds:

<sup>127</sup> E.g. Lewis, *We, the Navigators*, 124–33.

<sup>128</sup> Marianne George, ‘A Dynamic Pathway and Two Fences: Learning to “Read” an Interisland Swell Pattern’, *Royal Institute of Navigation News* (Nov./Dec. 2022): 21–5; George, dir., *We, the Voyagers*, Part 2.

<sup>129</sup> Andía y Varela in Corney, *The Quest and Occupation of Tahiti*, vol. 2, 285.

<sup>130</sup> George, ‘Polynesian Navigation’, 147.

<sup>131</sup> Andía y Varela in Corney, *The Quest and Occupation of Tahiti*, vol. 2, 285–6.



FIGURE 14. [Tupaia], [Longhouse and Canoes] (1769), British Library, London, Add MS 15508, f.14.

The task becomes more difficult if the day is cloudy, because of having no mark to count from for dividing out the horizon. Should the night be cloudy as well, they regulate their course by the same signs; and, since the wind is apt to vary in direction more than the swell does, they have their pennants, [made] of feathers and palmetto bark, to watch its changes by and trim sail, always taking their cue for holding his course from the indication the sea affords.<sup>132</sup>

The long bark and feather pennants or streamers, flowing from the masts to indicate shifting wind positions during a voyage, are indeed distinct features of central Polynesian voyaging canoes or *va'a*. They are very prominent, too, in one of Tupaia's watercolour drawings, showing a Tahitian *va'a motu* in action in changing winds (the position of the sails and streamers, and the direction the vessel is pointed towards are not in alignment) (Figure 14).<sup>133</sup> It forms part of a larger visual composition that also includes the depiction of a traditional naval battle, as well as a longhouse and ritually significant trees and plants in the background. The entire image was drawn collaboratively, probably together with Banks's draftsman Sydney Parkinson, in the presence of other officers and scientists. The composite image emerged from a larger project,

<sup>132</sup> Ibid., 286.

<sup>133</sup> [Tupaia], [Longhouse and Canoes] (1769), British Library, London, Add MS 15508, f.14.

probably started in Ra'īātea in early August 1769, that was first and foremost about facilitating a complex knowledge exchange between two parties with little shared language. This exchange arguably did not primarily feature Tupaia in the role of a student 'learning' how to draw in Western representational styles. Rather, Tupaia would have been in the role of the teacher in these exchanges, explaining, while and by way of drawing, to his European interlocutors the significances of Tahitian culture which they had not been able to observe themselves, and yet which they still end up writing about extensively in their journals. The most glaring cases in point are Banks's and Parkinson's detailed, graphic accounts of a traditional Tahitian naval battle, a battle they never had a chance to observe first-hand.<sup>134</sup> The same holds true for the operations of a fast-moving Tahitian *va'a motu* in action. However, if Cook, Molyneux, Pickersgill, Gore, Smith, or any other expert sailor on board the *Endeavour* did understand elements of Tahitian navigation from Tupaia's drawing and explanations, much less, unfortunately, was recorded in their journals.

#### VOYAGING ROUTES IN TUPAIA'S *RUA MATA'I*

What is available, at least, are substantial records of the vast ancestral voyaging paths that would have been built into the model of Tupaia's *rua mata'i*. The three primary sources to reconstruct these paths are, as mentioned before, a list and two maps. First, the list of 57 islands Robert Molyneux set down in the correct order in which Tupaia recited them, and which therefore still allows retracing island-to-island voyaging sequences as laid out in the traditional chants which Tupaia presumably drew upon. In Molyneux's log, the list of islands is placed right before the 'Otaheite names for the Winds according to Tobia', that records the basic grid of Tupaia's *rua mata'i*. The other sources, of course, are the two surviving copies of different draft stages of Tupaia's Map.

When discussing the voyaging paths in Tupaia's *rua mata'i*, the ultimate path recorded in Molyneux's list and the longest single passage that Tupaia drew on both drafts of his map need to be set apart and treated separately. This is the long passage from the Marquesas (*te fenua tane*) to O'ahu in Hawai'i. Unlike all other routes Tupaia recited or drew, it ranges far beyond the latitudinal corridor in which the characteristic winds of Tupaia's *rua mata'i* apply. This means that the passages from and to Hawai'i must have drawn on specialized knowledge and ultimately a different model configuring relevant winds, astronomical events, seasons, swell patterns, etc., a model which accounts for leaving the southern trade-wind zone, crossing the doldrums, and entering the northern-hemisphere trade winds, and the reverse. Such passages not only bring distinct qualities of the sea and a range of unique sea-marks and landmarks – as can be gleaned from an ancient chant from Ra'īātea, recorded in 1817 as 'The Birth of New Lands', which details a composite passage from the Society Group through the

<sup>134</sup> Banks, *The Endeavour Journal*, vol. 1, 365; Parkinson, *A Journal of a Voyage*, 24–5.

Tuamotus to the Marquesas and on to O'ahu.<sup>135</sup> Given the extensive latitudes that such passages cross, they also bring shifts in the positions of signature stars and asterisms in Society Islander traditions.<sup>136</sup>

I turn now to the routes in Tupaia's tradition that would have been integrated into his *rua mata'i*. What immediately stands out here is that the vast majority of ancestral island-to-island passages that Tupaia recited and drew for Cook and his crew detail passages against the prevailing *mara'ai* winds. Most passages range to the ESE; very few range to northward or southward; and probably no voyaging path that Tupaia recited or drew details a passage westward. What might be the reasons for this? To begin with, it seems significant that most paths thus follow the direction of the first ancestral migrations into central Polynesia. In the context of *rua mata'i*, however, it also makes very good sense that Tupaia chose to recite and draw traditional paths in the direction which would have required the greater navigational challenge: in terms of knowing the specific voyaging season and its signature sun and star positions that would bring special winds; in terms of the wind- and weather work that enabled placing such winds and prediction of their directions and duration for a chosen passage; in terms of knowing the shortest legs between islands on composite passages that allowed use of successive wind systems; and of course also in terms of knowing the corresponding complex astronomy and swell patterns to hold course. All of this would have mattered, too, for passages westward during the stable trade-wind season – however, without posing serious challenges to initiated master navigators.

Combining the knowledge from Molyneux's list and the two copies of different draft stages of Tupaia's Map, the following are the composite voyaging paths which we can ascertain that Tupaia discussed with Cook and his men.<sup>137</sup> The overwhelming majority of island-to-island paths consist of eastward voyages. They are, ordered from W to E:

**Rotuma to Samoa:** Rotuma – 'Uvea (Wallis Island) – Savai'i – Upolu – Tutuila – Manua – Motu O Manu (Rose Atoll);

<sup>135</sup> Henry, *Ancient Tahiti*, 401–2.

<sup>136</sup> It is remarkable in this context that one of the pillar stars of creation (*'ana*), as outlined in the Poraporan chant 'Birth of the Heavenly Bodies' recorded from Rua nui in 1818, is *'ana ni'a* (Polaris), which becomes visible only after crossing into the northern tropics. Henry, *Ancient Tahiti*, 359–63. David Lewis speculated that other *'ana* listed in the chant were integral latitudinal markers, particularly relevant for the passages from and to Hawai'i. In this context, Lewis observed how the declinations of four *'ana* correspond with the latitudes of different Line Islands: Starbuck (*'ana roto*, Spica), Malden (*'ana heuheu po*, Alpherat), and Kingman Reef (*'ana iwa*, Betelgeuse and *'ana tahu'a vahine e to'a te manava*, Procyon). These islands might have been traditional targets breaking down the long passage to and from Hawai'i. Lewis, *We, the Navigators*, 284, 372. The declination of *'ana muri* is roughly that of Johnston Atoll, while the zenith star of (the south of) Big Island is famously *'ana tahu'a ta'ata metua te tupu mavae* (Arcturus), known as *hokūle'a* in Hawaiian traditions.

<sup>137</sup> See Eckstein and Schwarz, 'Corrections'.

**Rotuma to the Niua Group:** Rotuma – Futuna and Alofi – Niuafo’ou – Niuatoputapu and Tafahi;

**Tonga to the Southern Cook Islands:** Vava’u/’Uiha – Niuē – Rarotonga – Mangaia;

**Southern Cook Islands to the Austral Group:** ’Ātiu – Rimatara – Rurutu – Tupua’i – Ra’ivavae – Rapa Iti;

**Mangareva to the Pitcairn Group:** Mangareva – Temoe – Oeno – Pitcairn Island – Henderson – Ducie.

Further eastbound passages are documented for the Society Islands and the vast archipelago of the Tuamotus. In Molyneux’s list, these are unfortunately incomplete, and on Tupaia’s Map they do not follow the *avatea* system (but roughly a Western projection model). Their intended direction of travel can therefore only be inferred from the previous paths. They are:

**Leeward Society to Windward Society Islands:** Manuae (Fenua Ura) – Maupiti – Porapora – Taha’a – Ra’iātea – Huahine – Mo’orea – Tahiti – Mehetia;

**NWern to SEern Tuamotus:** Tikehau – Rangiroa – Toau – Fakarava – Hao – Amanu – Tatakoto – Pukarua – Rēao.

In sequence in Molyneux’s list, again, is the only passage Tupaia would have discussed in the context of his *rua mata’i* that ranges ENE:

**(Windward) Society Islands to NEern Tuamotus:** Tahiti Iti – ’Ana’a – Makatea – Ahe – Mānihi – Takapoto – Takarua – Tikei – Tepoto – Napuka.

It would have brought voyagers in range for a passage to the Marquesas, the only recorded passage bearing to the NNE:

**NEern Tuamotus to the Marquesas:** Napuka – Marquesas Group.

Tupaia’s Map also indicates the alignment of the Southern Marquesas (*hiva tautauamai*, including Tahuata and Hiva Oa) and the Northern Marquesas (including Nuku Hiva and ’Ua Pou) as bearing to the NNW. The only other NNW-bound passage on record (beyond the long passage to Hawai’i) is from:

**Southern to the Northern Cook Islands:** Rarotonga – possibly Aitutaki and Suvarrow – Puka Puka.

Finally, three shorter passages document voyaging southward, from:

**Samoa to Tonga:** Savai’i – Vava’u – ’Uiha;

'Ātiu to Mangaia in the Southern Cooks;

as well as from:

**Society Islands to the Australs:** Ra'īātea/Tahiti – Rurutu.

It is important to stress that these paths are unlikely to be exhaustive of Tupaia's geographical knowledge. After recording the list of islands he received from Tupaia, Molyneux after all commented in his log: 'Towbia has seen many of these Islands & has a number more on Tradition that are not here mention'd'.<sup>138</sup> And of course, we must assume that Tupaia's *rua mata'i* would have included detailed knowledge of the corresponding return passages for all the paths outlined above. These would not necessarily have retraced the same routes, especially along the East-West axes of travel. Throughout the season of *matari'i i raro*, extended voyages westward would have been possible on stable *mara'ai* winds without much risk, such as the passage Tupaia so insistently suggested to Cook upon leaving Ra'īātea on 9 August 1769. As argued before, that route would have initially led the *Endeavour* on a traditional path from the Society Islands to the Southern Cooks, a path that seems not to be recorded on Tupaia's Map. Following the lead of 'ana mua (Antares) and the aligned stars of Maui's fishhook (in Scorpio) setting in the WSW, the wide target screen extending between Aitutaki, Nga Pu Toru, and Mangaia would have been impossible to miss before reliable *mara'ai* winds. Voyages eastward (during the first half of *matari'i i ni'a*), by way of contrast, would have required intense wind work, ideally shorter legs, and as Tupaia himself stressed, substantially more time.

Kaveia's teachings of the Taumakoan *te nohoanga te matangi* and the available archival evidence indeed suggest that Tupaia, too, would have tied the voyaging paths that he recited and drew to very specific seasons and specialized winds which allowed them to be undertaken safely. Evidently, in Tupaia's *rua mata'i*, the season for the passage that Cook took him on in August 1769, a straight southern course from Ra'īātea to Rurutu, had passed by early August (just as for a passage from Tahiti to Ra'ivavae that would have had ritual significance for him,<sup>139</sup> or for a course from Samoa to Tonga, for instance). The exact season and winds Tupaia associated with such passages remain speculative in the absence of living traditions. Still, his *rua mata'i* suggests that the likely period would have been from around the March equinox to not long after the *matari'i i raro* celebrations, bringing specialized winds such as the *huatau* and *mohiotū*. Voyages northward, in contrast, would have been tied

<sup>138</sup> Molyneux, 'Master's Log', 61v.

<sup>139</sup> This can be suggested from the name and architecture of Mahaiatea *marae* in Papara, constructed under Tupaia's supervision from 1767 to underscore the chiefly ambitions of his lover Purea's son Teri'irere. According to Libor Teonui Prokop, Mahaiatea is itself an ancient name of Ra'ivavae, and the *marae's* *ahu* had been oriented towards it. When Tupaia understood that Cook could not be deterred from his southerly course in mid-August 1769, he recommended heading towards Ra'ivavae; however, the south-easterly *mara'ai moana* did not permit this course.

to the late trade-wind season around and after the September equinox, with winds more regularly passing through the house of *marā'ai maita'i* to more southerly positions.

The most solid argument about seasonality can be made for all those paths to the eastward as recited and drawn by Tupaia, based on Cook's intelligence about 'westerly winds' in his 'Description of the Islands, Ulitea, Otaha, and Bolabola'.<sup>140</sup> From the revisions of this record in different manuscript stages, it is clear that Cook and Tupaia repeatedly discussed the capacities of Tupaia's ancestors to voyage against the prevailing *marā'ai* systems. As discussed above, Tupaia would have explained to Cook that westerly winds which are suitable for eastbound voyaging most reliably occurred during the first half of *matarī'i i ni'a*, which would have been associated with the wind positions of *marā'ai arafenua*, *marā'ai tōrōrō*, and especially *to'erau*. Of these, Anderson singled out *to'erau* as 'the only wind in which the people of the islands to leeward come to this [Tahiti], in their canoes'. He also remarked that the *to'erau*, like other westerlies, 'seldom lasts longer than five or six days without interruption'.<sup>141</sup> This underscores the importance of following island-to-island voyaging paths which allow long passages to be broken into as many shorter legs as possible, ultimately allowing voyagers to 'without danger lengthen or shorten their voyage as appearances are for or against them',<sup>142</sup> on the basis of expert wind predictions.

#### THE COSMOGONIC CONCEPT OF *HITI* AND TUPAIA'S *RUA MATA'I*

The traditional passage before the *to'erau* that Anderson discussed – from the Leeward Society Islands (most notably Maupiti, Porapora, Taha'a–Ra'iātea, and Huahine) to Mo'orea and Tahiti – bears about 112° to the ESE. All these islands are, essentially, aligned along a single axis bearing from the WNW to the ESE. This direction also marks, quite intriguingly, the rough overall bearing of most other composite passages to the eastward that Tupaia drew: from Rotuma to the Niua Group; from Southern Cook Islands like Aitutaki and Ātiu through the Austral group to Ra'ivavae; through the Tuamotus from Tikehau and Rangiroa via Fakarava to Hao; and it is also the direction of Pitcairn from Mangareva. All these passages invariably bear between 111° and 113° to the ESE. Only the composite route Tupaia drew from Rotuma to Samoa, as well as the passage from Tonga via Niuē to Rarotonga range a little more eastward (at around 95° and 100°, respectively).

I propose, following research by Libor Teaonui Prokop and my extended conversations with him in 2022 and 2024, that the convergence of eastbound voyaging paths around a set of axes that bear about 112° to the ESE is not accidental, but fundamentally indebted to the ancestral Society Islander concept of *hiti*. The Tahitian *hiti* in this context tends to be translated as 'border' (throughout in Henry, see also Fare Vāna'a); however, it is better conceived of as a primordial cosmic axis along which islands have drifted or 'swum' away from different manifestations of Hawai'i.

<sup>140</sup> Cook, *The Voyage of the Endeavour*, 154, n. 2.

<sup>141</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

<sup>142</sup> [Marra], *Journal of the Resolution's Voyage*, 217.

Havai'i, translated by Henry as 'invoked-space-that-filled', is itself a foundational cosmogonic concept that Polynesian settlers have carried into remote Oceania and (re)installed in different regional manifestations.<sup>143</sup> Bruno Saura argued that 'havai'i' is best understood as a 'primordial matrix': 'Intrinsically a bearer of wealth', he writes, 'the Hawaiki matrix is a mythical concept in the full sense of the term: it is both a material principle of origin and a dreamt up, magnified historical space'.<sup>144</sup> In the context of the Society Islands, for instance, the first manifest island to have been born from the local Havai'i matrix is Vavau, later known as Porapora; the second is Uporu, later known as Taha'a, followed by the remaining islands in the archipelago.<sup>145</sup> Eventually, the island of Ra'iātea itself emerged as the historical manifestation of the generative Havai'i nucleus.<sup>146</sup>

To understand the cosmic axis and geographical orientation expressed in the concept of *hiti*, it is important to remember that in Society Islander traditions, Havai'i/Ra'iātea and Tahiti-Mo'orea were originally a single body of land until Tahiti-Mo'orea, as legend has it, was transformed into a fish and swam away from Havai'i to the ESE.<sup>147</sup> Legends of 'Tahiti the fish' are widely recorded.<sup>148</sup> They abound with detailed explanations how different parts of the fish relate to Tahitian and Mo'orean topography. Other legends recount how the sinews of 'Tahiti the fish' needed to be cut to stabilize it in its new position. Intriguingly, the cutting of the sinews required the hero Ta'fai to voyage straight south from the new position of Tahiti to Tupua'i, where he acquired a legendary axe that eventually allowed him and his clan to sever Tahiti and Mo'orea from Havai'i/Ra'iātea for good.

What matters for the purpose of my argument, however, is the direction in which Tahiti the fish swam. In the legend 'The Departure of the Fish', assembled by Henry from recitals 'by King Pomare II; Mahine, a chief, and Tamera, a priest [in

<sup>143</sup> Eckstein, 'Hawaiki According to Tupaia'.

<sup>144</sup> Bruno Saura, *A Fish Named Tahiti: Myths and Power in Ancient Polynesia (Tahiti, Ra'iātea, Hawai'i, Aotearoa New Zealand)*, trans. Lorenz Gonschor (Faa'a: Maison des sciences de l'homme du Pacifique, 2021), 34.

<sup>145</sup> Henry, *Ancient Tahiti*, 95–6.

<sup>146</sup> Saura, *A Fish Named Tahiti*, 47–50.

<sup>147</sup> In his conversations with Cook and his crew, Tupaia persistently used the ancient name 'Urietea' (spelled 'Ulietea' by the Europeans) when discussing his home island, instead of the more recent Ra'iātea, indicating that he was trying, from the beginning, to impart its cosmogonic significance. Urietea is essentially a contraction of (*te ao*) *uri e* (*te ao*) *tea*. *Te ao uri*, literally 'dark land', denoted the sea of islands to the east of an imaginary meridian dividing Ra'iātea into two halves. This meridian, drawing to the south toward the upright *tau hā* (Southern Cross) is the primary cosmic orientation in Society Islander traditions (Libor Teaonui Prokop, personal communication); in Tupaia's *rua mata'i*, it is represented by the relational *rua* of *mara'ai fe'eti* and *tumutumuroa*. The sea of islands to the west of the meridian cutting through Ra'iātea was referred to as *te oa tea*, literally 'light land'. The division of Ra'iātea/Urietea into 'dark and light' along an axis that draws to the plain south thus mirrored nothing less than the division of two extensive genealogical and geographical Polynesian dispensations. See Henry, *Ancient Tahiti*, 116.

<sup>148</sup> See *ibid.* 433–43; and especially Saura, *A Fish Named Tahiti*.

1822 and 1824]’, the following line stands out: ‘Mai te pahi rei mua nui ra o Tahiti i te tae ra’a mai i *Hiti-ni’a*’. Henry translates this as: ‘Tahiti-nui (Great-Tahiti) arrived like a ship with a great figurehead (high cliff) at *Hiti-ni’a* (Upper-border)’.<sup>149</sup> *Hiti*, here, is expressive of a concept that is both cosmogonic and geographical: the fish named Tahiti did not swim just anywhere, but precisely along an axis bearing 112° to the ESE, that is, toward the rising sun in the early season of *matarī i ni’a*. Crucially, this direction is also the precise bearing of an invisible line drawn from the azimuth of setting Aldebaran, *’ana muri*, the back pillar of celestial creation (at 287° WNW), to the azimuth of rising Antares, *’ana mua*, the front pillar of celestial creation (at 117° ESE). The name ‘Tahiti’ itself is expressive of this cosmogonic relation: ‘ta’ speaks of the severing from Havai’i, while ‘hiti’ denotes the relational location of the island mirroring the celestial axis between *’ana muri* and *’ana mua* that still connects it with the primordial matrix.

According to Prokop, the axis expressed in the concept of *hiti* is also built into the foundational orientation of the *ahu* (ceremonial platforms) and archery platforms of many of the most significant and oldest *marae* in the region. The exploration of the patterns of the foundational alignment of the regional *marae* for their relations to this and other celestial axes, and eventually wind positions, is material for another research project that scholars like Prokop are better suited to explore than myself. At this stage of my argument, the example of *hiti* is to indicate that the holistic cognitive model of Tupaia’s *rua mata’i* would not only have connected signature seasonal winds with complex calendrics, astronomy, swell patterns, and other ocean phenomena, but also drawn on foundational celestial alignments that are mirrored in architectural orientations, refigured in countless (voyaging) legends, and ultimately constitute a complex Oceanian geography.

The geographical reach of the concept of *hiti* begins to resonate if the *hiti* axis is extended, and if we take into account that Havai’i as a ‘primordial matrix’ generating islands is an inherently iterative concept replicated several times in the settlement processes, allowing for more than one *hiti* axis in central Polynesian traditions.

If extended beyond Havai’i/Ra’iātea and Mo’orea-Tahiti to the WNW, the *hiti* axis discussed above draws directly on Pukapuka, the only island in the Northern Cooks Tupaia placed on his chart. And significantly, when extended to the ESE, the same axis draws right through Mangareva, Temoe, and ultimately, Pitcairn Island. To name these islands on his map, Tupaia chose the same ancestral names that also feature in the legend of Rātā, each expressive of their relational position on the Havai’i/Ra’iātea-centred *hiti* axis: Hitipoto (Mangareva), Hititautauatu (Temoe), Hititautauamai (possibly Oeno), and Hititaurēveva (Pitcairn Island).<sup>150</sup> Again, *hiti* signifies the swimming or floating positions of these islands on the cosmic *’ana muri–’ana mua* axis drawing from Havai’i/Ra’iātea. *Poto*, in this context, indicates ‘nearness’; it always partners with the concept of *roa*, indicating ‘distance’: and Hitiroa, on the *hiti* axis centred on Havai’i/Ra’iātea, is indeed another ancient designation for Tahiti.<sup>151</sup> The adverbs *atu* and *mai* express oppositional directions,

<sup>149</sup> Henry, *Ancient Tahiti*, 439, my emphasis.

<sup>150</sup> *Ibid.*, 447, see also Figure 1.

<sup>151</sup> See Henry, *Ancient Tahiti*, 471–2, 607–15.

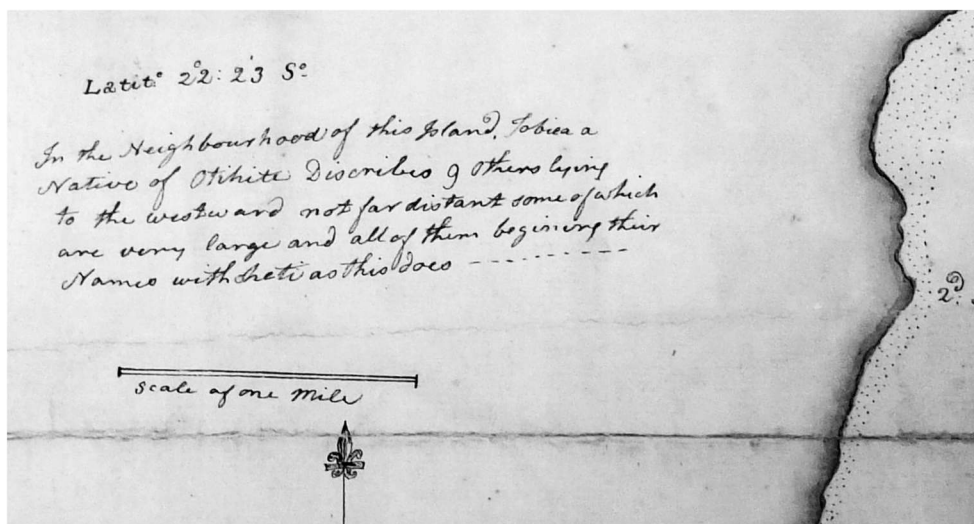


FIGURE 15. Richard Pickersgill, [Map of 'Ohetiruah'], (1769), detail, National Archives Kew, London, Adm 352/469.

the one indicating drifting 'away from', the other 'toward'; *rēveva*, finally, evokes an originary 'departure' of Pitcairn, presumably from Hitiroa/Tahiti on the *hiti* axis centred on Havai'i/Ra'īātea.

But clearly, Tupaia did not conceive of Havai'i as singular. In the Tuamotus, for instance, the eventual historical manifestation of the Havai'i matrix is understood to be the second-largest atoll, Fakarava, while the first island of creation, Vavau, is the ancient name of the largest atoll, Rangiroa. And intriguingly, the passage Tupaia chose to put on his chart extending to the WNW from Havai'i/Fakarava to Rangiroa and Tikehau, and to the ESE to Hao, aligns perfectly with the cosmic orientation of *hiti*.<sup>152</sup>

The most compelling evidence that Tupaia attempted to teach the concept of *hiti* to Cook and his crew, however, is an annotation Richard Pickersgill, one of Molyneux's mates, set down on a draft map of the island of Rurutu, which the *Endeavour* hit upon when voyaging south from Ra'īātea. The annotation reads: 'In the neighborhood of this Island [Rurutu], Tobia ... describes 9 others lying to the westward not far distant some of which are very large and all of them beginning their Names with oheti as this does' (Figure 15).<sup>153</sup> Evidently, then, when discussing the

<sup>152</sup> There is some indication that the Havai'i/Ra'īātea axis and the Havai'i/Fakarava axis relate as an inverted mirror image: according to Tuamotuan legend, the deified ancestor Tū created the lagoons of Rangiroa and Tikehau so that they could enclose Tahiti and Mo'orea respectively; but when trying to conduct 'the fish and its attendant' to their designated positions, they 'ran aground upon a shoal, where they have remained fast ever since'. See Henry, *Ancient Tahiti*, 443. Hitiroa/Tahiti thus correlates with Hitiroa/Rangiroa.

<sup>153</sup> Richard Pickersgill, [Map of 'Ohetiruah'], (1769), detail, National Archives Kew, London, Adm 352/469.

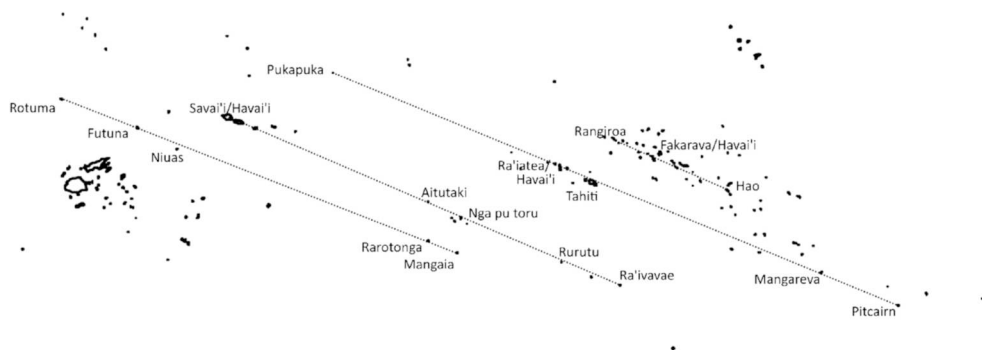


FIGURE 16. Lars Eckstein, ‘*Hiti* axes that probably tie into Tupaia’s *rua mata’i*’ (2025).

geographical orientation of islands in *te ao tea* to the west of Ra’iātea and Rurutu – presumably in the Southern Cooks and Samoa/Tonga – Tupaia initially explained their alignment by resorting to the cosmogonic logic of *hiti*, even if none of the ancient names ‘beginning [with *hiti*]’ were eventually transferred onto Tupaia’s Map.

Tupaia called Rurutu ‘Hitiroa’ whenever he discussed it with Cook and his crew: as with Havai’i, then, the ancient names indicating relational positions on different *hiti* axes are not singular island names, but conceptual terms organizing genealogical and geographical space. They therefore seem to recur on each *hiti* axis: the notion of Hitiroa applies to Hitiroa/Tahiti on the Havai’i/Ra’iātea *hiti* axis, to Hitiroa/Rangiroa on the more easterly Havai’i/Fakarava axis, as well as to Hitiroa/Rurutu on a more westerly axis drawing from yet another primordial Havai’i matrix. The Havai’i of this axis is clearly Savai’i in Samoa. On their copy of the first draft of Tupaia’s Map, the Forsters annotated the island of Savai’i as follows: ‘*Ohiavie* Tupaia called the father of all the rest’,<sup>154</sup> which suggests that Tupaia probably invoked Savai’i/Havai’i as the first matrix of ancient creation in his own traditions when discussing it with Cook and his crew. An axis drawing from Savai’i to the ESE by precisely 113° passes straight through Hitiroa/Rurutu. And on its way, it crosses a whole number of significant islands which Tupaia eventually drew on his chart: they include ‘Upolu and Tutuila in Samoa; Aitutaki, Manuae, and the Nga Pu Toru chain (Ma’uke, Miti’āro and ‘Ātiu) in the Southern Cooks; as well as Rimatara in the Australs. Together with Savai’i, they may well make up the ‘9 [islands] lying to the westward’ of Rurutu that Pickesgill mentioned and that Tupaia seems to have recounted by giving them ancient names expressive of their relational position on the Savai’i/Havai’i *hiti* axis (see Figure 16). To the eastward from Rurutu, the axis continues just past Tupua’i and leads straight to Ra’ivavae. The island names on this axis which Tupaia instructed would have included, again, *ni’a/raro*; *poto/roa*; *tautau mai/atu*; *rēveva* and other relational designations.

At this point, I propose that there might be a fourth *hiti* axis in Tupaia’s cosmogonic framework that he drew upon when designing his map of Oceania for Cook and his crew. Different from the other three axes where the Havai’i matrix can be

<sup>154</sup> Georg Forster, ‘Copy of a Chart’.

clearly identified as Havai'i/Ra'iātea, Havai'i/Fakarava, and Havai'i/Savai'i respectively, the generative nucleus of this fourth axis is less easy to identify. Yet it seems to draw from Rotuma, to which Tupaia evidently attributed great genealogical significance judging from the sheer size of the island shapes he drew for Rotuma (rivalled only by the outline of distant O'ahu in Hawai'i). After sketching an eastbound passage from Rotuma to Savai'i in the process of drawing his Map, Tupaia ventured to offer a second path from Rotuma which passes through Futuna/Alofi and the Niua Group. An extension of this passage draws right through Rarotonga in the Southern Cooks and ends at Mangaia. All these islands range, again, on an axis that draws about 111° to the ESE, following the same primordial orientation provided by 'ana mua rising and 'ana muri setting (Figure 16).<sup>155</sup>

How does the concept of *hiti* tie in with the conceptual model of Tupaia's *rua mata'i* and ultimately ancestral Polynesian navigation? First, given their attachment to distinct Havai'i matrices, I suggest that the *hiti* axes Tupaia invoked are intimately related to histories of successive migration into remote Oceania. Subsequently, (segments of) the axes would have been privileged paths of voyaging primarily against the dominant trade winds: this is underscored by the fact that Tupaia chose to recite and draw island-to-island passages on the *hiti* axes always from west to east. Second, the fundamental celestial orientation of the underlying 'ana mua–'ana muri axis in this context ties in closely with the *matari'i* system discussed earlier, where the simultaneous presence of 'ana mua and 'ana muri in the sky after sunset marks the two annual moments of perfect cosmic balance that ultimately structures the two principal seasons of the Tahitian calendar. Also previously discussed, the celebrations of *matari'i i ni'a* and *matari'i i raro*, respectively, were probably also the two 'turning points' of Tāne, if conceived (like the Taumakoan Lata) to be pushing back wind systems to signature reset positions and placing winds at the centre of Tupaia's *rua mata'i*. Finally, I propose that in Tupaia's model, the concept of *hiti* is strongly attached to the season of the *to'erau*, the signature wind for eastbound passages. In Tupaia's *rua mata'i*, in other words, *hiti* would have been applied as a sphere of certain winds for sailing specific voyaging paths.

Voyaging eastward on the primordial *hiti* axes before the *to'erau* during its designated voyaging season (that is, in the three lunar cycles following *matari'i i ni'a*), would have been particularly advantageous. It would have allowed following the sun during daytime (whenever available): the sun, after all, rises at about 110° ESE at *matari'i i ni'a*; this position moves slightly further south to about 115° around the December solstice, and back north again, passing the *matari'i i ni'a* position, until towards the end of the lunar cycle of *fa'ahu* it rises at about 100° ESE. The sun thus would have served as an excellent directional marker on the *hiti* axes, also given that it rises almost vertically, especially in the first two lunar cycles following *matari'i i ni'a*.

During the season of the *to'erau*, moreover, a series of signature stars and asterisms in the Tahitian tradition qualify as directional markers at night when rising on the ESEern horizon. In the early season, *taurua nui amo aha* (Sirius) rises at

<sup>155</sup> Lars Eckstein, 'Hiti axes that probably tie into Tupaia's *rua mata'i*? (2025).

107° soon after dawn; a little less than two hours later, *taurua heuheu po* (Alphard) appears at 99°, followed after about another three hours by the southern *'ana roto* (Spica) rising at 102° ESE. Some two hours later, the southern *'ana muri* (Zubeneschamali) appears in about the same position as Alphard and Spica (at 100°), followed swiftly (in less than an hour) by the constellation known in different Polynesian traditions as Maui's fishhook. Its signature star, *'ana mua* (Antares), rises just beyond the southern frontier of the sun (at 118°), while Acrab, marking the top of the hook's handle, appears at 110° ESE. They are followed, in the same house (at slightly different times depending on the season's progression), by the rising sun.

What this reveals is that a dense pattern of signature directional stars and asterisms (and their minor partners) in the Tahitian tradition was available specifically for the challenging ESEern passages during the *to'erau*, which constitute the vast majority of island-to-island paths discussed and drawn by Tupaia for Cook and his men; both on *hiti* axes and on slightly more easterly passages, such as the leap from 'Uiha–Vava'u in Tonga via Niuē to Rarotonga. Intriguingly, the very same sequence of directional stars (but not sun positions) can be used when they set, on a passage bearing to the WSW (such as, for instance, from the Society Islands to the Southern Cook Islands) in the first lunar months of *matari'i i raro*, in the season of *mara'ai moana*. One of the differences, however, would have been that during the *to'erau*, star and sun bearings are less frequently available than during the *mara'ai*. As Anderson remarked, the *to'erau* was 'generally attended by dark, cloudy weather, and frequently by rain'.<sup>156</sup> This means that an intimate knowledge of seasonal and regional swells (and their refraction and reflection patterns for each island-to-island sequence), during the *matari'i i ni'a* season in particular, would have been an indispensable backup in Tupaia's *rua mata'i*.

## CONCLUSION

This essay set out with the assertion that Tupaia's Map of Oceania is not an expression or representation of Polynesian ways of modelling navigation. While documenting the vast extent of Society Islander voyaging knowledge at the time of Cook's travels, it is important to understand that it is an astounding feat of translation between two very different ways of being in, relating to, organizing, and representing the world. Tupaia's Map is testimony to the fact that Tupaia must have acquired a solid command of the alien ways in which Cook and his crew used their instruments and charts when attempting to locate themselves and trace their paths through his world. How he used this understanding in 'The Making of Tupaia's Map' is another long story that has been told elsewhere.<sup>157</sup> In contrast, there is little evidence that Cook and his men understood much of the ways in which Tupaia conceptualized and modelled voyaging in his own tradition, before translating some of it into representational forms that were more recognizable to them.

<sup>156</sup> Anderson in Cook and King, *A Voyage to the Pacific Ocean*, vol. 2, 143.

<sup>157</sup> Eckstein and Schwarz, 'The Making of Tupaia's Map'; idem, 'Corrections'.

I have argued in this essay that Tupaia imparted more of his ancestral voyaging knowledge than has been hitherto thought. This is particularly true of what I have called Tupaia's *rua mata'i*, or wind positioning system. The realization that Molyneux's record of the 'Otaheite names for the Winds according to Tobia' would have been the foundational orientation of a complex system, modelling ancestral open-ocean voyaging, was the starting point for reassessing the archive for all relevant traces of how Tupaia might have conceived of his own navigational practice.

This research was guided by the Taumakoan *te nohoanga te matangi* as taught by Te Aliko Koloso Kaveia and documented, at his behest, in the Vaka Taumako Project by Mimi George through several publications and two documentary films she directed in collaboration with the Pacific Traditions Society and Kaveia's heirs. While similar wind positioning models are documented across the Southern Pacific, Taumakoan voyagers are the only ones, to the best of my knowledge, who still actively use much of *te nohoanga te matangi* in navigational practice, drawing on Polynesian traditions which survived the onslaught of imperial capitalism and colonialism. The core experiment of this essay has been to test whether the historical archive predominantly resulting from 18th-century European voyages to the Society Islands allows a cursory reconstruction of a complex wind positioning system, similar to the Taumakoan model, that Tupaia might have used: by relating signature wind positions (including wind and weather work that can predict, or even alter, winds) to astronomical events (the positions and paths of the sun, moon, planets, stars, and asterisms); to specific calendrics and seasonality of ancestral voyaging; to distinct swell patterns; to the particularities of specific island-to-island voyaging paths (including the expected winds, swells, directional stars, sea-marks, migratory patterns of birds and sea fauna, etc.) and the primordial axis of (island) migration in Tahitian traditions. One of the key propositions of this project is that, in order to understand how Tupaia's *rua mata'i* modelled voyaging, we must recognize that it is grounded in an ontology alien to Western dualistic and disenchanting science, by envisaging a world centred on voyagers who actively relate to ancestral presences manifest in special winds, astronomy, and in birds and sea fauna of ritual significance.

At the end of the research, my understanding is that a diverse array of available archival source material strongly supports the argument that Society Islanders, and by extension probably most Polynesian voyaging traditions, modelled voyaging in very similar ways to how Kaveia instructed in his teachings of the Taumakoan *te nohoanga te matangi*. Of course, there is significant regional and historical variation between Kaveia's and Tupaia's model, as best as it can be reconstructed from the archival sources. The wind names are different, and it seems that Tupaia's system did not operate as rigidly as Kaveia's with oppositional wind pairs. The ancestral presence imagined to dance and work winds at the centre of the system is not, as in the Tuamakoan and Mangaian models, Lata/Raka, but presumably Tāne, whom Tupaia is recorded to have regularly invoked in his own wind work. However, there are also very substantial convergences. There is compelling evidence that, like Kaveia, Tupaia not only had an astounding knowledge of astronomy in terms of sun, moon, planet, and star positions, but thought of wind systems and astronomical events as being intimately related. We must assume that, in both traditions,

specialized astronomical knowledge allowed prediction of the direction, duration, and quality of winds that are ultimately suitable for voyaging. Both traditions, too, evidently conceived voyaging as intricately seasonal. Based on sometimes minute archival traces, I have attempted to reconstruct the ways in which Tupaia might have modelled the calendrics of his *rua mata'i* (beyond the lunar calendar, *tārena tahito*), suggesting links between seasonal wind positions with the events of *matari'i i raro* and *matari'i i ni'a* as well as the solstices, equinoxes, and further possible connections between signature winds and stars. There is converging evidence, too, that both Taumakoan and Society Islander traditions knew and made use of the positions of both visible and invisible stars and asterisms in navigational practice. That the ability to read complex swell patterns and their relation to winds was a key skill in ancestral navigation, and was the most important backup strategy during overcast weather for Tupaia, as well as Kaveia, is not recorded in the *Endeavour* archive, but can be gleaned from records about the Makatean navigator Puhoro, who in 1774 shared the outline of another wind positioning system with the Spanish crew of Andía y Varela's *Jupiter* in the Society Islands.

Much of Tupaia's wind positioning system I have attempted to reconstruct from archival traces remains admittedly hypothetical and incomplete. This begins with the identity of some of the (minor) wind names which cannot be unambiguously identified from Molyneux's transcriptions. It certainly extends to some of the attributions of wind positions to seasonal astronomical events that follow Kaveia's model, but can only be very loosely underscored with archival evidence, or for claims about Tupaia's knowledge of swells. Other phenomena like *te lapa* – flashes of light which radiate out from target islands on the ocean surface to guide voyagers on their paths – are important elements in Taumakoan and some other Western Pacific wayfinding traditions,<sup>158</sup> but find no mention whatsoever in central Polynesian historical records. And not everything boils down to the incompleteness of the Western archive: much of what would have made very good sense to Tupaia within his ontological and cosmogonic framework is bound to remain opaque, as it simply does not translate into the conceptual and terminological language at my disposal. This applies, for instance, to the more specific ways in which Tupaia would have known and predicted winds by closely observing the stars (such as the bend of *vaiora a tāne*, the Milky Way), or other phenomena such as the migratory patterns and behaviours of birds and sharks or other sea fauna (which were also potential manifestations of Tāne). What I hope is that this predominantly historical research is corrected and complemented by new research into other Oceanian wind positioning systems and perhaps even encourages communities who still have traditional knowledge about related wind models in the Western Pacific, in Tikopia, the Cook Islands, the Tuamotus, in Aotearoa, and elsewhere, to come to the fore.

The reconstructed model of Tupaia's *rua mata'i* allows speculation on how the extensive voyaging paths he drew on his map of Oceania might be re-conceptualized and re-translated into Polynesian worldings – into ways of knowing the world which

<sup>158</sup> George, 'Polynesian Navigation'.

do not assume that voyagers traverse an objectified and fixed ocean space that is flattened and mapped out with a grid of invisible lines; but a world where islands may migrate along cosmic axes, a world in which voyagers inhabit a dynamic space full of ancestral presences which can be called upon to 'fish up' target islands from under the horizon on set voyaging paths as laid out in the ancestral chants.<sup>159</sup> Tupaia's *rua mata'i* gives an idea, at least, of the signature winds master navigators like Tupaia would have requested from Tāne for specific voyages, from Rotuma to Samoa, Tonga to the Cooks, the Australs to Mangareva and Pitcairn, and through the Tuamotus to the Marquesas, while the long passage to Hawai'i would have required additional and specialized knowledge. It suggests the seasons that would have been recommended for specific voyages, the astronomical events which would have indicated them, the rising and setting positions of sun and stars and their relationships to islands, weather, swell patterns, as well as the primordial axes that provided geographical as much as genealogical orientation. It allows us to speculate, too, about the specific patterns created by seasonal swell trains guiding voyagers on each island-to-island passage, without foreclosing that Tupaia knew much more than all this which no longer translates back from his maps and related archival traces.

Tupaia's *rua mata'i* thus also ultimately helps to better understand how ancestral navigators were able to conquer and maintain connections of trade and kinship across the Polynesian triangle centuries before Europeans even ventured into the largest ocean on the planet. At the heart of Oceanian wind positioning systems, and presumably key to the success of ancestral Polynesian voyaging, has been a highly sophisticated understanding of the intricate relations between the behaviours of astronomical bodies, wind systems, and the ocean. If Western knowledge traditions ever developed this science, they lost it over the course of modernity. Andía y Varela recounted:

What took me most in two Indians whom I carried from Otahiti to *Oriayatea* [Ra'iātea] was that every evening or night, they told me, or prognosticated, the weather we should experience on the following day, as to wind, calms, rainfall, sunshine, sea, and other points, about which they never turned out to be wrong: a foreknowledge worthy to be envied, for, in spite of all that our navigators and cosmographers have observed and written anent the subject, they have not mastered this accomplishment.<sup>160</sup>

It is time, then, to give proper respect to all those navigators, named and unnamed in often frugal colonial records, who sailed on European ships and gifted

<sup>159</sup> In the 'The Birth of New Lands, after the Creation of Hawai'i' (which lays out a composite passage from Ra'iātea through the Society Group and the Tuamotus to the Marquesas and on, possibly via several Line Islands, to Hawai'i), the recurring phrase for successive islands *moving toward* the voyager is 'areare te tai, [o Vavau/o Maurua/o Huahine, etc.]', 'the sea casts up [Porapora, Maupiti, Huahine, etc]'. Henry, *Ancient Tahiti*, 401–3.

<sup>160</sup> Andía y Varela in Corney, *The Quest and Occupation of Tahiti*, vol. 2, 286–7.

their knowledge of the ocean. But what matters even more is to remember and celebrate those legendary ancestral voyagers who came before them and to say their names before those of Magellan or Tasman or Cook: Tāne, Maui, Rū and his sister Hina, Hinora, Pele, Liktanur, Ukura, proving that ancestral voyaging was a female as much as a male domain, whose legacy is carried on by the likes of Fealofani Bruun in Samoa or Moeata Galenon in Tahiti; Kupe, Turi, Tafa'i, Hono'ura, Rātā, and countless others. Tupaia, of course, but so many more.