THE POLYNESIAN TRIANGLE: 10 Million square miles of Ocean

Samoa, Fiji & Tonga in near Polynesia settled by c. 1000 BCE

Rarotonga and Tahiti at the Center (circa 500 BCE)

Hawaii to the North (circa 500 CE)

Rapa Nui (Easter Island) to the East (circa 500 CE)

Aeoterora (New Zealand) to the South and West (c. 800 CE)
TRADITIONAL VOYAGING CANOES

PAINTINGS BY HAWAIIAN ARTIST HERB KANE’
THE POLYNESIANS: DID THEY COME FROM ASIA OR THE AMERICAS?

In 1947 Norwegian adventurer Thor Heyerdahl sailed his raft Kon-Tiki downwind from Peru to Polynesia in an attempt to show that Polynesians must have originated in South America because the wind blows consistently east-to-west in the Pacific.

This led New Zealander Andrew Sharp and others to claim that Polynesia was settled not by great sailors and explorers but by “orphans of the storm”.

All anthropological evidence (pottery, language, DNA, animals transported in the voyages) favors a Polynesian origination in Southeast Asia, not South America.
The Polynesian Voyaging Society (founded in 1973 by Ben Finney, Tommy Holmes and Herb Kane') built the voyaging canoe Hokule'a but no one knew how to navigate by traditional methods....until Ben found Pius Mao Piallug of Satawal in Micronesia who was taught by his grandfather. He was flown to Hawaii to navigate Hokule'a to Tahiti and back even though he had never been more than 500 miles from his home island...and he did it!
THE LINEAGE: Mao Piallug Taught Nainoa Thompson

Kalepa Chad Babayan

Nainoa Thompson taught

Bruce Blankenfeld and Shantell Ching
Nuku Hiva to Hawaii: 2500 miles of open ocean

“Sail North until you see the star that never sets. Then turn downwind and allow the Star of Gladness (Hokule'a) to go directly overhead every night”
Latitude determined by altitude of stars as they cross the meridian (i.e., at their highest point above the horizon)

Using your hand and fingers as a measuring device to determine the altitude of stars close to the horizon can be accurate to a fraction of a degree of latitude. {One degree = 67 miles}. Someone adept at this method can determine their latitude within 10—20 miles. Modern traditional Hawaiian navigators now use entire “Star Lines” to determine their latitude.
ACRUX and GACRUX are a “Meridian Pair” in the long axis of *Cared-for by the Moon (Southern Cross)*.

When the *Southern Cross* stands vertically it marks due South!
ACCURACY OF OBSERVATIONS:

- **LATITUDE**: 1 DEGREE = 67 MILES
  \( \{24,000 \text{ MILES} \div 360 \text{ DEGREE} = \text{MILES Per Degree}\} \)

IF a Traditional Navigator can determine the height of the Southern Cross to \( \frac{1}{2} \) pinky finger width = \( \frac{1}{2} \) degree then she knows her latitude to 33 miles.

- **LONGITUDE**: Since stars change their east-west location with time, longitude cannot be known without a clock!

   - Star could be higher in the sky either because
     1. It is spotted at a later time
     2. You spot it from a location farther east than you think!

THE PROBLEM OF LONGITUDE

A **CLOCK** IS NEEDED ALONG WITH AN OBSERVATION OF A HEAVENLY BODY (STAR OR SUN TRADITIONALLY) TO DETERMINE LONGITUDE!
QUESTIONS WHICH NATURALLY ARISE

1. WHAT HAPPENS WHEN IT IS CLOUDY? Or during the daytime?
Near equator, where Polynesians navigated, the stars, sun and moon move nearly vertically up and down the sky.

And so...

They stay on the same “bearing” (azimuth) and so give a nearly constant heading as they rise or set.

Near equator, stars stay on nearly same bearing (AZ) as they rise. Not so at mid- to high-latitudes.
NOTE THAT STARS RISE AND SET SYMMETRICALLY AROUND THE MERIDIAN...THEY DO NOT SET OPPOSITE THEIR RISE POINT!

CLOSE TO THE EQUATOR (± 20 DEGREES OF LATITUDE) WHERE THE POLYNESIANS SAILED, STARS RISE AND SET NEARLY VERTICALLY GIVING NAVIGATORS A CONSTANT BEARING MARKER AT SEA.
STEER RELATIVE TO THE WIND OR WAVES WATCHING FOR WIND SHIFTS

ESTIMATE SPEED AND HEADING BY “DEAD RECKONING’... TAKING CURRENT & LEEWAY INTO ACCOUNT

Sailing toward a star low on the horizon.

Changed heading to compensate for current and leeway.
QUESTIONS WHICH NATURALLY ARISE

1. WHAT HAPPENS WHEN IT IS CLOUDY?

2. CELESTIAL NAVIGATION (POLYNESIAN STYLE) ONLY GETS YOU TO WITHIN ~ 30—60 MILES OF MAKING “LANDFALL”. WHAT THEN?
Nä Manu = Navigator Birds
Making Landfall: The Signs

LIMU = Seaweed
Nä Ao = Clouds over Mountain Islands
QUESTIONS WHICH NATURALLY ARISE

1. WHAT HAPPENS WHEN IT IS CLOUDY?

2. CELESTIAL NAV ONLY GETS YOU TO WITHIN ~ 30—60 MILES OF MAKING “LANDFALL”. WHAT THEN?

3. WHAT HAPPENS IF YOU MISS AND GET DOWNWIND OF THE ISLANDS?
THE PLAN  { 1990 Voyage by Hawaii Loa }  THE REALITY

Reference Course
- Canoe navigator’s dead reckoning (DR) estimates
- Escort Boat’s morning (M) & evening (E) GPS fixes, actual courseline

Correspondence between DR and GPS
Huina Au Holo

Current Refraction

Model of how opposing swells from east and west refract around an atoll, and subsequently intersect to the north and south of the island giving rise to telltale nodes (bulb) and lines of nodes (okar) indicating proximity and bearing to the island. (Adapted from Winkler 1901:493–494; Lewis 1972:58–59.)
QUESTIONS WHICH NATURALLY ARISE

1. WHAT HAPPENS WHEN IT IS CLOUDY?

2. CELESTIAL NAV ONLY GETS YOU TO WITHIN ~ 30—60 MILES OF MAKING “LANDFALL”. WHAT THEN?

3. WHAT HAPPENS IF YOU MISS AND GET DOWNWIND OF THE ISLANDS?

4. WHAT HAPPENS WHEN YOU HAVE TO SAIL UPWIND TO GET TO YOUR DESTINATION?
TRADITIONAL VOYAGING CANOE CANNOT SAIL AS CLOSE TO THE WIND AS MULTI-SAIL, MONO-HULLED SAILBOATS AND SO MUST MAKE LONGER TACKS TO MOVE TO WINDWARD

... SO HOW DID POLYNESIANS SAIL WEST-TO-EAST TO MAKE VOYAGES OF DISCOVERY IN THE PACIFIC WHEN THE PREVAILING WINDS ARE EAST-TO-WEST?
BUT CONTRARY TO THE BELIEFS OF SOME...IT WAS WELL-KNOWN TO SOME POLYNESIANS THAT THERE ARE SEASONAL WIND SHIFTS, ESPECIALLY DURING YEARS OF "EL NINO"

Here is a recent example when the voyaging canoe Hawaii Loa sailed from Samoa to Tahiti. The arrows indicate the directions of the winds during that voyage. Although it took 1 ½ months to accomplish due to the need to tack many times, this voyage shows it is possible to sail successfully from west-to-east in the Pacific. { Notice particularly the long tack north on July 14th & 15th and then south to Aitutaki on the 16th and then to Rarotonga in August }. 
Ua Pae...
Landfall
POLYNESIANS ARE RETURNING TO THE SEA, THEIR TRADITIONAL BIRTHRIGHT
Native Hawaiian navigators have become inspirational teachers in their community.

Inspiring others to learn traditional navigational skills and to build their own canoes.

.... And even inspiring some haoles (Caucasians) to learn these same skills!!
“I am so proud to sail on Hokule‘a so that we can go down and pull Tahiti out of the sea and pull pride and dignity back to our culture, ancestors and people.”

Eddie Aikau
POLYNESIANS ARE RETURNING TO THE SEA, THEIR TRADITIONAL BIRTHRIGHT
MAHALO (THANKS) & CREDITS

• The Hawaiian Navigators: Kalepa (Chad) Babayan, Bruce Blankenfeld, Shantell Ching & Nainoa Thompson

• Other Interview Material: Professor (Emeritus) Ben Finney & Professor Brent Tully

• Fiske Production Team: Francisco (Tito) Salas, Amanda Todd, Robin Beck, Gwen Eccles, Shelbe Timothy & Will Fleming

• Anthropology Support: Professor Paul Shankman (CU)

• Funding: Our thanks to the CU OUTREACH COUNCIL & the FISKE PLANETARIUM

• And for continual inspiration: the Polynesian Voyaging Society (www.pvs.hawaii.org)