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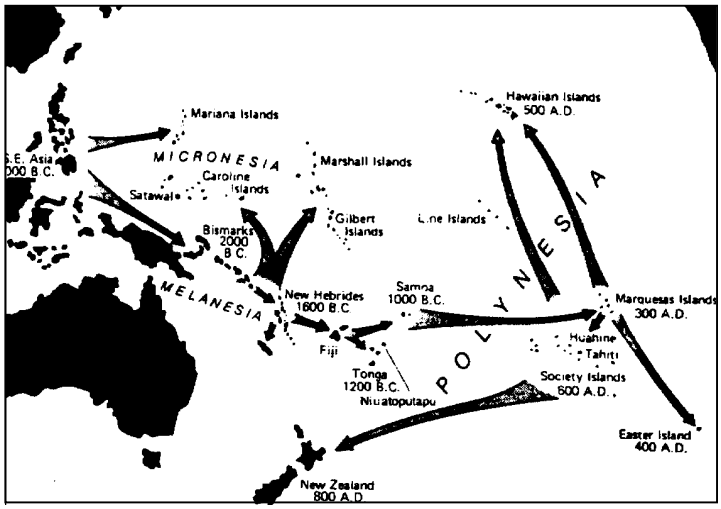
# The Sons of Palulap: Navigating Without Instruments in Oceania

Darkness fell as the rain of another line squall hissed across the tropical Pacific. The stars were smudged out. Our navigator, Piailug, ordered us to drop the sail of our 30-foot outrigger canoe, *Suntory*. *White Horse*, our partner canoe, followed suit, and we settled down to endure the chilly, wet night.

Piailug estimated that we were just inside the *etak* of birds, the fishing grounds for seabirds from the island of Pikelot, our destination. There we drifted, waiting for morning, when the birds would fly out from their nesting sites and thus indicate the way to the island.

Two days before, our little fishing expedition had left Satawal, one of the most remote of Micronesia's Caroline Islands. Our purpose was to catch sea turtles, fish, and octopus for the 600 hungry Satawalese. We were led by Mau Piailug, one of the last of the *palu*. These Micronesian navigators pilot hand-hewn canoes without charts or instruments, guided only by the sea's signs of land: stars, birds, and patterns of waves. Thousands of years ago Piailug's distant cousins, the Polynesians, probably used similar navigational techniques on their epic voyages of discovery to the Marquesas, Tahiti, Hawaii, Easter Island, and New Zealand.




The Polynesians spread throughout the Pacific from the west in small sailing canoes like that shown opposite. (Map courtesy of Bernice P. Bishop Museum. Photo by author/The Navigators).

As we lay hove to in Pikelot's *etak* of birds, squall after squall swirled around our canoes. The crew took turns trumpeting a conch shell to ward off rain. Despite the cold, between conch blasts drifted in and out of sleep, until at long last, dawn crept across the empty sea. We mumbled the Hail Mary in Satawalese, made sail. and continued, worried because we saw no birds flying out to fish - birds that would guide us to our landfall. The ocean swells we had been steering by for the past two days were jumbled and contused by the shifting wind and rain. Nevertheless, Piailug could discern the swell coming from under tan (rising) Mailap (the star Altair) After about an hour, two sooty terns flew by, which gave us some encouragement, but by noon there was still no island. The sun came out, the sea grew calm, and we continued looking for land.

Finally, a sharp-eyed crew member spotted Moen, a deep-sea reef. Then we knew Pikelot lay east, under tan Mailap. At sunset, we spotted the tiny islet and, after paddling for several hours through a calm, quiet drizzle, we beached our canoes at about 3 A.M. It had taken 3 days to make the 60 mile passage from Satawal to Pikelot. If you took away the flashlights, the dacron sailcloth, the Winston cigarettes, and the prayers to the Virgin Mary, it could have been a voyage of a thousand years ago.

## From Whence the Polynesians

"How shall we account for this Nation spreading itself over such a vast ocean?" Captain James Cook asked upon discovering the Hawaiian Islands in 1778. From New Zealand in the south, up through Tahiti and Easter Island to Hawaii in the north, he had found people whose languages, customs, canoes, dwelling houses, and social organizations were strikingly similar Cook had discovered the Polynesians.

In the following two centuries. many hypotheses were forwarded in attempts to answer Cook's question. One held that the Polynesians were the aboriginal inhabitants of flooded continents, forced to retreat to the mountain peaks by the rising sea. Another proposal was that ancient South American Indians sailed across the Pacific on balsa rafts to reach Polynesia. (In 1947, Thor Heyerdahl set out to test this hypothesis on the raft *Kon Tiki*) Others held that the Polynesians were great seafarers who left their homeland in the western Pacific to colonize the Pacific islands. Surprisingly, modern research has shown this idea to be correct.

## Southeast Asian Origins

Linguists have found that Polynesian languages are similar to those spoken in other parts of Oceania. Coconut, for instance, is *niur* in Malay, *niu* in Hawaiian, and *nu* in Satawalese. Eye is *mata* in Malay, *maka* in Hawaiian, and *mas* in Satawalese. Maylay, Hawaiian, and the languages of the Carolines (including Satawalese) probably are descended from a single tongue, the now-extinct Proto-Austronesian language once spoken in the islands of Southeast Asia.

Archaeologists have found a distinctive type of reddish earthenware pottery, called Lapita, at sites on New Guinea and the Bismark archipelago, the Solomons and New Hebrides, and all the way to Fiji, Samoa, and Tonga (see map). And on Huahine in the Society Islands, Yosi Sinoto of the Bishop Museum (Honolulu) made the spectacular find of two planks from an ancient Polynesian voyaging canoe buried in a mud slide 1,100 years ago. The rough adze marks and lashing holes on the planks show that they were hewn for a canoe almost identical to the one we sailed to Pikelot in 1984.

Ethnobotonists, studying how humans interact with plants, have determined that the ancestors of Polynesian crop plants - breadfruit, taro, and bananas - once grew

wild in New Guinea and Southeast Asia. Now found on virtually all the islands in the Pacific, these plants must have been carried by early explorers intent on colonization.

From this confluent evidence, the following picture has emerged: Four to six thousand years ago a seafaring people left their homeland in the islands of Southeast Asia to wander down the Melanesian Islands and into the Pacific. Some sailed north to populate the Marshall, Gilbert, and Caroline islands. Others went east to Tonga and Samoa. Here they paused for nearly a thousand years, developing a uniquely Polynesian culture. Then, sometime between 200 B.C. and 300 A.D. at least one sea-going canoe with a cargo of crop plants and domestic animals made the passage from western Polynesia to the Marquesas. From there the Polynesians struck out into the whole of the central Pacific, to Hawaii, New Zealand, and Easter Island.

But how could they have done it? How could a race of primitive seafarers, without chart, compass, or sextant, using canoes lashed together with coconut fibers and driven by sails woven of pandanus leaves, find their way across thousands of miles of sea? To answer this question we turn to the contemporary navigators of Micronesia, the last practitioners of a way of sailing that evidently once flourished throughout Oceania.

## Direction: The Star Compass

Any successful navigation system must allow a sailor to do three things: determine the direction to an objective, maintain that course at sea, and measure and compensate for displacement from the intended course caused by leeway, current, and steering error. Let's investigate Piailug's system and compare it to ours.

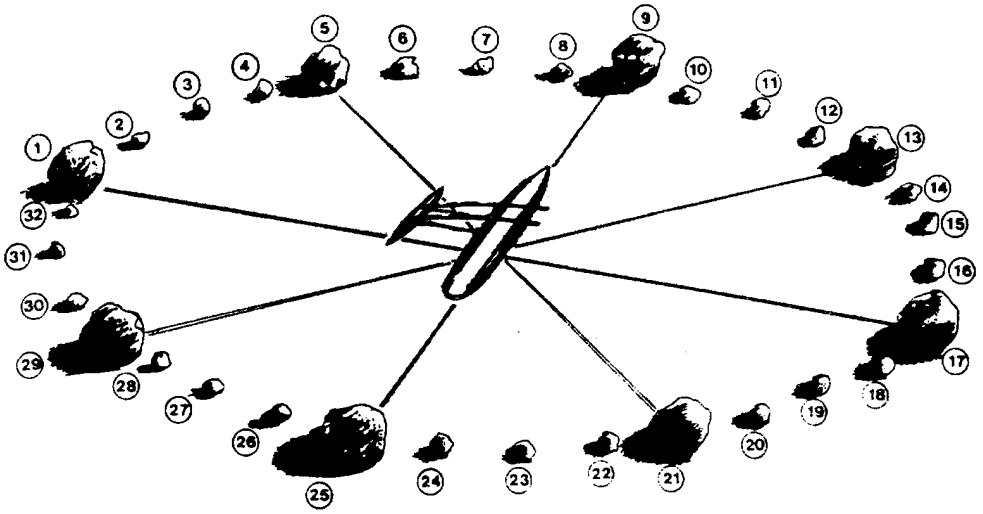
For the Western navigator, points along the horizon are marked and named by the compass: north, northeast, east, southeast, and so on. Note that the compass both names the directions and gives the navigator a means to maintain direction while sailing. But without a compass, how could one name the directions? Micronesian navigators use the rising and setting points of certain stars.

The stars wheel above us as if traversing the inside of an immense sphere. Among them, spatial relationships change very slowly, over eons. Thus the constellations of the ancient Greeks have the same configurations today. But more importantly, the stars rise and set in the same spots on the horizon - that is, their azimuths, or compass headings at rising and setting, remain the same as long as one does not drastically change latitude.

Watching the tropical Pacific sky evening upon evening, you always see Altair top the horizon just north of east, arc through the heavens, and set just north of west. Vega rises in the northeast and sets in the northwest; Shaula, in the tail of the constellation Scorpio, rises in the southeast to set in the southwest. Hovering in the north is Polaris, the North Star. Marking south is the Southern Cross in its upright position Night after night you watch the stars. You notice that, although they rise four minutes earlier each evening, each star consistently breaks the horizon in its own place.

This is the basis of Piailug's system of navigation. At the age of five, Piailug began learning the stars from his grandfather, who placed 32 lumps of coral on a woven pandanus mat to represent the rising and setting positions of the 15 principal navigational stars and constellations. This is the "star compass"; the stars lend their names to the directions they denote.

To find the correct course to his objective, the Western navigator lays parallel rulers on his chart, one forming a line between his point of origin and his objective, and one indicating the true compass course to the objective on the compass rose printed on the chart After correcting for magnetic variation, he can maintain that heading at sea by following his compass.




A device used to teach the principal navigational stars In this exercise, the navigator places thirty-two lumps of coral in a circle on a mat. The canoe is used to help the student visualize himself at sea, always in the center of a web of "roads" reaching out to the stars. English names of the stars are 1) Polaris, 2) rising Little Dipper, 3) rising Big Dipper, 4) rising Cassiopeia, 5) rising Vega, 6) rising Pleiades, 7) rising Aldebaran, 8) rising Gamma Aquilae, 9) Rising Altair, 10) Rising Beta Aquilae, 11) rising Orion's Belt, 12) rising Corvus, 13) rising Antares, 14) rising Shaula, 15) Southern Cross rising, 16) Southern Cross at 45 degrees, 17) Southern Cross upright, 18) Southern Cross 45 degrees setting, 19) Southern Cross setting, 20) setting Shaula, 21) setting Antares, 22) setting Corvus, 23) setting Orion's Belt, 24) setting Beta Aquilae, 25) setting Altair, 26) setting Gamma Aquilae, 27) setting Aldebaran, 28) setting Pleiades, 29) setting Vega, 30) setting Cassiopeia, 31) setting Big Dipper, 32) setting Little Dipper.

To maintain his course at sea, Piailug, with no compass, must follow the stars.* Instead of sailing east, he sails "under rising Mailap". At night, at the right time of year, Piailug simply points the bow of his canoe at the rising star to steer the course. But since the stars rise 4 minutes earlier each evening, Mailap may be either too high in the sky to be useful or may not have risen. So Piailug must know a score of lesser stars which follow the same "pathc or "road" as the guiding star. Now, after 45 years of study, Piailug knows the entire nighttime sky. On a squally night he needs only an occasional glimpse of the stars to check his course.

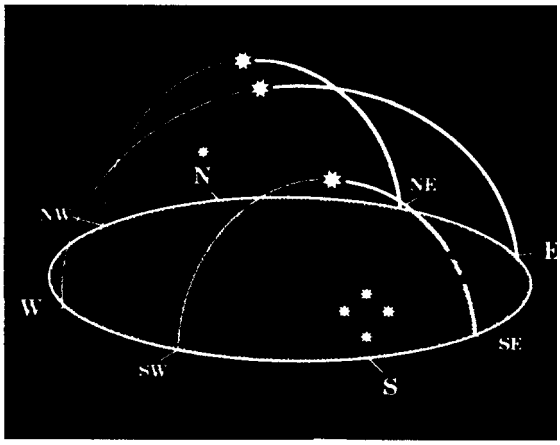
## The *Palu* Chart Case: *Wofanu*

With a full chart case, the Western navigator can determine the course from one destination to any other. But with no charts or written language, the *palu* must memorize the stars under which every island lies. This is called *wofanu*, literally "gaze at the island". Seated in a circle around their teacher - often relaxing with the

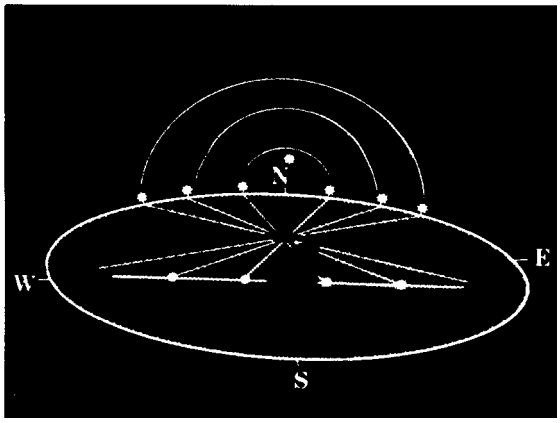
* The magnetic compass, according to the Satawalese elders, was introduced to Satawal by the German administration of Micronesia in the early part of this century. The Satawalese noticed that the face of the compass was divided into 32 points (instead of 360 degrees), corresponding exactly to their own star compass. So, with the points appropriately renamed, the compass was used to maintain direction at sea and did not affect the other portions of the Satawalese navigation system.

alcoholic palm-sap drink tuba - students learn the web of star courses to and from every island in their world. The more *wofanu* a *palu* knows, the greater his voyaging range. An average *palu* knows *wofanu* for those frequently sailed passages around his home island. But a great navigator knows *wofanu* for all the islands in the Carolines. Piailug instructed me in *wofanu* for all these islands and then, to my amazement, added the star courses from Hawaii to California, South America, Tahiti, Samoa, Marquesas, Tuamotus, Cooks, Marshalls, Tonga, and Japan. These he learned from his grandfather. The star courses came "from long, long ago", although I suspect they were figured out by *palu* serving as sailors on European sailing ships late in the last century.

Mau Pialug teaching the star compass to his sons.
(Photo by author/The Navigators)




The star compass works because of the Earth's rotation, which causes stars to appear to rise in the east and set in the west. (Illustration courtesy of author)




By imagining lines through a reference island to the rising and setting points of different stars, a Satawalese navigator can monitor the progress of his canoe without charts. (Illustration courtesy of author)

Though it is an impressive task, memorizing this long list of star courses is only a small part of what the *palu* must keep "inside the stomach", the traditional Micronesian seat of knowledge. Indeed, by mastering navigation, a man earns the highest rank he can achieve by his own efforts (that is, without being born into a chiefly clan). "My grandfather spoke of navigation", Piailug explained. "If you learn it you will have a name. You will eat the navigator's food. At sea you will have more power than a chief".

## The Talk of Sailing

Having mastered the star compass and *wofanu*, the apprentice *palu* goes on to learn the "Talk of Sailing," a quiver of practical skills that allows *palu* to translate memorized lore into actual landfalls.

By day or on overcast nights, when the stars are not available as guides, the navigator must use other sea-signs to keep his bearings. Most important of these are ocean swells. Generated by distant winds, the long, low swells of the open ocean maintain constant direction as they march across the sea. When coming from only one direction, with the sea calm and the wind light, swells are easy to interpret. But when there are swells from two, three, or even four directions, topped with small, choppy waves generated by the local wind, the apparent result is chaos. Piailug and his colleagues can analyze the various component swells in what to us is the confusion on the sea's surface. To maintain his course at sea, Piailug keeps a constant angle between his canoe and the swells approaching from one direction.

Micronesians recognize eight swells, one from each octant of the star compass. During our voyage to Pikelot four of these swells were present; Piailug could readily distinguish the swell under Mailap, generated by the prevailing easterly tradewinds, from the three others that overlaid and obscured it. After some study (and with patience on Piailug's part) I could identify them as well.

On very dark nights, when there is no moon behind the clouds to light the sea, the *palu* must maintain his course by feeling the pitch and yaw of the canoe on the seaway This technique, called simply "to feel," is the ultimate test of a *palu's* skill.

## Compensating for Current

One of the most difficult problems facing a navigator is to measure the displacement from his intended course caused by current. Currents can be swift and variable in the central Caroline Islands; failure to measure them properly when leaving land or to apprehend a change while at sea is the primary reason navigators get lost.

The Western navigator measures current with a compass when first taking leave of land. Let's say he departs on an easterly course. After traveling a while, he sights back along his track to his point of departure. If it lies directly west, he knows he is not being pushed off course by a current. If the departure point lies south of

Steering of a Polynesian sailing canoe. Except for flashlights, modern sailcloths, Winston cigarettes, and prayers to the Virgin Mary, today's voyages are virtually identical to those of a thousand years ago. (Photo by author of The Navigators)

west, he knows a current is pushing him north. Conversely, if it lies north of west, a current is pushing him south. Then, by plotting the intended course and the actual course on a chart of the area, he can measure the displacement caused by the current.

The Micronesian navigator does this with a different conceptual approach. When starting a voyage, the *palu* takes a bearing on the island of departure just as it disappears beneath the horizon, a point known as "one tooth" since the island is a single tooth of land. Let's say his intended course is east - rising Mailap. If there is no current, the island will be under setting Mailap. However, if there is current the island will appear to move. If a current is pushing the canoe south, the island will move north to under the position of setting Paiifung or setting Ul. If a current is pushing the canoe north, the island will move south to under setting Paiiur or setting Uliul. The star under which the island has moved determines the course compensation the navigator must make. The Talk of Sailing includes specific course corrections for all permutations of wind and current for those voyages commonly made from Satawal.

Detecting current shifts when out of sight of land is much more problematic. The Satawalese have developed several methods for this situation. In calm weather, a navigator might drop a weighted line with a vane attached into the water. In anything other than flat calm, Piailug reads the shape and size of the waves. A short, steep sea indicates a current running counter to the direction of the swells. A longer, smoother sea means the reverse. Piailug also taught me to read the current by observing the whitecaps. If the current is setting in the direction of the wind and swell, the whitecaps smoothly and gently topple over and flow with the swells. If the reverse is true, the whitecaps peak up abruptly and appear pulled back from the wind.

### *Pookof*

"What if you still can't tell what the current is doing?" I asked Piailug. He took my pencil and drew a rough chart of the seaway between Satawal and West Fayu.

"You have fish here," he solemnly explained. "You have bird here. If you see one you know you are not on the road to West Fayu".

Micronesian navigators believe that certain sea creatures - a species of flatfish, a pair of seabirds, a shark with special markings, or a pod of killer whales, to name a few - reside in specific places in the seas. According to legend, they were placed in the sea by Fanur and Wareyang, the two sons of Palulap, father of all navigators, to aid *palu* when lost. When one creature dies, another one of the same species and markings takes his place. One navigator explained: "The spirit gave us *pookof* because we don't have charts and sextants like the navigators from America."

All *palu* I queried claim to have sighted some of the creatures from *pookof*. I myself saw a billfish very near its prescribed location northeast of Satawal. Some creatures may inhabit specific areas because of prevailing conditions (such as the whales that feed in summertime on Stellwagen Bank, near the Boston Harbor approach buoy). Failure to sight a creature from *pookof* is not interpreted as a challenge to the validity of the system; it is simply taken to mean the canoe is out of visual range of the creature.

### *Etak*: A Mental Plotting Method

Once he has set his course, a navigator must measure his movement along it. The Western navigator, measuring speed with instruments and having measured any displacement by current, keeps a running plot of his estimated position on a chart to

model the progress of his vessel in relation to stationary land. He can check this dead reckoning position with sextant sights or by using an electronic system such as loran.

Without charts or instruments, the *palu* uses a mental plotting system called *etak*. He envisions the island of departure and the target island moving, unseen, beneath the horizon. A third island or reef off to one side of the course becomes his reference point. Imaginary paths radiate from the canoe through the reference point (never actually sighted) to the stars beyond, dividing the voyage into segments or *etak*. By visualizing the reference island moving under a succession of stars, the navigator mentally structures his voyage.

The first and last segments of a voyage are called the *etak* of sighting and the *etak* of birds. The length of the *etak* of sighting depends on the elevation of the island of departure. The *etak* of birds is the distance seabirds nesting on the island fly out to fish - generally about 18 miles. If uncertain of his bearings a navigator will pause at the *etak* of birds (as we did off Pikelot) to confirm the direction to land.

There are two noteworthy features about this system. Like its Western counterpart, dead reckoning, *etak* provides no independent confirmation of position once out of sight of land; it is a conceptual method that gives the *palu* a framework in which to model the course of his vessel and the factors acting upon it. Also, the Micronesian navigator envisions his canoe as stationary with islands moving around it, whereas the Western navigator pictures his vessel moving through stationary Islands.

### The Decline of Navigation

Satawal's remoteness and commercial insignificance shielded it from the West until after World War II. The Talk of navigation was kept alive through the generations, handed from father to son, master to apprentice, in the broad, cool canoe houses. But the grip of tradition is loosening. For much of the year, the young Satawalese abandon the canoe-house classrooms of their fathers to attend a Western-style high school on distant Ulithi Atoll. There, they learn the customs and values of the West - a world view with little room for the fusion of teacher, fisherman, captain, and community leader that was the *palu*.

"My generation and the generation before me strove to learn navigation," Piailug explained. "But the young men don't care about it. They want to earn money. They go away to high school on Ulithi or college on Guam and often do not come back. They go to Yap, Palau, Ponape, and Saipan to find jobs."

In a way, this is in keeping with an ancient Pacific tradition. Perhaps the young captains who turned their canoes north, to leave their New Hebrides homeland and discover Micronesia, did so for the same reasons young men leave their islands today - to seek prosperity, to escape the strictures of a tightly organized society, and to behold new lands.

That a culture must change is the way of the world, but it weighs heavily on Piailug and his peers. They recognize a loss of more than just a set of navigational techniques: it is the loss of a way of life and a conception of the world. These men are the last living representatives of an unbroken tradition that began "before, before, before!" with Palulap, the great navigator. The Talk of Navigation has been handed down through the succession of his sons, the *palu*. It spun myth, magic, ethics, and practical knowledge into a seamless web, the center of which was navigation.

Once, after we had talked many hours, I asked Piailug how he felt about the Talk of Navigation. "I don't know about the others" he said, forcing his words out in a kind of

pain, "but in my mind the Talk of Navigation is beautiful. Inside my body the same, I say the Talk of Navigation is beautiful".

*Stephen D Thomas became interested in non-instrumental navigation in Oceania after working as a yacht-delivery captain in the Pacific, Atlantic, and Mediterranean. He has made two trips to Satawal, where Mau Piailug adopted Thomas as a brother and instructed him in navigation.*

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