

**MAX-PLANCK-INSTITUT FÜR WISSENSCHAFTSGESCHICHTE**

Max Planck Institute for the History of Science

2002

**PREPRINT 216**

Jarita C. Holbrook

**Celestial Navigation and Technological  
Change on Moce Island**

ISSN 0948-9444

# CELESTIAL NAVIGATION AND TECHNOLOGICAL CHANGE ON MOCE ISLAND

Jarita C. Holbrook

Jarita C. Holbrook, Center for the Cultural Studies of Science, Technology, and Medicine,  
History Department, University of California, Los Angeles

## *Abstract*

Moce Island is part of the Lau island archipelago, which borders eastern Fiji. In 1998, I conducted a study of how new technologies are interfacing with the local navigation methods of Moce. Using ethnographic interviews and observations, the research reported in this paper explores the “traditional” system of navigation of Moce, which consists primarily of utilizing extensive knowledge of the wind and currents, along with celestial east/west markers. However, this system of navigation has changed over the last fifteen years to include the use of stars. This is unique among contemporary navigation studies where the majority of cultures are in the process of losing the celestial part of their navigation techniques. In most cases, celestial navigation skills are lost as new navigation and other technologies become available. The uniqueness of the Moce case is amplified further because the new navigation system began with a change in boating technology. My research suggests that the introduction of the outboard motor, which allows one to travel in straight lines prompted the use of stars on the horizon as guiding beacons. When presented with this hypothesis, the navigators who have transitioned to this new system agree.

## INTRODUCTION

The islands of Fiji are located one thousand miles north of New Zealand, in the “Melanesian” part of the South Pacific. The people who settled Fiji are thought to have migrated from Indonesia across the Pacific; island hopping from land form to land form and reaching Fiji around 4000 years ago. The oldest archeological sites in Fiji are dated at around 1300 BC (Kirch 1997).

In 1998, I had the opportunity to travel to Fiji to assess Fijian astronomy and celestial navigation. Initial inquiries into contemporary Fijian navigation revealed that the Moce Islanders are considered the best sailors of all of Lau, and the Lauans are considered the best sailors in all of Fiji. “Moce,” pronounced “mo-they,” means “goodbye” or “goodnight” in Fijian. One Moce islander, Simione Paki, had acquired some fame for having sailed from Moce to Suva, the capital of Fiji, using ‘traditional’ methods in a traditional canoe. Traditional methods refers to the methods used by the oldest generation of navigators on Moce, not necessarily ancient methods or even methods used prior to this oldest generation.

Moce Island, some 325 kilometers (172 nautical miles) from the capital of Fiji, Suva (Figure 1), is about ten square kilometers in size and roughly circular in shape. The Lau group extends about 250 nautical miles north to south. Moce is in Southern Lau and is one of the easternmost islands in the group. There are two villages on Moce: Korotolu and Nasau. Today, with a population approaching six hundred people, the two villages have merged. However, the architectural style of the two villages has remained distinct: the houses in Korotolu are primarily oval in shape with a single room, while in Nasau, the “bure” houses are rectangular with several rooms, thus reflecting historical differences in the original settlers.



Figure 1: Map of the Fiji islands

According to the people of Moce, there was a group of smaller darker skinned Fijians living on Moce when a group of people from Tonga arrived. The Tongans asked permission to stay and set up a village some distance from the original village, Nasau. About one hundred years ago a whale was beached on the reef near the 'Tongan' village, and for months the smell of the decomposing carcass made living there unbearable<sup>1</sup>. The new settlers asked permission to relocate to a site closer to Nasau and named their new village "Korotolu" which means "third village" in Fijian. Today, only the descendents of the original inhabitants are allowed to bury the dead on Moce. This was the only instance I observed where origins were relevant. There has been and continues to be considerable intermarriage between the two groups<sup>2</sup>.



Figure 2: Remains of the canoes used for the famous trip to Suva

---

<sup>1</sup> The people of Moce gave the event as 100 years ago, however, Laura Thompson (1972: 136) gives the date of Leva village moving to Korotolu as 1921.

<sup>2</sup> Fijians have maintained their chiefly system of local governance. The choice of the chief of Moce is dependent upon bloodlines, but it was not obvious to me that they were chosen exclusively from the descendents of one village over the other.

Near Suva, there is a group of Moce Islanders in ‘diaspora’ living in a village named “Korova” – Fourth village. In addition to being the capital, Suva is the largest city in Fiji with a population of over 73,000 people. I conducted my preliminary inquiries into the navigation practices of the Moce Islanders in Korova. Simione Paki’s son, Semiti Cama Paki, lives in Korova and provided me with information about his father, the famous trip to Suva, and allowed me to photograph the remains of the canoes used for the voyage (Figure 2). The people living in Korova were very excited about the possibility of me studying Moce navigation. They were eager to have their traditions recorded.

From the information provided in Korova, I determined that the Moce islanders used celestial bodies as part of their navigation. I made the decision to travel to Moce and talk to Simione Paki in order to find out more about the navigation methods. My plan was to interview Paki and the other navigators on Moce. I hoped to discover the Fijian names and English equivalents of as many celestial bodies as possible, including those used for navigation, and to gain an understanding of the mechanics of their system of navigation. In this paper, I report my findings on the navigation techniques and only discuss those celestial bodies used in navigation.

What follows is a brief outline of the economics of the island. I point out those activities that are connected with the use of boats. 1) Masi production - Most of the women of working age work six days a week making bark cloth called ‘masi’ or ‘tapa’, which they sell to the local shopkeeper who in turn sells to a distributor in Suva. 2) Sea Cucumber gathering – people collect sea cucumbers, which they dry and sell in Suva for export to Asia. These activities require the use of a boat only when delivery to the mainland is necessary. Then the shopkeeper will place his cargo on one of the government boats that stop at Moce, or he will arrange a local boat to carry the goods to the island of Lakeba, pronounced “La kem ba,” the capital of the Lau group, which is served more frequently by government boats than Moce. 3) Seafood trade with China - There used to be a trade with China for lobster and giant sea scallops. The Chinese company even provided a generator and a freezer, both still on Moce, to store the seafood. Their boats would come to Moce to pick up the cargo. However, that trade has dropped off. The Moce men participating in this trade would use a boat to reach the best places for gathering the lobsters and scallops. 4) Employment in Suva - Moce Islanders periodically go to Suva for work and for their

higher education<sup>3</sup>, they send part of their paychecks back to their families on Moce. There are three ways to get to Suva: take a government boat which stops at Moce, or travel by local boat to Lakeba then catch a plane or government boat to Suva. 5) Teaching - There is an elementary school on Moce. The teachers and the principal are government employees, some but not all are from Moce. Those not from Moce tend to travel to their homes during school holidays via the same methods as reaching Suva. 6) Local businesses - Yaqona, the national drink, does not grow on Moce; thus yaqona salesmen on the island do very good business as well as the two shopkeepers who sell staples such as flour, tinned fish, produce, and sugar. These businessmen rely upon individuals bringing goods with them from visits to Suva and shipments placed on government boats. 7) Preachers – There are three religions that I encountered on Moce: Bahai, Catholicism, and Methodist. Each of these had a spiritual leader or preacher. I am not sure if they had an external source of funding or if they drew a salary from the weekly church offerings. They do travel to serve communities on other islands. 8) Post Officer – There is a Moce man who runs the post office and radiophone and is a government employee.

The people of Moce rely primarily on subsistence farming and fishing for their daily food supply. A family unit will have one member out fishing at least twice a week. Both men and women fish, the men with spears, masks, and goggles, the women with nets. Both travel to various fishing sites via boats. The closest clinic and secondary school are on Lakeba, about 30 nautical miles to the northeast of Moce. Lakeba has an airstrip as well as being visited regularly by government and commercial boats. The first Prime Minister of Fiji, Ratu Mara, is from Lakeba, perhaps one of the reasons it has the most modern conveniences in Lau. Most Moce Islanders have traveled to Lakeba by boat many times.

## NAVIGATION TECHNIQUES OF MOCE ISLANDERS

My work in Moce began with interviewing Simone Paki (Figure 3). I went on to interview a series of men - sailors and farmers ranging in age between 54 and 84. During these interviews, I focused on the mechanics of their system of navigation, the use of celestial bodies for navigation, their knowledge of celestial bodies, the places to which they had traveled, and their sailing stories. The sailing stories often involved surviving a storm,

---

<sup>3</sup> Higher education means primarily secondary school. Some people go on to the teaching college, University of the South Pacific, or to Brigham Young's college all in the Suva area, but the majority stop at the secondary school level.

hurricane, or being capsized. Some involved getting lost and improvising to get back to Moce. The improvisations included cutting the size of the sail using a knife or cane knife (machete) to reduce wind resistance, tying objects to the hull to increase the drag, and maintaining their course by marking the wind and/or current directions under low visibility conditions.



Figure 3: Simione Paki

One example of a survival story was told by Johnny Rapui (~ 40 years old), who was sailing back to Moce when he encountered a hurricane. He cut down the size of his sail so that it would catch less wind and maintained his course to Moce. He arrived safely.

I have chosen to present the narrative of Simione Paki in this section. It serves as a typical example of the navigation style of the Moce Islanders. However, Paki's story is unique because he sailed an exceptionally long distance, from Moce to Suva, using traditional methods in the early 1990s. Most of the men have sailed only the extent of the Lau group of islands. The difference is not only the distance, but that when sailing in the Lau group

one is rarely out of sight of land, whereas the route to Suva involves stretches of many hours on open ocean<sup>4</sup>. Paki is also unique in that he sailed weekly to other islands in the Lau group and occasionally to Tonga using Fijian canoes and using 'traditional' methods<sup>5</sup>, whereas the other interviewees made a few long trips a month. Paki is 72 years old<sup>6</sup>. Today, he sails to his garden about a mile away from his home most mornings to collect vegetables for his family's consumption. What follows is a summary of Paki's narrative:

The trip to Suva was initiated by one of Paki's sons, Metui. Metui thought that it would be a good financial enterprise to have traditional canoes in Suva to give tourists rides for a fee. There are no hardwood trees on Moce, thus they traveled to Oneata<sup>7</sup> and acquired a double hulled canoe and a single canoe for the trip. In the last week of February 21 in 1992, by my calculation<sup>8</sup>, on a Friday, Simione Paki, his son - Metui, and a third man set out for Suva.

They sailed to Olorua Island (west of Moce) and had originally planned to spend the night there, but since the weather was so nice, they continued. When they reached halfway between Vanuavatu Island and the reef near Tavu-na-sici, the wind was blowing from the east. They set their sail and went southeast to Totoya Island. Once Totoya was sighted, they reset their sail for Moala Island. When they reached Moala, the wind changed to east-southeast, so they changed the sail to go west towards Suva. On Sunday night, they sighted the lights of Suva, however; at that point the wind was not good. They reached a small island very close to Suva and spent a few hours there resting. The next day, they sailed on to Suva, reaching there at four in the afternoon on Monday. There the narrative ends.

---

<sup>4</sup> At this point scholars of long distance voyaging may scoff at the relatively short distances traveled by the Moce Islanders. However, very little has been published on any aspect of Fijian navigation and even documenting the techniques for short voyages is a significant contribution to Pacific navigation literature.

<sup>5</sup> "Traditional" is in quotes because, as earlier emphasized, this sailing method only reflects the techniques used by the oldest generation of navigators on Moce, not necessarily an ancient Fijian navigation method.

<sup>6</sup> Ages are given for 1998, the time of this study.

<sup>7</sup> Oneata is one of the few islands in the Lau group that has trees large enough to make canoes.

<sup>8</sup> Paki said that they left on a Friday in February in 1992 and the moon was past full. Using astronomy software I determined that this was the Friday in February 21, 1992.

The entire trip took four days and three nights. Paki marked the time using a radio, which he carried in his canoe, and the trio carried their own supply of food, water, and a Primus (kerosene) stove for cooking. Paki learned the route from riding on commercial boats between Moce and Suva.

In December 1993, Metui and a friend set sail for Suva in another double canoe. They were last sighted off of Moala, but never reached their destination. A month later, their canoe washed up on Kadavu, pronounced “Kan da vu,” an island south of Suva. Both Metui and his companion were presumed dead; their bodies were never recovered.

Historically, the people of Moce would make long trips to Tonga, rarely to Suva<sup>9</sup>. The wind patterns generally travel from west to east part of the year<sup>10</sup>, and since Tonga is east of Moce they would travel with the wind. The people of Moce estimate that they took their last trip to Tonga in the 1950s. When asked why such trips stopped, they said that the big traditional canoes called “drua” were no longer being made and that the trip is not easy in a smaller boat. Sometime in the 1980s, a boat containing one Tongan man washed up on the reef. He had run out of petrol while fishing in Tongan waters and been adrift for one month. When greeted he did not respond because he thought it was another of the many hallucinations he had experienced while adrift. Eventually he was returned home to Tonga. This drift story shows that the current travels from east to west during some part of the year<sup>11</sup>. Paki also made trips to Tonga in his canoe as a lay preacher. Tantalizingly, Paki mentioned that he used “the star to Tonga” when he traveled to Tonga. None of the other informants mentioned this star<sup>12</sup>.

---

<sup>9</sup>An interesting article on the history of voyaging between Fiji, Tonga, Samoa, and other Pacific Islands is Lemaitre 1970. Using a variety of historical techniques he tabulates the number of inter-island groups travel.

<sup>10</sup>This wind pattern, referred to as the Winter Trade Wind, travels from the southeast (Finney 1996)

<sup>11</sup> Finney (99: 1996) states that during the summer months, the winds blow from the southeast but take on a south to north circular pattern. Maps given in Lewis (1994: 142-143) show the ocean current traveling from east to west during August-September and February – March.

<sup>12</sup> Unfortunately, since I began with Paki, I did not realize the uniqueness or possible significance of his statement until after I had completed all the interviews and returned home. Thus, I did not follow up on his comment nor did I identify which star was the star to Tonga nor how he learned about the star to Tonga. As for possibilities one of the referees of this article suggested that this points to an older navigation system that did use the stars. However, I cannot agree with this supposition since it is dependent solely upon

In most cases, including Paki's, the men provided information on the celestial objects used as part of their system of navigation only after I asked, not during their descriptions of how they navigated. Then they would mention the Volasiga, the Volabogi, the Sun, and the Moon. 'Siga' means sun and day, while 'bogi' is night; 'vola' - is to mark. Thus loosely translated Volasiga is mark the day and Volabogi is mark the night. For completeness, 'vula' is moon. When the Sun or Moon is near the horizon, the men use it to mark the direction of east if it is rising or west if it is setting. The Volasiga and Volabogi are bright stars that appear near sunrise or sunset, i.e. the planet Venus<sup>13</sup> when it appears near sunrise and sunset, respectively. The Volasiga and Volabogi were used in the same way as the Sun and the Moon, to get a rough estimate of east and west. The men said that they were especially happy when they would sight the Volasiga for it meant that the Sun was coming up soon.

#### ANALYSIS: BLOWN BY THE WIND

The Moce Islanders in my first set of interviews had a tremendous knowledge of the passages through the local reefs, the currents, and the wind patterns in the Lau group. As with Paki's narrative, the stories contained detailed information such as a change in the direction of the wind or the direction from which the waves were coming (current direction) as noted by how the wavefronts broke against the hull. When they were required to change the sail, how many times they had to change the sail, and the sighting of islands and reefs, all punctuated the stories. The Moce Islanders gave the impression of having set routes for travel between the various islands of the Lau group. Included in their system are markers that had to be sighted before changing their sails.

The system of navigation depended first and foremost on an intimate knowledge of the wind and current patterns along with knowledge of the locations of reefs and islands both

---

one informant's statement. I think it is more likely that since Paki traveled regularly to Tonga as a lay preacher he may have learned that particular bit of information from his Tongan friends. It is also possible that similar to his younger counterparts, he discovered the best star to use on his own.

<sup>13</sup> The navigators, especially the second set of interviewees, were not all in agreement that both the Volasiga and Volabogi are the planet Venus. From their comments, namely that the Volabogi is after sunset and is brighter than all the other stars, and some went so far as to say that every night there was a both a Volabogi and a Volasiga, I deduced that the Volabogi in some cases might be whichever other planet is visible at night be it Mars, Jupiter, or Saturn.

uninhabited and inhabited. The only celestial bodies that were part of their navigation were the Sun, the Moon, the Volasiga, and the Volabogi. These celestial bodies were used to mark east and west upon rising and setting, and served as a rough compass used as a secondary method to check their bearings.

The interviewees learned to navigate as children by watching. Children are included on fishing trips and inter-island trips, the adults often allow the children to help with the sailing and navigating. None of the interviewees indicated that the adults gave formal lessons in sailing, instead the children had to pick it up as they went.

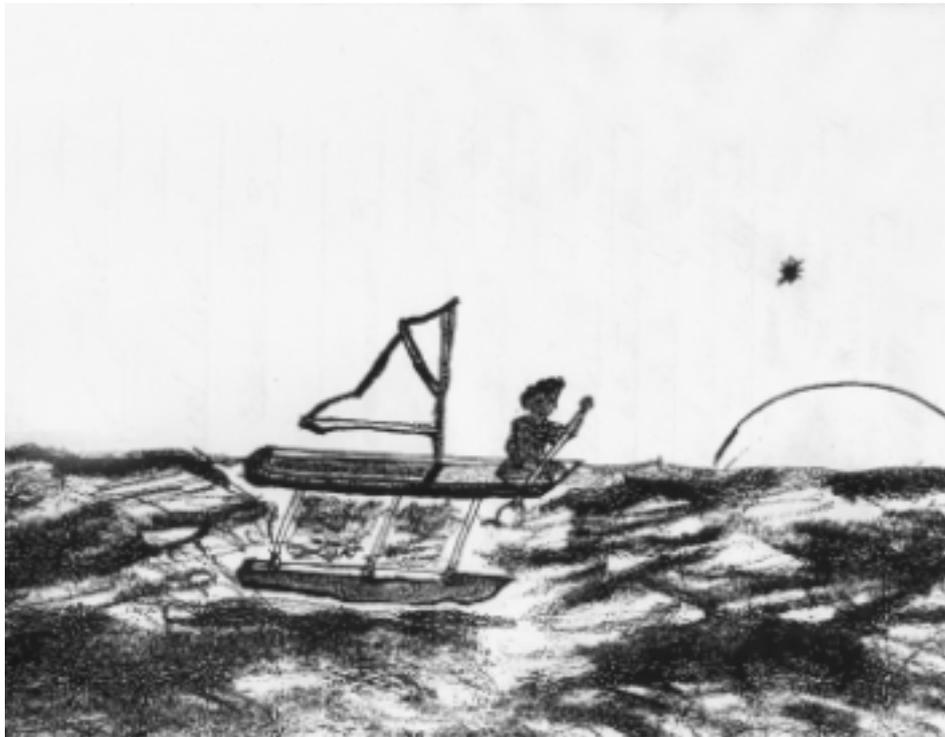


Figure 4: Diagram of the 'traditional' navigation of Moce. The Sun, Moon, and Venus were used as rough east and west markers when they were near the horizon.

The boat on which I traveled to Moce also transported about ten people returning home to Moce. While on the boat, I questioned these individuals about their knowledge of navigation, and had come to the conclusion that certain stars, the moon, and the sun were all used as part of their system of navigation. Thus, after conducting several interviews I was confused by finding that only the Sun, Moon, and the planet Venus played a role in

their system (Figure 4). I returned to the people I spoke with on the boat and interviewed them, they provided more details that led me to conduct a second set of interviews.

#### NAVIGATION TECHNIQUES OF MOCE ISLANDERS PHASE II: FIRST GENERATION STELLAR NAVIGATORS

The second set of interviewees averaged 42 years in age, were male, and had lived primarily on Moce. They tended to have traveled many times to Suva (via government boats) to work or visit relatives. They had completed primary school, and had often attended secondary school away from Moce at the school on Lakeba or one of the schools in Suva. Their voyaging was limited to islands within the Lau group.



Figure 5: Alifereti Amani (on top) helping to repair a boat.

The second set of interviews began with Alifereti Amani, 42, which I present as a narrative typical of the younger navigators (Figure 5). Amani was one of the people I met on the boat to Moce. Amani described how when traveling to another island, after exiting the reef, he would place Moce at his back at the correct angle to reach his destination until Moce disappeared from view or the next island marker appeared on the horizon. Although the next island is not visible, the Moce men know its direction relative to Moce. When twilight falls, if he has not reached his destination, he picks a star that marks the direction in which he is traveling. He follows that star until he reaches his destination. If the star that he is following rises or sets, he picks another star in the right direction. He said that there are plenty of stars in the sky, that is, there is no shortage of stars in the direction they wish to go (Figure 6). The stars he uses do not have names in Fijian. He was very firm about there being no compasses on Moce.

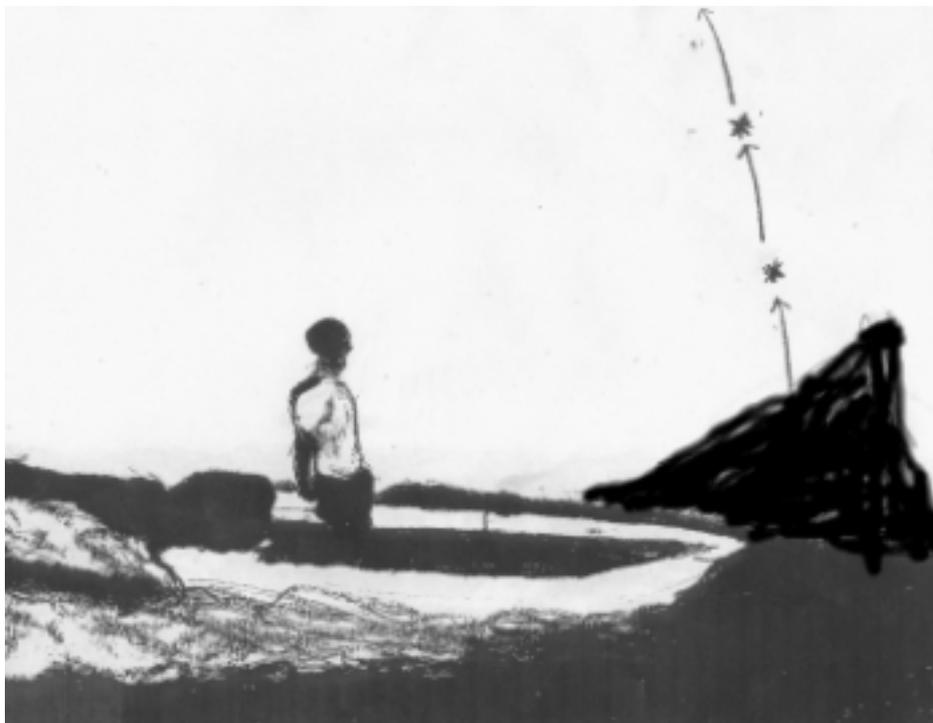


Figure 6: In the new system, there is no shortage of stars in the direction they wish to go

The interviewees in the second set all said similar things. They spoke of their knowledge of exiting the reef, using Moce or other islands as navigation markers, and at night using stars in the correct direction as beacons. There was no mention of current and wind patterns. However, they did name the Volabogi, Volasiga, and the Sun and Moon and

how they are used in navigation (as rough east/west markers). They all said that they did not use a compass.

## ANALYSIS II: MOTORING ALONG

The second set of interviews provided information on how stars are used in Moce navigation. The original narratives didn't mention stars, but used the Sun, Moon, and Venus as part of their method of navigation. Noting the change in technique, I began to search for reasons behind the different methods. I began to explore the possibility that a change in boating technology caused the change in navigation.

The older men used traditional canoes with sails. The younger men originally learned to sail, but over the last 15 years, the outboard motor has become common and the islanders have switched to wooden boats and punts. Today, there are very few traditional canoes on Moce - even Paki uses a punt with a sail.

The fact that boats are driven by outboard motors appears to have had more effect on navigation than the shape of the boats or the materials used to construct them. The outboard motor allows the boats to travel in straight lines, independent of the wind and current. The outboard motor significantly reduces the travel times because tacking is no longer necessary. In regards to navigation, this means that visual markers have come to dominate the method of the Moce Islanders. Bearings in relation to islands, reefs, and stars rather than settings of the sail and wind directions punctuated the narrative of Alifereti Amani and his contemporaries. It is the inclusion of stars in the new method which makes the Moce case unique in the Pacific where, in general, traditional celestial navigation methods are in decline.

The men who use the new method taught themselves or "figured it out" themselves. I was startled by the narrative of an older man who spoke of using the stars to mark his way home from Lakeba to Moce. However, he told me that he was using a motorboat at the time. He said he learned the technique of using the stars in this manner himself. In general, the outboard motor users felt that using the stars was the most obvious thing to do at night while traveling. The younger generation of navigators also told tales of capsizing and having to cut the sail in bad weather. These were the stories of their youth when they used canoes. None of the informants claimed to have had formal naval or navigation training and did not describe their techniques nor distances in nautical terms.

The new system and the old system of navigation are admittedly inexact, but sufficient for the type of navigation performed by the Moce Islanders. Travel undertaken by the Moce Islanders in smaller crafts is limited to destinations within the Lau group. Rarely is an island or the water breaking on a reef not visible during travel. Thus, the homing skills necessary for long distance ocean voyaging are not present in the contemporary narratives.

The new method of navigation is being transmitted to the next generation via the same methods as the sailing techniques. The children of Moce are often given command of the boats while traveling with adults and are told to keep the motor pointed towards a particular star when traveling at night. There is no formal training celestial navigation.

Once I was better able to articulate the two navigation techniques, I questioned the first set of informants on how they felt about the new techniques. All the men praised the fact that traveling by motorboat was much faster than sailing. A few thought the new method was bad, because the motorboat users no longer paid attention to the wind and current. They explained that the drawback to relying so heavily on visual cues is that when visibility declines, such as during a storm or in fog, they get lost unless they were paying attention to the wind and current. It was clear that the knowledge of wind and current patterns was considered to be the most important part of navigating for the old Moce sailors. They felt that this particular knowledge should not be forgotten.

## DISCUSSION

The situation on Moce is the first case I have found of a celestial navigation system being developed because of an introduced technology: the outboard motor. In this discussion, I examine other cases in the Pacific where a new system of navigation includes more celestial markers. I explore possibilities for why a stellar system of navigation was not present on Moce before the introduction of the outboard motor. I touch on earlier studies of Fijian and Lauan navigation techniques, technology transfer, and economic changes related to boat building. I end by presenting examples of similar responses to a change in navigation techniques from other communities of navigators.

Of the contemporary studies of Pacific navigators (Feinberg 1995; Finney 1976, 1994; Goodenough 1996; Lewis 1978), the majority of cases showed a loss of the celestial aspect

of navigation as the navigators became more dependent upon modern navigation equipment. The authors often had to search their fieldsites for the few remaining celestial navigators. This was definitely not the case in Moce. One of the studies did mention a change in navigation technique towards a celestial one, but the circumstances did not involve a response to a change in technology: In Lewis' *The Voyaging Stars*, Siona Mafi of Nomuka Island in Tonga is presented as someone who was formally trained in the use of charts and compass, but got tired of using them. He developed a celestial system by first using the compass to note the rising and setting positions of certain stars, and finally using the stars alone (Lewis 1978: 85, Lewis 1994: 32, 121). Unlike the Moce case, he was not motivated by a change in boating technology.

Another possible example of an ad hoc celestial navigation system can be found in Feinberg's *Seafaring in the Contemporary Pacific Islands*. In his article on the Nukumanu Islanders, when the author asked which stars were used for navigation, he was told that each navigator chose his own set of stars (Feinberg 1995: 189). The author did not believe that this was true, but instead thought that they were being secretive. He managed to get only one informant to name the set of stars that he used. The Moce case may cause him to re-evaluate his initial conclusion since they also use stars that do not have formal names, and use stars that are convenient for each particular trip.

There is a similarity between the new method of Moce navigation and navigation techniques found in other parts of the Pacific. In the late 1960s, David Lewis recorded the words of a Tongan navigator, Kaloni Kienga:

“You head towards that star...and when it has moved too high and too far to the left, you follow the next to arise from the same point on the horizon. Then the next, and the next, and so on until dawn. This we call *kaveinga*, the star path.”

[Lewis 1978: 18]

Kaloni Kienga only named the first star, which he pointed out to Lewis; the other following stars he did not name. Lewis found this method in use in many other parts of the South Pacific, where the location of island groups is marked by the rising and setting of a “bright” star and the course is maintained by following a chain of less prominent stars. The Fijians

currently use a convenient star that is not named but also use successive rising or setting stars. This technique clearly marks the beginning of a new *kaveinga*-like system.

The ethnography done by Laura Thompson mentions the methodology of celestial navigation she found on Kabara, an island about 20 nautical miles to the southeast of Moce (1940: 177). Her informant, Risolo, said that each island had several stars and when one star rises or sets another star is chosen. She clearly states that only the most experienced navigators used the stars. Her informants used traditional sailing canoes. The method sounds identical to the one now used by the Moce navigators, however, the Moce Islanders insist that they taught themselves this method.

Why given similar traditional boating equipment across the Pacific did the Moce Islanders not have a *kaveinga* system before now, especially since at least one person on Kabara had such a system? Is a *kaveinga* system typical of long distance ocean voyaging, which the Fijians rarely pursued during the last century? I return to Paki's statement that he used "the star to Tonga" to navigate to Tonga. Paki is the only informant to say this. His simple statement may indicate that for longer voyages there were well known stars that were used as markers to reach their destinations. Thus, the young navigators of Moce may be recreating an older Moce *kaveinga*-like system on a much smaller distance scale. If the new method is indeed a revival of an earlier tradition, the Moce Islanders are firmly unaware of it for all claimed to have made up the new method themselves. The Moce navigators in both sets of interviews did think that perhaps their forefathers knew more stellar names, but none connected this to a lost system of navigation that relied more heavily on celestial markers. Further, there is the question of the Tongan influence on Moce navigation. The Moce islanders presented their system of navigation as their own; there was no distinction between the systems described by the inhabitants of Nasau or Korotolu. If there had at one time been such a distinction on Moce, it has been forgotten<sup>15</sup>.

---

<sup>15</sup> Goodenough and Feinberg mention that historically Fiji has relied on the skilled Lauan sailors to make up the ranks of their navy (Goodenough and Feinberg 1995) this reflects the contemporary belief that Lauans are the best sailors in Fiji. Historically, in his study of various islands in the Lau group [he did not include Moce] Hocart mentions that the Lauans had a unique indigenous directional system with three major directions (Hocart 1929). Neyret also talks of this direction system and uses the same Fijian names as Hocart (Neyret 1950). I found no such designations on Moce. Though, similar to my findings, Neyret concluded that the navigation methods of the Fijians is vague (Neyret 1950). Neither researcher mentioned chains of stars being used for navigation which is consistent with what I found with the older navigators.

At latitudes of the United States (greater than 30 degrees north), people are familiar with Polaris which marks the north celestial pole. Over the course of the night, certain constellations close to Polaris are seen to circle the pole further emphasizing the location of the north celestial pole and therefore north. Thus, most of the navigation systems we find at these latitudes utilize Polaris and constellations which allow you to find Polaris. At the latitude of Fiji (18 degrees south), Polaris is not visible, nor is there an obvious marker for the south celestial pole. All stars rise in the east and set in the west following the path of an arc. Given that the stars move in this manner, the obvious way to use the stars for navigation in this part of the world is to follow chains of rising and setting stars. Once the motion of the stars is understood, elaborate theories of navigation technique transfer or technique revival are not necessary.

Going back to the question, especially now given our understanding of how the stars move at these latitudes; why did not Fijians have a Kavienga-like system? It is my opinion that given the short distances that Fijians traveled while sailing, a Kavienga-like system may have proven too inexact. I hypothesize that when sailing over long distances, the zig-zag pattern necessary to maintain a heading under sail would average out to a line. However, for traveling short distances, traveling too far without resetting the sail may cause you to overshoot your destination. Thus, the set routes which included when to tack may have proved more accurate than following the stars.

The implications of technological change add another complexity to studying contemporary celestial navigation. Why has the outboard motor been adopted into Moce culture<sup>16</sup>, yet the islanders are very proud that there are no compasses on their island? I examined other cases of changes in boating technology in Lau in an attempt to answer these questions:

Lauan sailors say that a mat sail is better than a canvas one for the mat allows the wind to pass through and therefore the mast is not easily strained or broken.  
[Thompson 1940: 176]

This passage is significant because it shows that introduced technologies were in Lau over sixty years ago. At that time, the Lauans were not eagerly adopting the new canvas sails, but instead tested them and found their own mat sails better met their needs.

---

<sup>16</sup> For an example of a culture that has not successfully adapted the outboard motor due to economic difficulties, see Montague 1995: 59.

Further,

Salvaged hardware from shipwrecked yachts is commonly adapted for use on Lauan sailing canoes. Friction hitches and simple mechanical advantages, in conjunction with simple wooden hardware, are used in the rigging of a sailing canoe

[Gillett 1993: 41].

This shows that the people of Lau are amenable to adapting new technology if there is a clear advantage.

On Moce, the outboard motor has a clear advantage over sailing because it has led to faster inter-island travel. The compass they have rejected and therefore, following the logical flow, their navigation system must be superior to the compass. The compass may be at a disadvantage because in a small boat the shaky needle of a compass is difficult to read<sup>17</sup>. Or it could be that the Moce Islanders take pride in knowing their surroundings in great detail and that somehow their reputation as being the best sailors in Fiji is entwined with not needing compasses<sup>18</sup>.

The Moce Islanders have switched from using canoes to using punts and boats. Though I did not question the navigators about the pros and cons of the change in boats, I imagine that the roominess of the new boats is an advantage. An outboard motor easily fits to the back of the punts as opposed to the tapered end of the canoes. Interestingly, Lewis states that the Fijians around the Koro sea (west of Lau closer to Viti Levu) called their canoes “waqa ni tagane”- boats of men (boys), whereas the punts were called “waqa ni yalewa”, predictably, boats of women (girls) (Lewis 1978: 110). This division may imply that the Fijian canoe is regarded as more manly than the punts, or that women preferred to travel in punts. I found no such distinctions on Moce or other references that would shed light on this designation.

---

<sup>17</sup> For an example of a culture that has adapted the compass as well as modified the boat design of larger boats to accommodate motors, see Ammarell 1995. The Bugis of Indonesia use both the compass and celestial navigation in their voyaging. Ammarell includes extensive information about the astronomy of the Bugis and their wind compass.

<sup>18</sup> I did not question people as to why they did not use compasses, thus I can only speculate.

Another author to comment on the adoption of technology and the change in boats in Fiji is G.K. Roth:

There has been a marked effect on the regular use of traditional, Fijian-made articles through the introduction from overseas of tools and utensils and other manufactures, all of which have tended to displace the former but have not always displaced them entirely. The result is that many introduced articles exist in modern times side by side with those which they are gradually replacing. Instances are to be seen any day and in every island: ...English fish-netting in place of nets made from local vegetable fibres; boats and punts in place of dugout canoes, some with outrigger attachment and sail..."[Roth 1953: 43]

Historically, one economic factor which led to a revival in canoe building and sailing occurred in the 1930s when copra prices fell. Copra is the dried fruit of the coconut. When copra prices were high, the Lauans sent their harvests to the refineries via the larger government and commercial boats. Thompson notes that while copra prices were high copra was harvested and exchanged for goods and "...they began to neglect their other economic pursuits such as fishing, gardening, canoe building, and interisland trade" (1938: 196). Once the prices fell the number of boats servicing Lau dropped from six boats to one (Knapman 1976). The Lauans could no longer afford to pay the shipping fees and began using their sailing canoes to transport the copra (Ladd 1935). This circumstance allows for a possible historical comparison with the current technological changes. During the time of reduced canoe travel, did the Lauans lose or modify their traditional navigation methods? Only a few of the Moce Islanders were of an age to navigate during the 1930s. The oldest navigator that I interviewed, Bui – 84, was part of the crew on one of the larger boats during that time. However, his career on the ocean was brief because he stated that he has been a farmer for most of his life. He did not know most of the navigation techniques practiced by his neighbors. Thus, the interviews from Moce did not include any new information which could shed light on this issue.

My research at the United States Naval Academy has shown that contrary to the belief that celestial navigation is a continuous tradition leading back into antiquity; celestial navigation as practiced by the military was not perfected until the invention of the chronometer at the end of the 18<sup>th</sup> century. Moreover, it has continued to be modified by innovations in technology such as the calculator and publications such as the Nautical Almanac as well as

navigation instruments such as radar, Loran-C, and the NAVSTAR GPS. My research on the navigation of the Kerkennah Island fishermen found that the celestial navigation aspect of their navigation system is in decline. However, the decline in the teaching of celestial navigation is not due to new technologies, but because of education. Young fishermen are now attending school instead of spending time fishing. These findings as well as the Moce case may cause scholars of Pacific navigation to consider how ancient are the methods of 'traditional' navigation. It may be more appropriate to call navigation methods observed today the latest techniques or 'surviving techniques' rather than traditional. It is reasonable to suppose that navigation techniques that rely on no external instruments could have been practiced thousands of years ago, but I do not think it is wise to insist that these techniques have been handed down without change to the present.

## CONCLUSIONS

The navigators of Moce use two navigation techniques: the old navigation system emphasizes the skills necessary for sailing, whereas the new method is ideal for the linear travel that is possible using motors. The new system of navigation incorporates more celestial markers than the old. In particular, the old method used the Sun, Moon, and the planet Venus as celestial east-west markers, the new method adds the use of rising and setting stars. There is a possibility that the new method of using stars is a revival of an older navigation system; however, the evidence from the interviews is overwhelmingly against such a conclusion. Instead, the navigators uniformly say that they invented the method themselves and that the new system is the simplest method given motorized boats. I add that given the motion of the stars at these latitudes, using chains of stars is the obvious choice for navigation, and suggest that for short distance sailing set routes were more practical than following the stars.

The Moce Islanders are not all in agreement about the new system of navigation being better. According to the older generation of navigators, the new method is too dependent upon good visibility, but both generations of navigators appreciate the fact that travel with motors is faster. The older generation hopes that navigators will continue to learn the wind and current patterns so that they will be able to maintain their course during times of reduced visibility. Both the old and new systems of navigation are inexact but sufficient for the contemporary Moce Islanders.

Moce serves as another case of the complex interaction between introduced technologies and navigation. In 1962, the Bugis of Indonesia were mandated to include a compass on board boats larger than 52 cubic meters. Similar to the debate on Moce, the traditional Bugis celestial navigators feel that the younger navigators rely too much on the compass. The older generation use the compass as a secondary check to their celestial methods. My own research at the United States Naval Academy revealed a similar debate about the Global Positioning System. In general, the older officers feel that there is too much dependence on the GPS and the art of celestial navigation is being lost. However, officially, celestial navigation is used to check the accuracy of the positions returned by the Global Positioning System, and therefore celestial navigation continues to be taught at the Naval Academy<sup>19</sup>. Thus, the Moce Islanders are not unique in their response to a change in navigation techniques.

At the end of his article on Amplett Islanders' navigation, Peter Lauer states:

As the Amplett men are considering buying a motor launch...it seems likely that the spread of modern means of transport may soon begin to alter the inter-island voyaging techniques described...

[Lauer 1976: 89].

Moce is a case study in this type of change. However, I doubt that Lauer envisioned that such a change could include the utilization of stars in a system of navigation previously devoid of them.

---

<sup>19</sup> I explore these responses to introduce technologies further in a paper I'm preparing on the celestial navigation of the Kerkennah Islanders of Tunisia entitled "Celestial Navigation, Charfia, and the Blind Fisherman"

## REFERENCES

- Ammarell, Gene. "Navigation Practices of the Bugis of South Sulawesi, Indonesia." Seafaring in the Contemporary Pacific Islands. Ed. Richard Feinberg. DeKalb: Northern Illinois University Press, 1995. 196-218.
- Feinberg, Richard. "Continuity and Change in Nukumanu Maritime Technology and Practice." Seafaring in the Contemporary Pacific Islands. Ed. Richard Feinberg. DeKalb: Northern Illinois University Press, 1995. 159-95.
- Finney, Ben, ed. Pacific Navigation and Voyaging. Wellington: Polynesian Society Inc., 1976.
- . Voyage of Rediscovery: A Cultural Odyssey through Polynesia. Berkeley: University Of California Press, 1994.
- . "Colonizing an Island World." Prehistoric Settlement of the Pacific. Ed. Ward Goodenough. Philadelphia: American Philosophical Society, 1996.
- Gillett, Robert. Traditional Sailing Canoes in Lau. Suva: Institute of Pacific Studies, 1993.
- Goetzfridt, Nicholas J. Indigenous Navigation and Voyaging in the Pacific: A Reference Guide. New York: Greenwood Press, 1992.
- Goodenough, Ward. "Navigation in the Western Carolines: A Traditional Science." Naked Science: Anthropological Inquiry into Boundaries, Power, and Knowledge. Ed. Laura Nadar. New York: Routledge, 1996.
- , ed. Prehistoric Settlement of the Pacific. Philadelphia: American Philosophical Society, 1996.
- Goodenough, Ward, and Richard Feinberg. "Epilogue: Seafaring in the Pacific, Past and Present." Seafaring in the Contemporary Pacific Islands. Ed. Richard Feinberg. DeKalb: Northern Illinois University Press, 1995. 219-30.
- Hocart, Arthur M. Lau Islands, Fiji. Honolulu: The Bishop Museum, 1929.
- Howard, Alan. "Rotoman Seafaring in Historical Perspective." Seafaring in the Contemporary Pacific Islands. Ed. Richard Feinberg. DeKalb: Northern Illinois University Press, 1995. 114-43.

- Kirch, Patrick. "Lapita and Its Aftermath: The Austronesian Settlement of Oceania." Prehistoric Settlement of the Pacific. Ed. Ward Goodenough. Philadelphia: American Philosophical Society, 1996.
- . The Lapita Peoples: Ancestors of the Oceanic World. Oxford: Blackwell, 1997.
- Knapman, Bruce. "Indigenous Involvement in the Cash Economy of Lau, Fiji, 1840-1946." Journal of Pacific History 11.3-4, (1976): 167-88.
- Ladd, H. S. "Fijians and Their Sailing Canoes." Asia 35 (1935): 468-73.
- Lauer, Peter K. "Sailing with the Amplett Islanders." Pacific Navigation and Voyaging. Ed. Ben Finney. Wellington: Polynesian Society Inc., 1976.
- Lemaitre, Yves. "Les relations inter-insulaires traditionnelles en Océanie: Tonga." Journal de la Société des Océanistes 26 (1970): 93-105.
- Lewis, David. The Voyaging Stars. New York: W.W. Norton, 1978.
- . We, the Navigators. Honolulu: University of Hawaii Press, 1994.
- Montague, Susan P. "Kaduwaga: A Trobriand Boat Harbor." Seafaring in the Contemporary Pacific Islands. Ed. Richard Feinberg. DeKalb: Northern Illinois University Press, 1995. 55-67.
- Neyret, Jean-Marie. "Notes sur la navigation indigène aux Iles Fidji." Journal de la Société des Océanistes 6 (1950): 5-31.
- Qereti, Paula, [Paul Geraghty], et. al. Ivolavosa Vakaviti [Monolingual Fijian Dictionary]. 1998. Computer Files. Suva: Institute of Fijian Language and Culture.
- Roth, George Kingsley. Fijian Way of Life. Melbourne: Oxford University Press, 1953.
- Thompson, Laura. "The Culture History of the Lau Islands, Fiji." American anthropologist 40 (1938): 181-97.
- . Southern Lau: An Ethnography. Bishop Museum Bulletin. Vol. 162. Honolulu, 1940.
- . Fijian Frontier. New York: Octagon Books, 1972.

### *Acknowledgements*

I would like to thank my editor Tracy Sweely, Tina Gallier for the sketches, the anonymous referees from Archaeoastronomy, John Lewis, Paul Geraghty, Romeel Dave, and the people of Moce.

A special thanks goes to the Max-Planck-Institut für Wissenschaftsgeschichte for financial support during the writing of this article, the use of their facilities, and the aid of editors Peter Damerow and Lindy Divarci.

This material is based upon work supported by the National Science Foundation under Grant No. 0003234. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.