

11 The Pacific migrations by Canoe Form Craft

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The Pacific Migrations

It is now generally agreed that the Pacific Ocean islands began to be populated from a time well before the end of the last Ice Age by people, using small ocean-going craft, originating in the area now called Indonesia and the Philippines. It is speculated that the craft they used were based on either a raft or canoe form, or a combination of the two. The homo-sapiens settlement of Australia and New Guinea shows that people must have been using water craft in this area as early as 60–40,000 years ago. The larger Melanesian islands were settled around 30,000 years ago (Emory 1974; Finney 1979; Irwin 1992).

The final long distance migratory voyages into the Central Pacific, which covers half the world's surface, began from Samoa/Tonga about 3,000 years ago by the migratory group we now call the Polynesians (Irwin 1992). They continued to populate every remaining island in the Pacific, covering vast distances. These migrations are believed to have been accomplished with craft based on

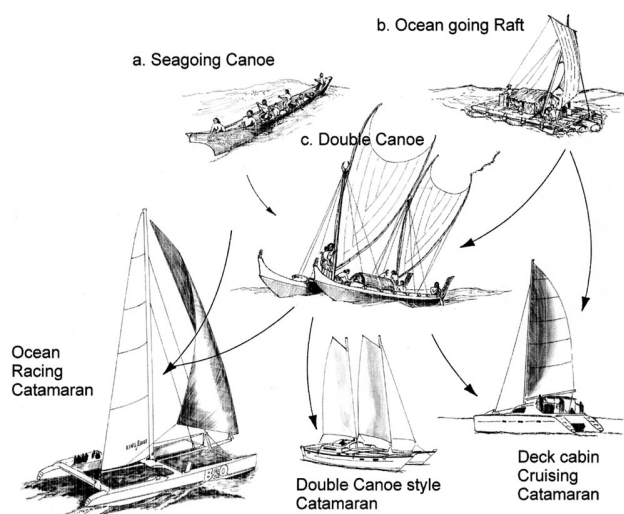


Fig. 11.1. The proposed evolution from canoe and raft into double canoe and ultimately the modern catamaran. (Drawn by Hanneke Boon).

the canoe form, which the Polynesians developed into superb ocean-voyaging craft.

The Pacific double ended canoe is thought to have developed out of two ancient watercraft, the canoe and the raft, these combined produce a craft that has the minimum drag of a canoe hull and maximum stability of a raft (Fig. 11.1).

As the prevailing winds and currents in the Pacific come from the east these migratory voyages were made against the prevailing winds and currents. More logical than one would at first think, as it means one can always sail home easily when no land is found, but it does require craft capable of sailing to windward.

The Migration dilemma

By the 1950's, based on a combination of 'bad press' relating to the sailing abilities of Polynesian vessels that was proffered by early 19th century missionaries, and the innate European cultural attitude that such lightly built 'native' craft could not be seaworthy, it was a widely held western belief that the Pacific canoe form craft 'could not sail to windward', 'would break up in strong winds or gale seas', or that 'life on board would be so hard that many crew would die from cold' (Sharp 1956; Finney 1979).

This created a dilemma. The Pacific Ocean islands were settled by migrating sailors, who from studying genetics and linguistics appeared to have originated from South East Asia, but their observed canoe form craft were condemned by westerners as unsuitable to sail to windward or of surviving gales (Sharp 1956; Finney 1979) (Fig. 11.2).

Theory A: Thor Heyerdahl – sailing with winds and currents

In 1947, Thor Heyerdahl (1950, 1952) entered the debate. He presented a theory based on his study of the South American Indians, of downwind, down current, settlement of the Central Pacific by sailing rafts from South America

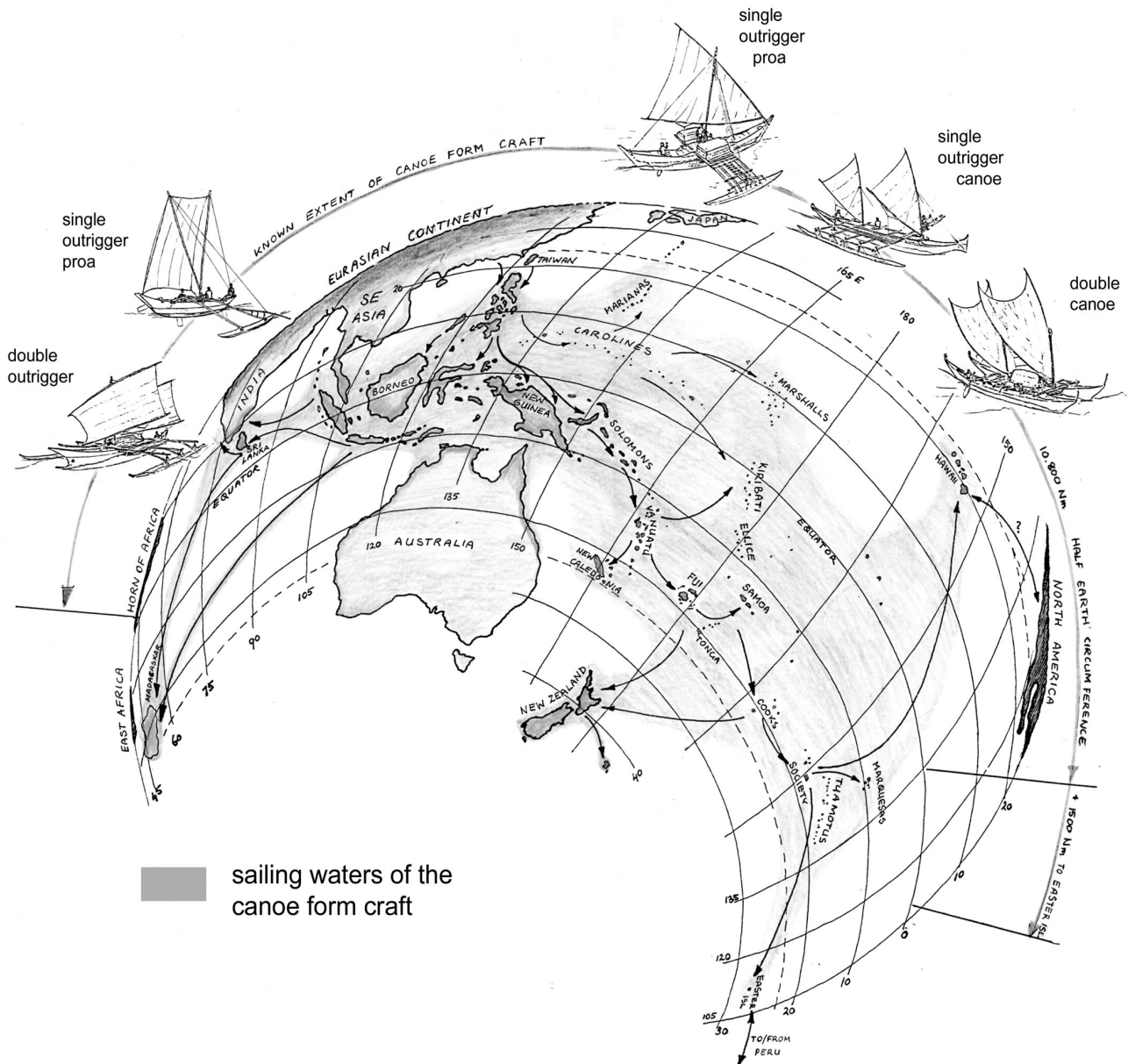


Fig. 11.2. Spread of canoe form craft over half the Earth's surface and main migration routes. (Drawn by Hanneke Boon).

(rafts that were observed by the first Spanish explorers in the early 16th century) (Heyerdahl 1952: Chapter VIII; Francesco Pizarro 1524–26).

Heyerdahl was one of the first proponents of 'Experimental Sea Archaeology' and set the scene for many later replica ship voyages. Unfortunately, he never sailed his Kon-Tiki raft against the wind, which is essential in proving that a vessel is capable of Pacific migratory voyages.

Theory B: Eric de Bisschop – sailing against the wind

Unknown to Heyerdahl, probably because the academics

of Hawaii refused to acknowledge or record it due to technical disagreements, a 20th century double canoe voyage was made by the Frenchman Eric de Bisschop (1940). In the 1930's, Eric de Bisschop had been studying ocean currents and wind systems with reference to ancient Pacific sea migrations whilst sailing into the Western Pacific from Formosa (now Taiwan) on a 40 ft Shanghai Junk. His junk was wrecked in Hawaii. Bravely, he announced: "I will build an ancient Pacific double canoe and carry on with my research work", which he did. In early 1937, he left Hawaii on his self-built 38 ft double canoe Kaimiloa. He sailed from Hawaii to Futuna and the Australian Barrier Reef, and from Surabaya to Cape Town, during which he endured severe gales. From Cape Town,

he then sailed non-stop to Cannes in the Mediterranean – a total voyage of 18,000 Nm in fourteen and a half months. By 1938, Eric de Bisschop was the first to prove, by what we now call ‘Experimental Archaeology’, the windward/storm sailing ability of the Pacific double canoe craft.

Unfortunately, Eric de Bisschop, as an ‘experimental’ archaeologist, disagreed with the ‘academic’ archaeologists in Hawaii on canoe design principles and his voyages were not regarded as ‘of value’ and therefore not used in 1947 to examine the theories of Thor Heyerdahl.

In 1956–57 de Bisschop, who was still intrigued by the Polynesian migration theories, made a raft voyage from Tahiti to South America, against wind and currents. This voyage effectively completed the Heyerdahl experiment and examined whether or not rafts from South America could have made the return voyage. This voyage was not totally successful as the raft was too heavy and slow, the voyage took a very long time, during which the raft deteriorated. The raft was eventually badly damaged in a storm off the islands off the South American coast (Danielson 1959).

By the early 1950’s, Eric de Bisschop had a few disciples of his theory of the ancient double canoe as voyaging craft (de Bisschop 1940), who were also prepared to take replicas out into the ocean and test sail them in gales and sail them to windward. I was one such disciple, the other was Rudy Choy in Hawaii.

More Experimental voyages

The 1950’s were a time of new ideas and new fields of adventure. As a youth in the late 1940’s, I dreamed of sailing the oceans in ‘ethnic’ boats. In Britain’s excellent libraries and museums I studied drawings, descriptions and models of Chinese Junks, Viking Ships, Arab Dhows and Indo-Pacific canoe form craft, the latter of which are documented in ‘Canoes of Oceania’ (Haddon and Hornell 1936–38 [1975]).

The easiest and cheapest ‘ethnic’ boat to build – with respect to materials and labour time – was a Pacific double canoe. The South Kensington Science Museum houses a model of a Tahitian Reef Canoe (Photograph Neg. Nr. 396/53) based upon which I built a 7 m double canoe and called it Tangaroa (the Father God of Pacific religious myth).

Fifty years later, this double canoe design looks incredibly crude, but by 1955, with a crew of two, I had sailed her across the Bay of Biscay to northern Spain where we encountered our first sea gale. Contrary to perceived opinion we found that the 7 m double canoe rode the Biscay gale seas in surprising comfort, which enabled us to publish a positive article on her sailing abilities in *Yachting Monthly* (Wharram 1956). By the end of 1956, we had sailed this double canoe across the Atlantic Ocean from the Canaries to Trinidad. Arriving in the West Indies, we had proven, as Eric de Bisschop had, that the double canoe was an incredibly safe craft,

could sail to windward and even had a surprisingly ‘sea kindly’ motion, even one as small and crude as the 7 m Tangaroa. Such are the inherent sailing abilities of the Indo-Pacific Ocean canoe form craft.

Modern Catamaran development

As we were exploring the ocean-going capabilities of the double canoe in the 1950’s, other westerner naval architects were exploring the speed potential of the double canoe for day yacht racing. In 1955, the Prout brothers in England developed a 16 ft day-sailing catamaran called *Shearwater*. Subsequently the Duke of Edinburgh sailed in one, and thus, catamarans ‘arrived’ on the yachting scene.

Even so, in the second half of the 1950’s, there were still serious doubts about the seaworthiness and sailing abilities of the double canoe, misnamed ‘catamaran’ (note 1), particularly when operating offshore in the cold waters of the North Atlantic. This scepticism was promoted by Sharp in his book ‘Ancient Voyagers in the Pacific’ (Sharp 1956, 1957) and was still being quoted in academic circles into the 1970’s.

First successful double canoe/catamaran voyage across the North Atlantic

In 1957 in Trinidad, we decided to challenge Sharp’s assumptions. With our transatlantic sea knowledge, we began building a new 40 ft double canoe design (called *Rongo*) and on 11th August 1959 sailed her up the West Indian Archipelago to New York, then proceeded to cross the 3,000 Nm stretch of the cold North Atlantic encountering gales and head winds, arriving in Britain at the end of September.

This voyage in the Atlantic, together with another by Rudy Choy in the Pacific (developing the Hawaiian canoe concept for Ocean racing), and the speeds achieved by the day-sailing catamarans, were all written about in the world’s yacht magazines. As a result came a surprising development – the ‘ancient’ canoe form concept, now generally termed ‘catamaran’, was enthusiastically taken up by the single-hulled world of modern yachting.

Experimental Archaeology continued by ‘ordinary’ sailing people

By 1965, ‘Multihulls’, a generic term for ‘catamarans’ and ‘trimarans’ (a western word for an adaptation of the Indonesian double outrigger canoe), were a vital new element of the western yachting scene. Choy and Wharram were early providers of catamaran designs for modern adventurous yachtsmen. By 1976, we had sold 3,000 sets of boat plans of ‘Polynesian Catamarans’ for self-building. Many world-wide ocean voyages were made by the Wharram Catamarans ranging in length from 27 to 50 ft, and crewed by ‘Mr and Mrs Adventurous Urban Human’.

That these voyages were successful is again tribute to the innate seagoing qualities and windward abilities of the previously academically derided double canoe craft (note 2). These many voyages undertaken with the minimum number of accidents raise the possibility that early Pacific exploration could have happened by a ‘slow Clan group seepage’ over many generations on small craft for the ‘pleasure and adventure values of sailing and exploration’, and not necessarily by highly organised fleet voyaging as the result of war or overpopulation.

Research in the 1990’s

Building and sailing a new experimental craft

As professional catamaran designers, we have had to develop and use general analytical yacht design formulae to find out the ‘real’ (as against the advertised), sailing abilities of competitive designs. These analytic formulae combined with our accumulated sailing experience on canoe form craft, can also be applied to understanding the performance of recorded historic canoe form ships or canoe form craft still sailing today.

In the late 1980’s we were asked to design a replica 19 m Pacific Voyaging Canoe for a member of the Andean Explorers Foundation and Ocean Sailing Club. While designing this craft we decided to build a modified version for ourselves, with a wider overall beam to give more stability for a larger western sail rig. We built the 19 m Spirit of Gaia, launched her and began sailing her across the Bay of Biscay in 1992.

The Spirit of Gaia sailed in the various different winds off the Canaries at speeds of 14–16 knots. She has surfed down waves at 18 knots. She sailed from New Zealand to Fiji encountering a three-day storm, with winds of up to 50 knots, sailing under a storm jib 70 degrees off the wind and still made 60 Nm a day and kept on course. She sailed 600 Nm non-stop to windward in the Red Sea, heavily reefed into the force 7–8 northerly winds for which the Red Sea is famous (Morgan and Davies 2002), 60 Nm ‘made good’ to windward per 24 hours. She sailed in the Canaries, island to island, for one month with 20 people on board, giving us practical experience on possible crew numbers of ancient migratory groups (Fig. 11.3).

Sailing data acquired

During all the voyages, Spirit of Gaia was monitored with electronic speed and wind instruments, backed up with GPS satellite navigation. After the first 6,000 Nm of sailing we were able to publish accurate Polar sailing diagrams. These give a comprehensive picture of double canoe sailing abilities, showing much better windward ability than had ever been suggested in previous academic Polynesian ship studies (Wharram 1994).

The 19 m Spirit of Gaia has deck space for 20 people, load carrying ability to carry food and water (by basic

western standards) for this crew for 22 days, which at a conservative 100 Nm/day average means a voyage of 2,200 Nm (30–35 days if rain water and fresh caught fish are added, extending the voyage to 3,000–3,500 Nm). A crew of 20 would be able to hoist and handle two 40 m² Polynesian style sails without blocks and pulleys (which the Polynesians had not developed), and be sufficient to run watches for the hand held steering paddles they would have used. All this data confirms that Polynesian double canoes the size of Spirit of Gaia could have made the migratory voyages.

Waka Moana Symposium

In 1996 the Auckland Maritime Museum, with UNESCO funding, organised the ‘Waka Moana Symposium’ on Pacific ships, and invited participants of the 1995 Tahitian Voyaging Society ‘Great Gathering of Canoes’, in which we had participated the year before, to speak. One of my lectures was on the establishment of the Roskilde Viking Ship Museum and its endeavors to develop experimental archaeology. This symposium subsequently encouraged more attention on the sailing of replica canoes and the gathering of data in the Pacific region.

Pacific Canoe hull shapes

Tikopian hull shape

The Auckland National Museum houses a 9 m Tikopian



Fig. 11.3. Double canoe Spirit of Gaia. (Photo by Hanneke Boon).

Sacred Outrigger Canoe (note 3), that had been presented to the Museum in 1916 when the island was converted to Christianity. Admiral Paris (Haddon and Hornell 1975: Vol II: 52) recorded identical canoes nearly 100 years earlier showing this canoe shape is a possible descendant of Pacific craft that were operating prior to the arrival of the Europeans.

This small craft it immediately struck us as being a seaworthy craft and we were confident that we could sail it offshore. Thus, we photographed and recorded the hull lines and when we returned home, to our excitement, we found that the underwater profiles and cross sections were so very close to the profiles and cross sections of our 19 m Spirit of Gaia, that the collected sailing data of Gaia could be used to predict the sailing performance of the 100 year old Tikopian canoe and other recorded Pacific V-shaped hull shapes.

Tikopian hull shape developed

Recently, we were asked to design an 'ethnic' double canoe for an American, who 20 years ago was sailing the Pacific in one of our 8 m designs. We have designed for him an 11.5 m double canoe using Tikopian hull lines. This 'Tama Moana' double canoe will be able to make voyages of the same duration as the Spirit of Gaia, but carrying 8 people instead of 20. A predicted 100–150 Nm sailed per day gives this craft a sailing range of 2,200 Nm (with minimum speed/maximum food consumption), or 5,000 Nm (maximum speed/minimum food) – data that suggests that ancient Pacific migrations could have been made with small groups on small ships. Thus, future voyages using a traditional Pacific 'crab claw' sail will provide invaluable experimental archaeological sailing data that hopefully will confirm our calculated predictions.

Double Canoes or Outriggers?

The question arises, did the proto Polynesians always use double canoe craft for their ocean voyages? If you take the Tikopian 11.5 m hull, described above, and assemble it as an outrigger canoe, as is the practice in Tikopia, you halve the labour and material required in the hull building. This size outrigger craft can still carry four to five people the same distances as the same size double canoe (Feinberg, 1974). For scouting voyages to discover new islands, this would seem the most cost effective craft, with minimum loss if the vessel never returned. Later settlement voyages to already discovered islands could then be made in double canoes (assembled from two outrigger main hulls) with the extra load carrying capacity and deck space for settlement stores and animals. In the present day Pacific it is the outrigger canoe that has survived, whereas the use of the double canoe has disappeared. This suggests that the cost/labour efficiency of the outrigger canoe is still a major factor in choice of vessel.

Melanesian Canoes

In 1996, we sailed north from New Zealand into the Melanesian Pacific, Fiji and Vanuatu. The Melanesian Pacific Islands are to the ancient sailors the stepping stone route, that Melanesian man, on canoe craft or rafts, began colonising at least 30,000 years ago from Sundaland (present day Indonesia) east into the Central Pacific (Emory 1974; Irwin 1992).

In Fiji and Vanuatu we met many outrigger canoe sailors. In Vanuatu the small dugout outrigger canoe is still universally used as a commuter craft, with daily trips to gardens on nearby islands, every family in a village would own one. Large canoe sailing only died out within living memory, and as such our large double canoe fascinated the older men. We invited them on board and took some out sailing. We could talk to them as equal canoe builders/sailors, on windward sailing, leeway angles, storm handling. We particularly noticed how they understood design elements like hull shape and bow angles. We in return learned how to sail on outrigger canoe with a steering paddle, something we have continued to study and have built a number of small outrigger canoes for this specific purpose.

A visit to Tikopia

From the North of Vanuatu it is 200 Nm to the Polynesian outlier island, Tikopia. We made a pilgrimage there to meet the chief whose great-grandfather presented the sacred outrigger to the Auckland Museum in 1916. Though the Tikopians still have paddling canoes, they are no longer sailed, but on the nearby island of Anuta the building and sailing of these same type of canoes was until recently, still practised, as studied and recorded by Richard Feinberg (1988) in his book 'Polynesian Seafaring and Navigation'.

Conclusion

From all our studies described in this paper of Pacific Ocean canoe form craft (and further studies of canoe form craft in the Indian Ocean not described here), through study of their design through mathematical yacht design formulae and means of experimental voyages and, we can confidently conclude that the canoe form craft used by the Polynesians for their migratory voyages were seaworthy and capable vessels able to sail to windward and travel long distances. It is thus a pity that there is such a dearth of actual archaeological ship finds upon which to base more accurate replica ships could be based.

We hope by building future craft; outrigger canoes, proas and more double canoes, on which we intend to carry out further studies of the Indo-Pacific hull shapes, rig types and the use of steering paddles, to gain further insights into the sailing qualities of the Indo-Pacific canoe form craft, which covered a sailing area of half the Earth's circumference.

Notes

- 1 'catamaran' is a misappropriated western term for a double-hulled vessel, that originally described an Indian log raft the kattumaram or tied/lashed-log raft as literally translated in Tamil (Rajamanickam 2004).
- 2 The writings of Sharp (1956) deride the abilities of the double canoe craft and Finney (1979) makes several long references to this attitude in the 1950s.
- 3 Tikopia is a small remote Polynesian outlier island at the eastern end of the Solomons.

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