OCN 201

History of Oceanography and Polynesian voyaging

Polynesian voyaging

Austronesian speakers settle New Guinea by 30,000 yrs ago and Philippines by ~20,000 yrs ago.

History of Settlement:

Fiji by ~ 1300 BC

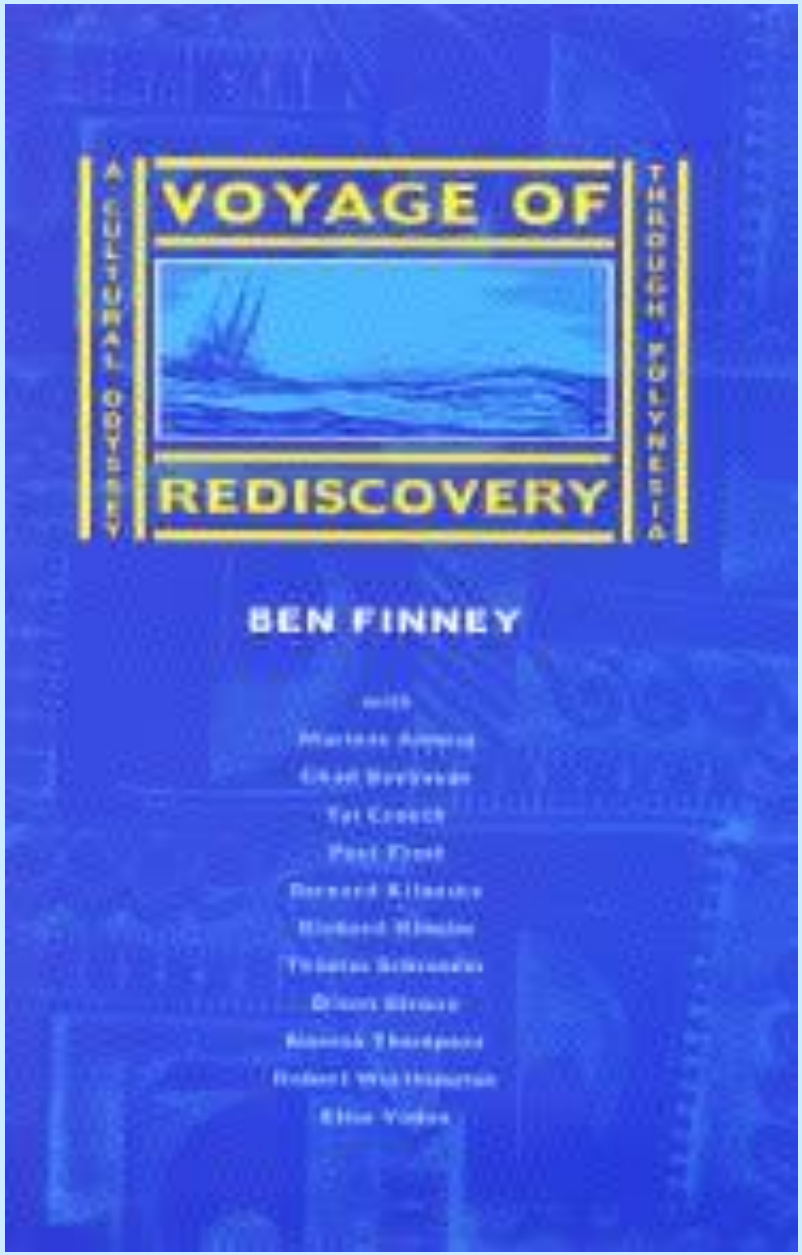
Tonga by ~1100 BC

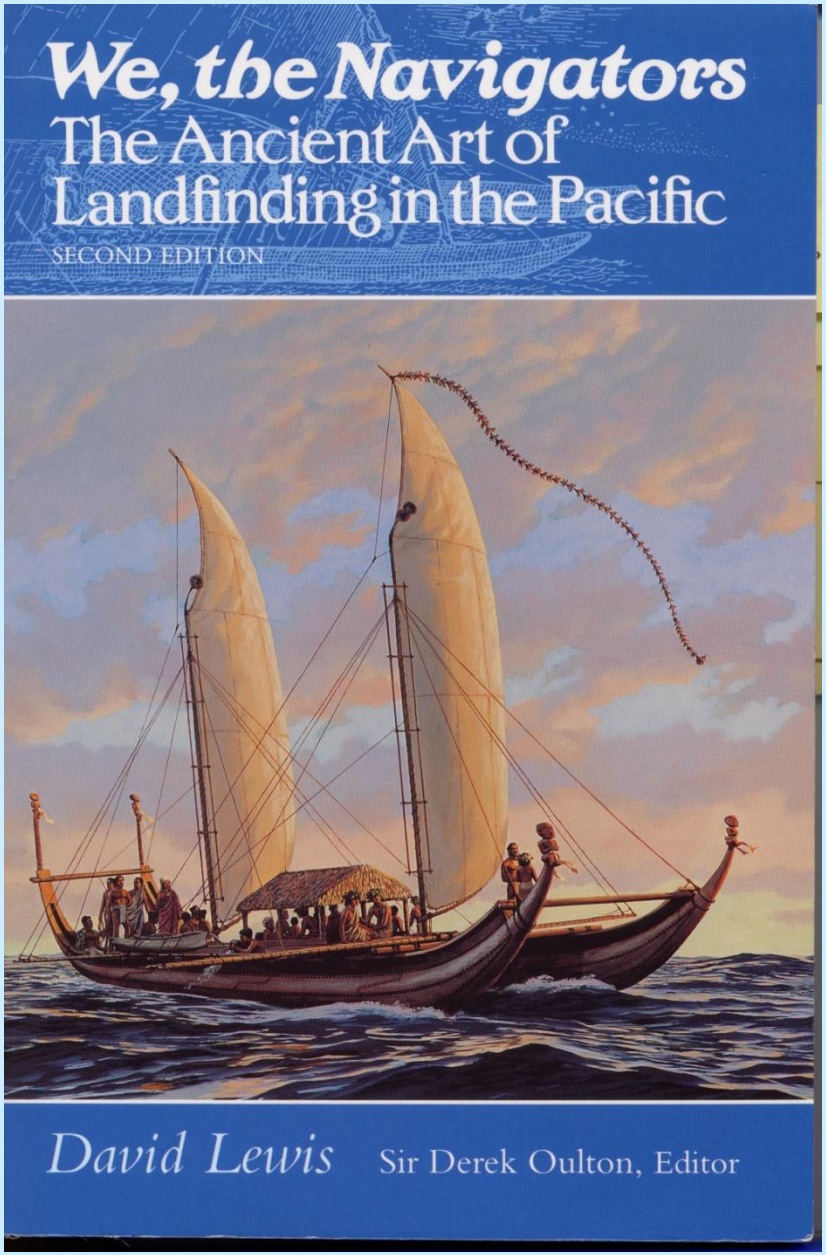
Samoa and Marquesas by 500 BC

By now there is a distinct Polynesian culture.

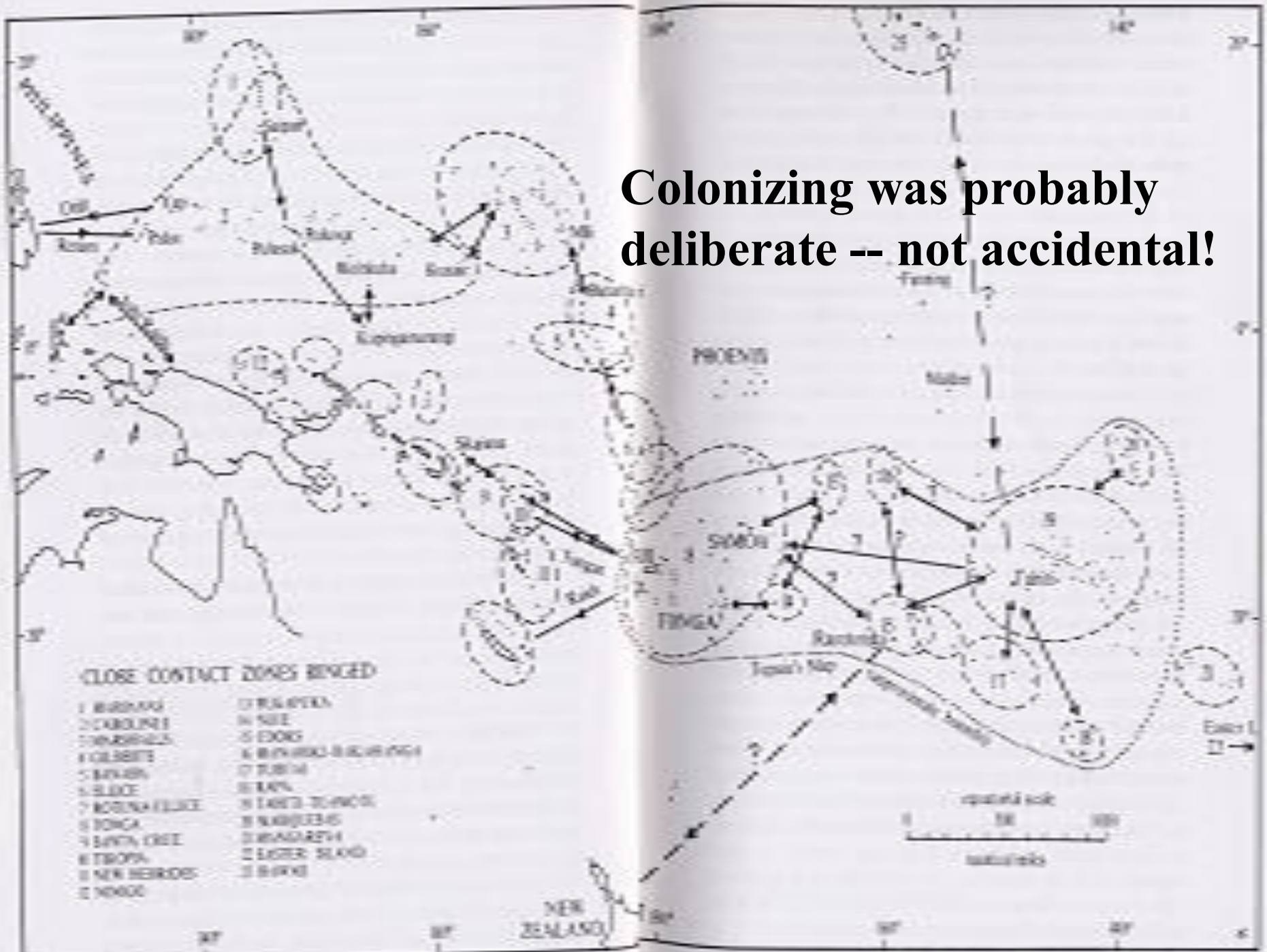
Easter Island and Hawaii by ~500 AD

New Zealand by ~800 AD

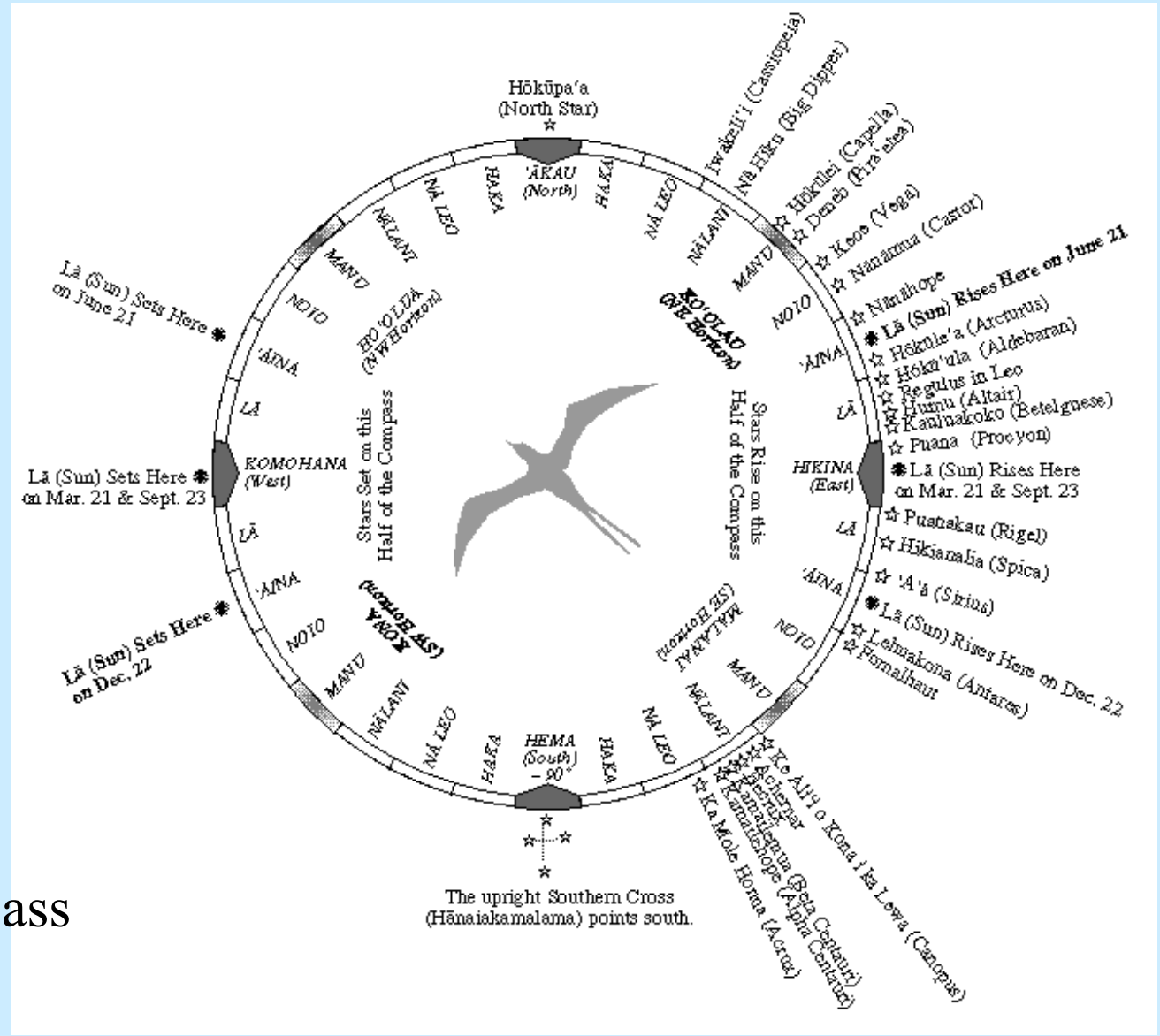




Check web for: Polynesian Voyaging Society

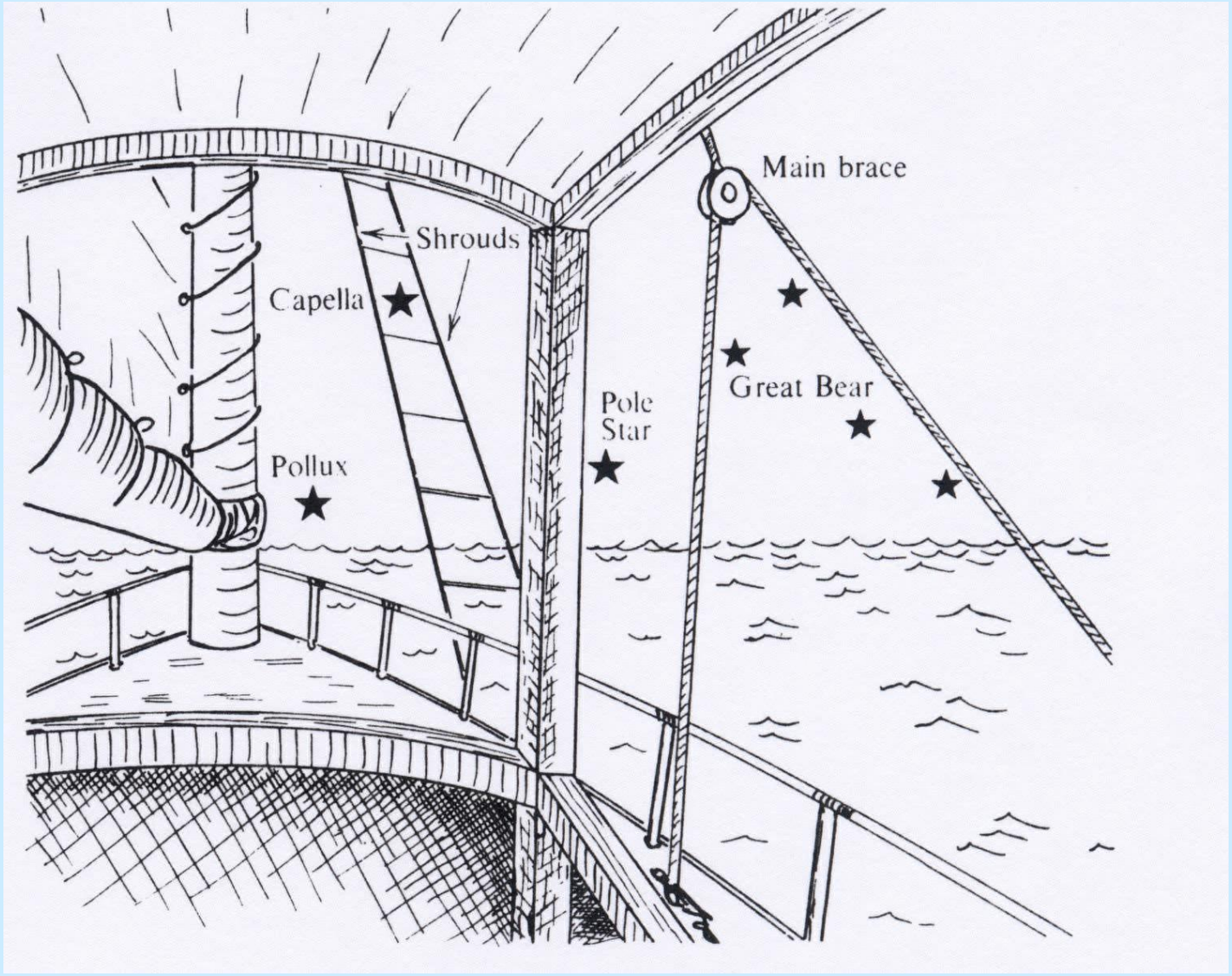

Colonizing was probably deliberate -- not accidental!
PHOENIX
SAMOA
TONGA
NEW ZEALAND

Navigation techniques were *secret*
--taught only to a select group of people!



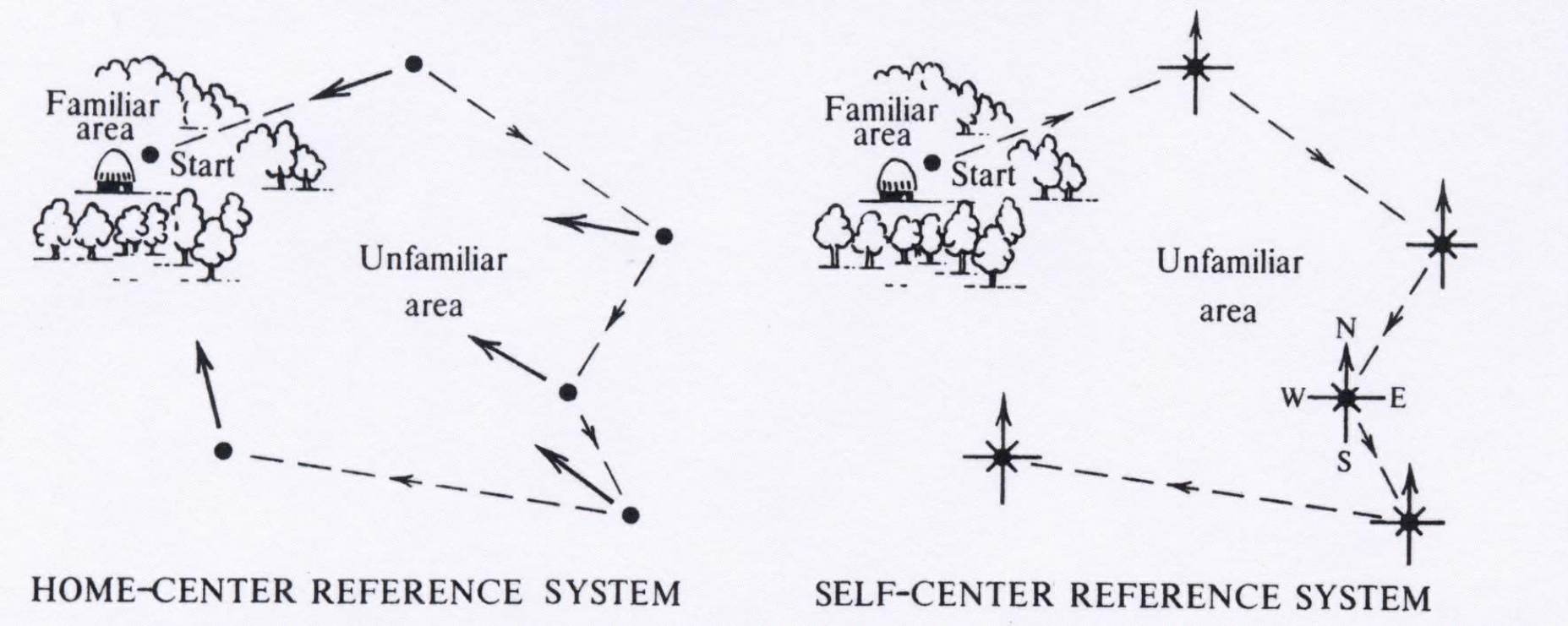
Hawaiian star compass

Courses were steered by the rising and setting of stars and by the sun, wind, and waves.



Time lapse photography of night sky showing star path

Position finding: a home reference system and dead reckoning



Polynesian navigation

European navigation

The danger of missing islands:

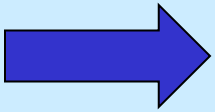
One can only see a relatively short distance from a canoe!

Distance seen (nautical miles) in perfect visibility
= square root (**sqrt**) of your height above the surface (in feet)
+ **sqrt** of height of the object above sea level (in feet)

Example:

From a canoe 9 ft above sea level to a coral atoll 20 ft above sea level:

D = sqrt (9) + sqrt (20)
= 3 + 4.5
= 7.5 nautical miles



You can only see ~ 6-8 miles from 9 ft above sea level.

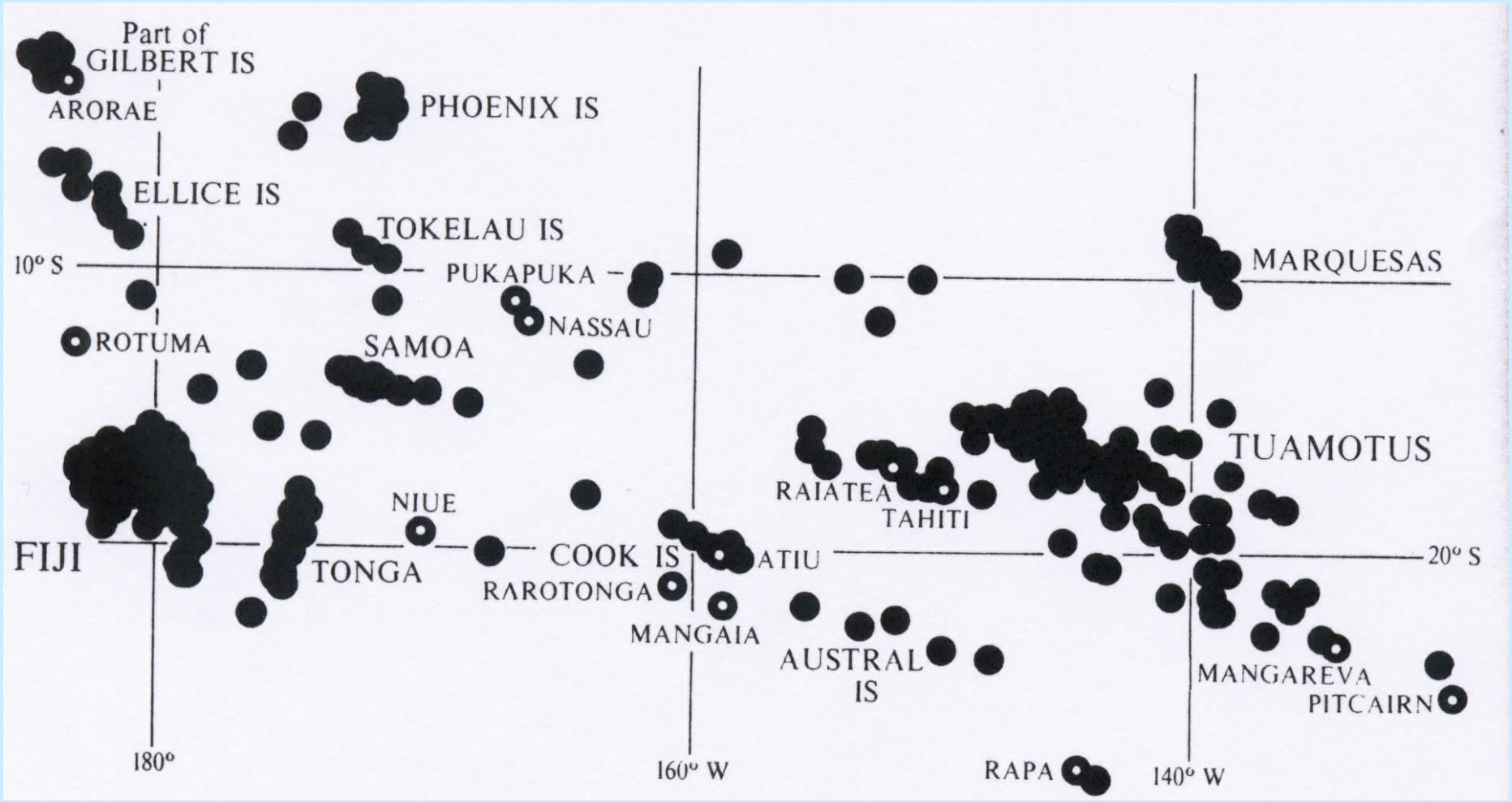
From the top of the mast (36 ft above sea level):

D = 6 + 4.5
= 10.5 nautical miles: ***not much improvement!***

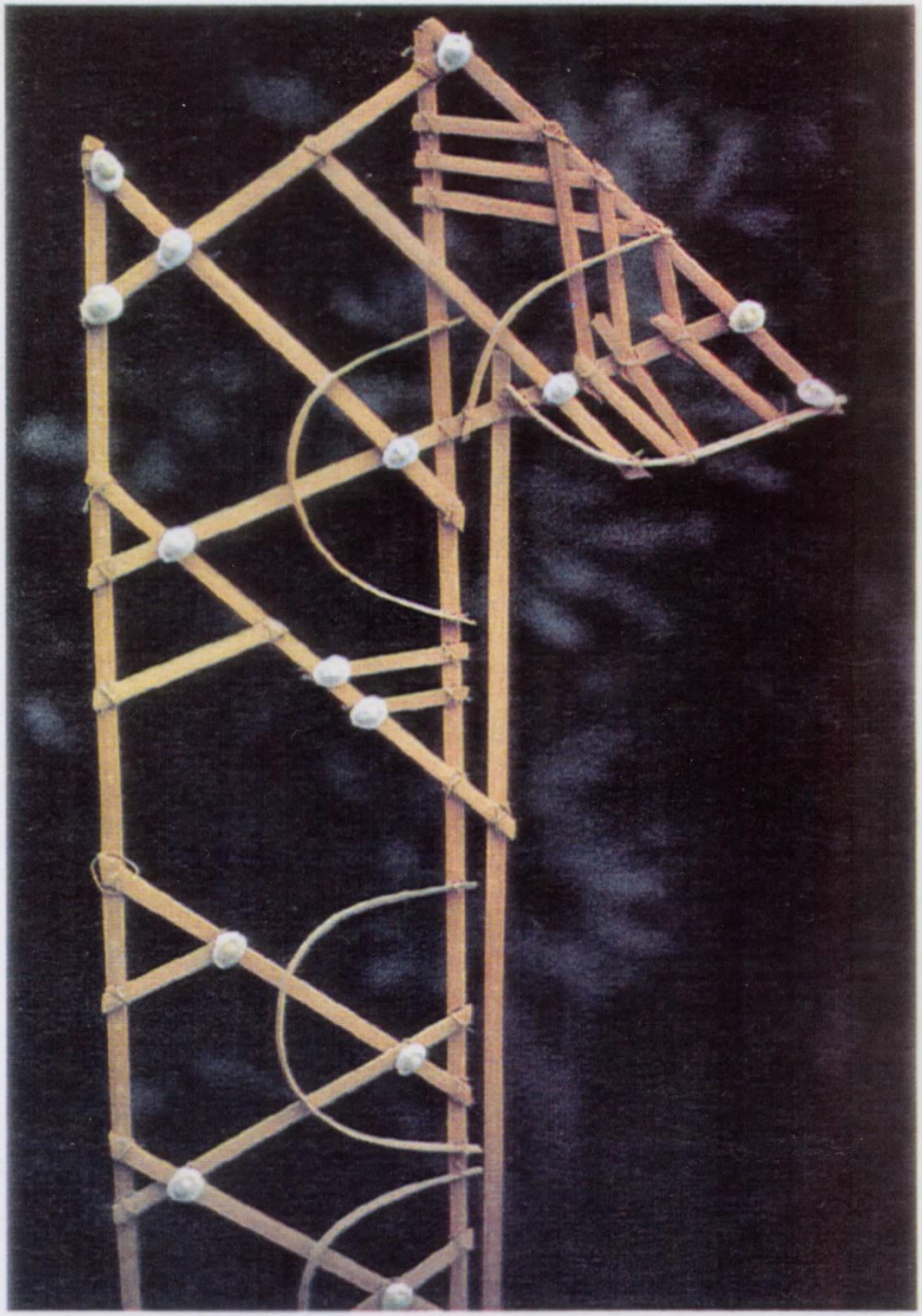
To se "high" islands such as Oahu from deck level of canoe:

Mt Kaala = 4025 ft high: D = 3 + 63 = 66 nautical miles
--but haze and sea spray will reduce this!

Recognized presence of and direction to islands
up to **30 miles away** using deflected swells, homing birds, cloud patterns, and reflection of land in sky

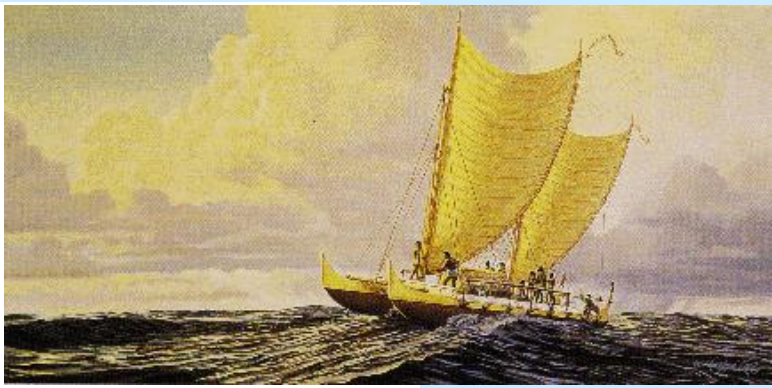


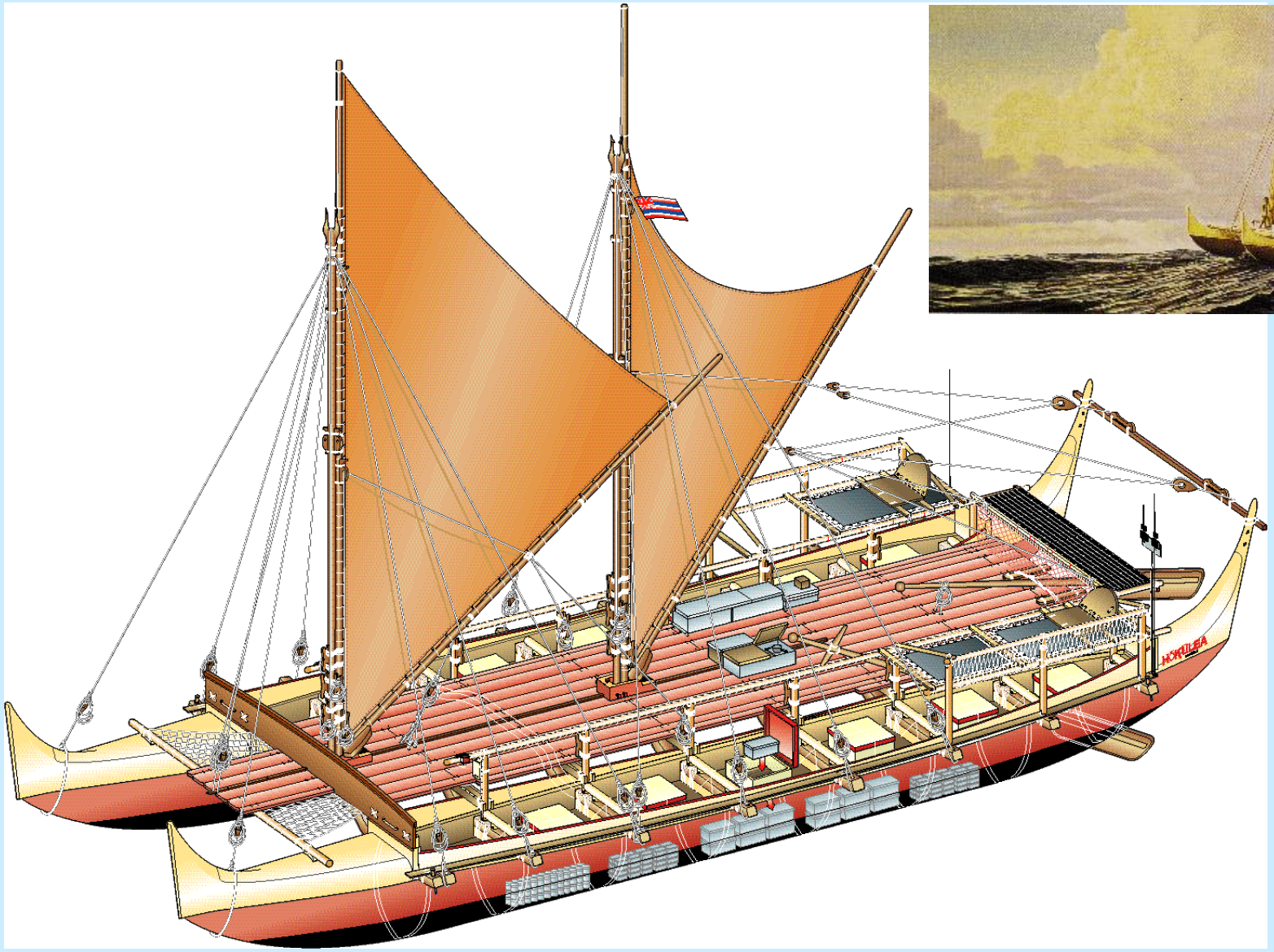
South Pacific islands "expanded" to 30 mile radius



Micronesian stick chart:
a record of swell patterns
or a tourist trinket?

Discovery of Hawaii represents a very difficult voyage
Recovery and rebirth: ***Hokulea*** built in 1976.





Double-hulled canoes cannot sail very close to the wind.

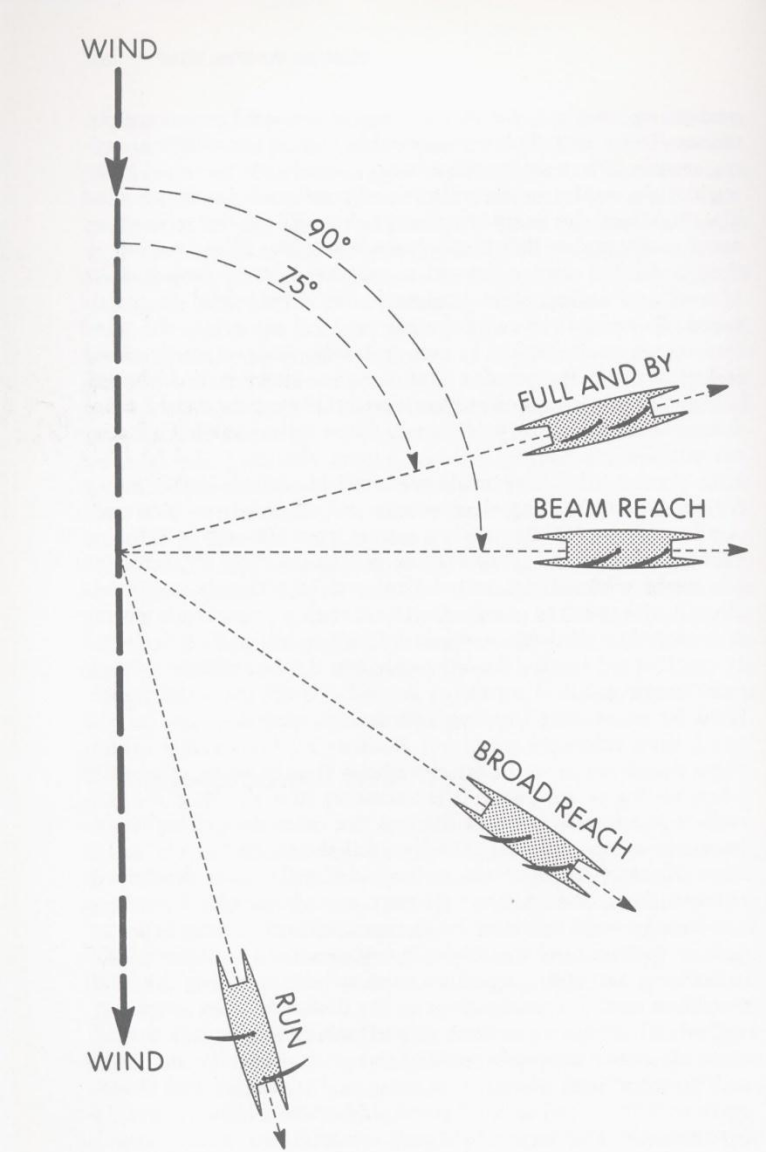
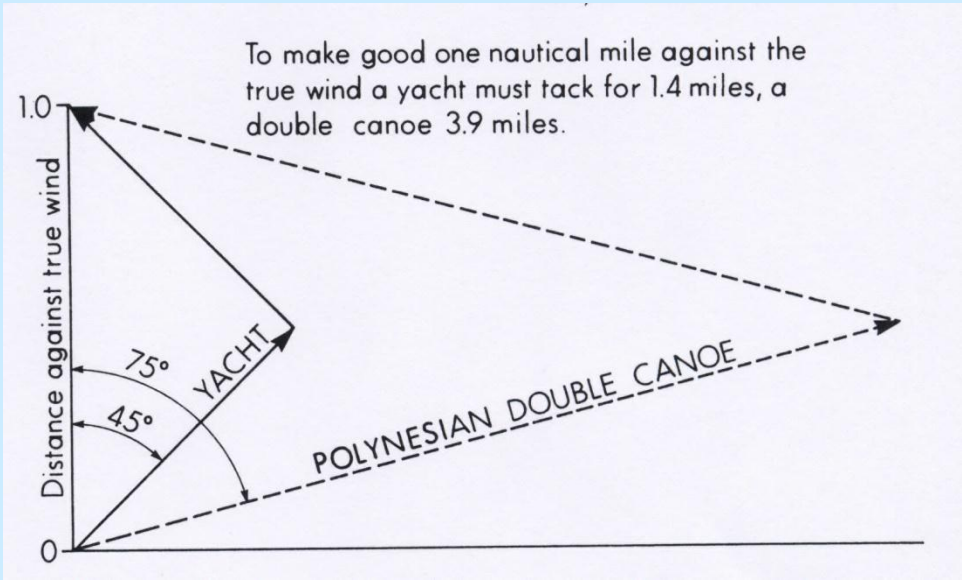
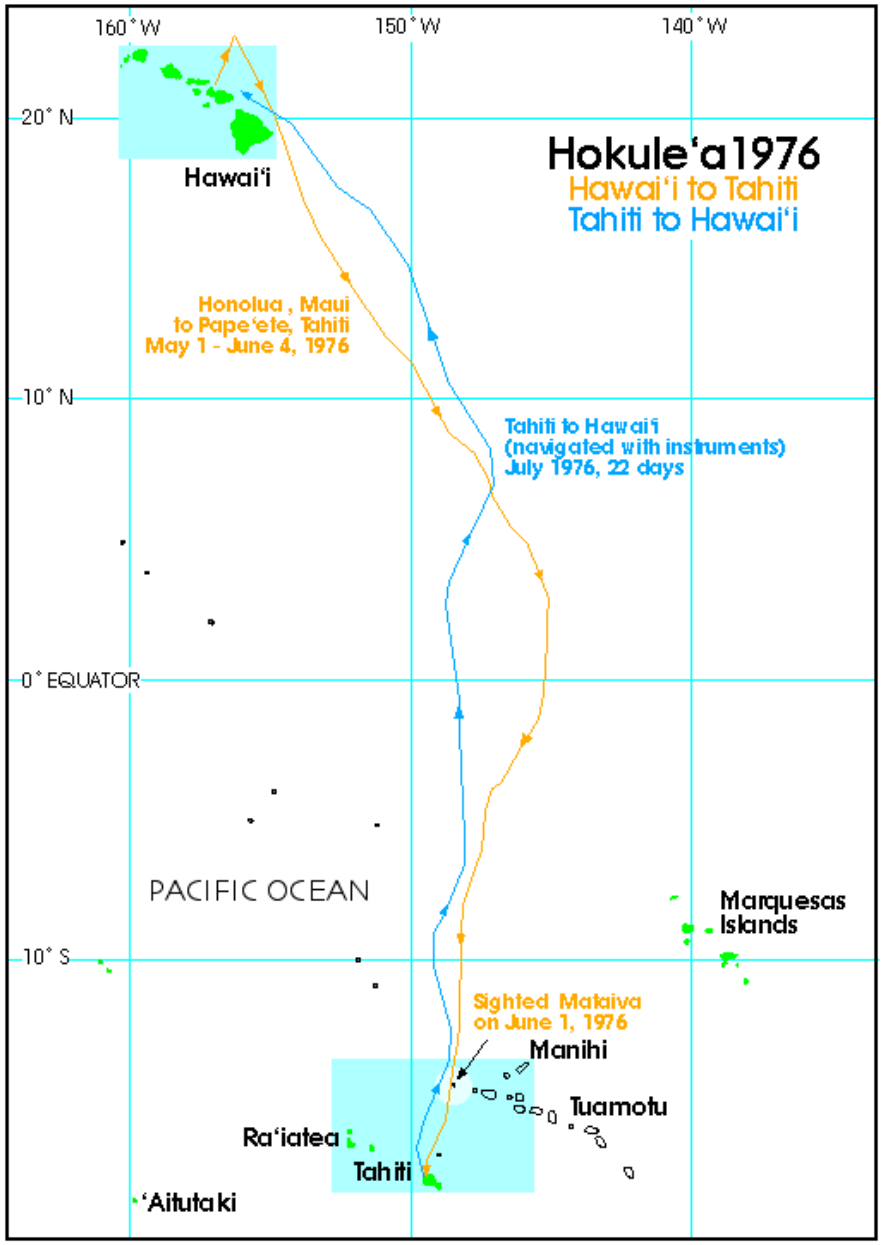


Figure 29. Best points of sail for Hōkūle'a.

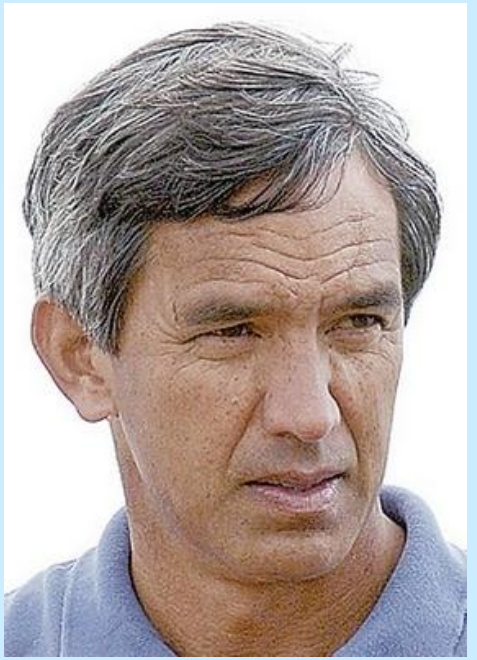


Built in 1976, ***Hokulea*** was sailed to Tahiti using traditional navigation by Satawalese navigator Mau Piailug.

At that time Hawaiians no longer knew the traditional navigation system of their ancestors.

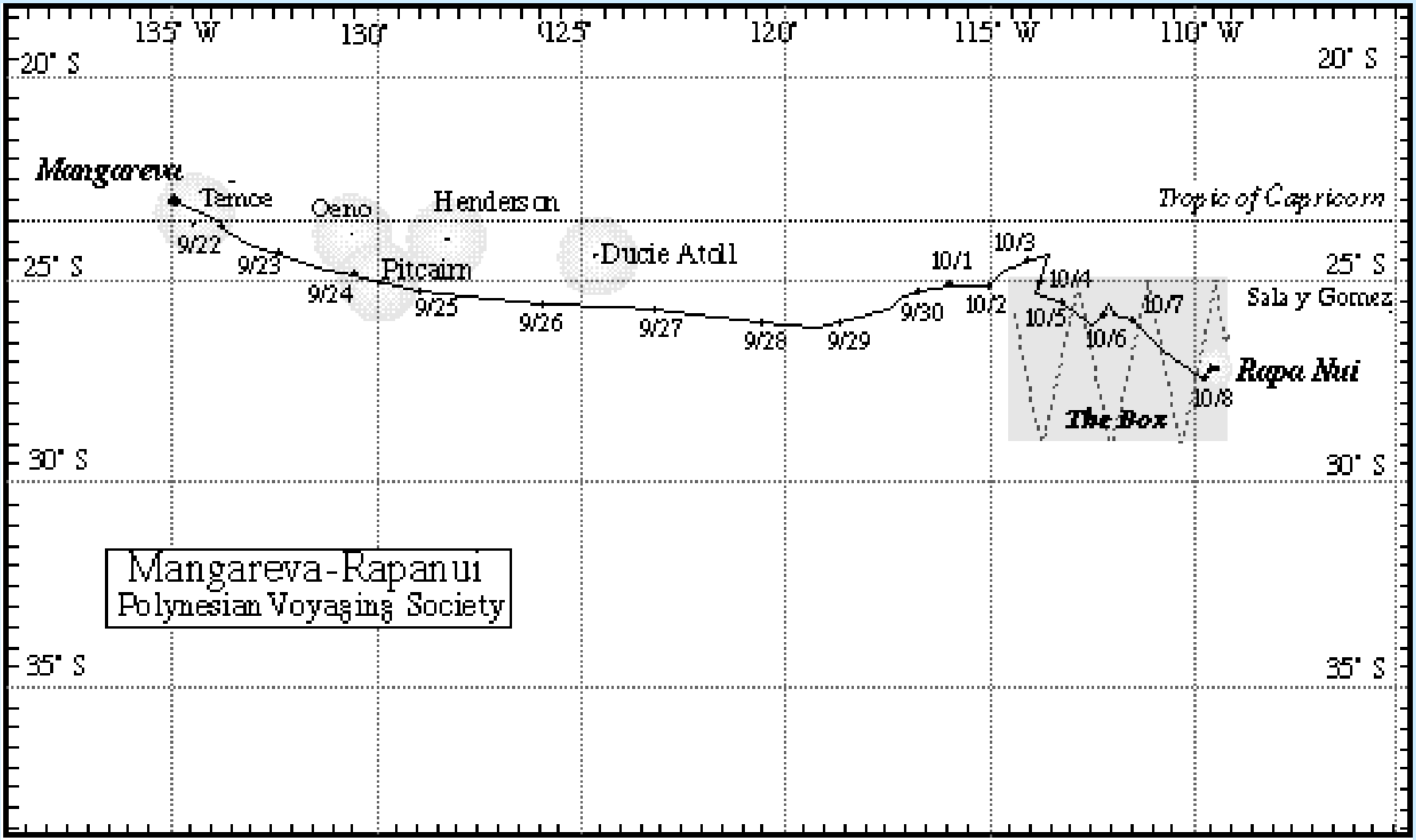


Crew member **Nainoa Thompson** returned to Hawaii and redeveloped traditional navigation in Hawaii.



Hokulea was taken on nine other cruises: 1980, New Zealand; Tonga, and Samoa in 1985-87; etc.
New canoes have been built since…

In 1999 ***Hokulea*** sailed to Mangareva and then to Rapa Nui, the most distant island in Polynesia, showing that Polynesians could have colonized this island.



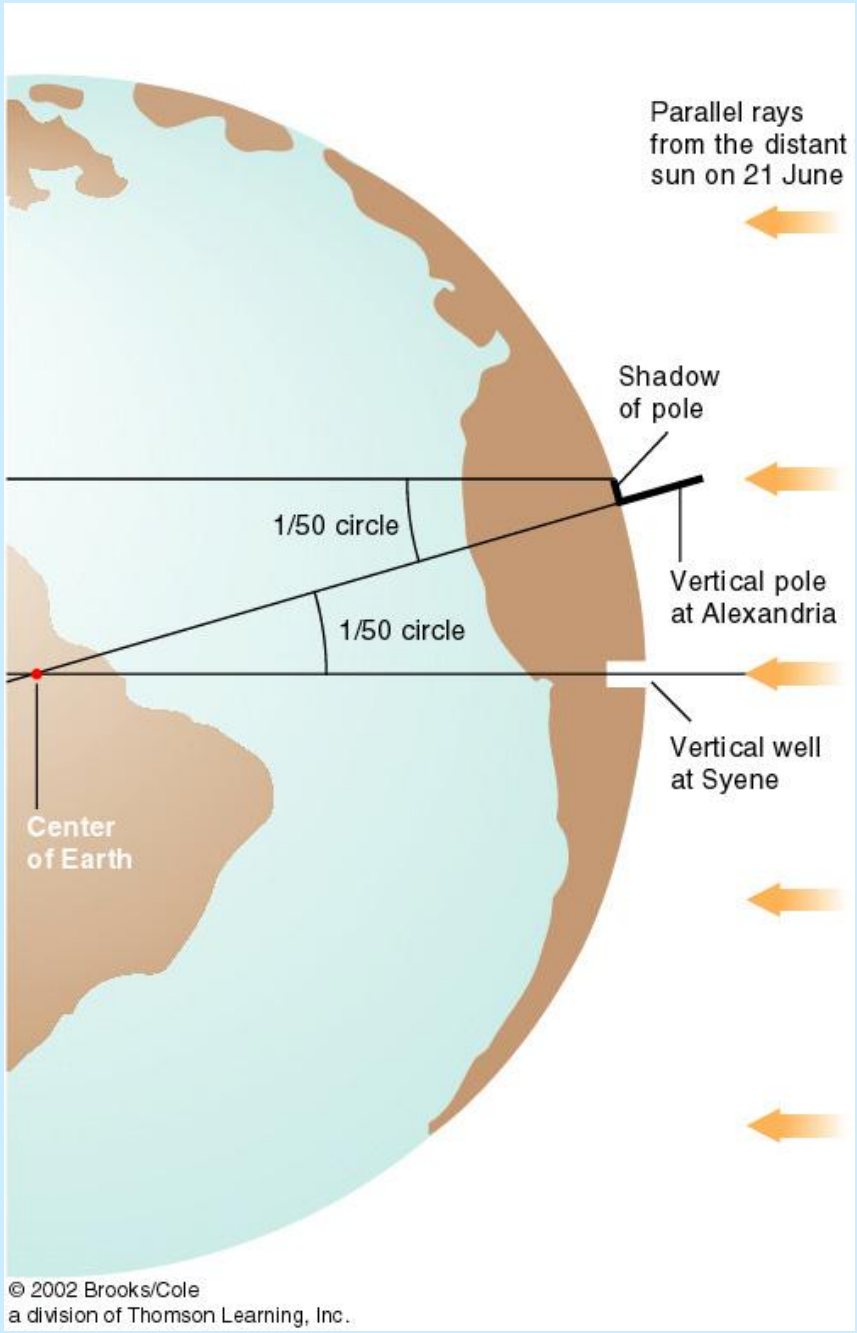
PVS and other canoes

- More recent trips to Micronesia and Satawal
- Satawalese bestowed Hawaiian navigators with “master navigator” titles
- Hawaiian crew donated canoe to Satawal as thanks for Pialug’s teaching and renaissance of traditional navigating techniques
- Voyage continued on to Japan…

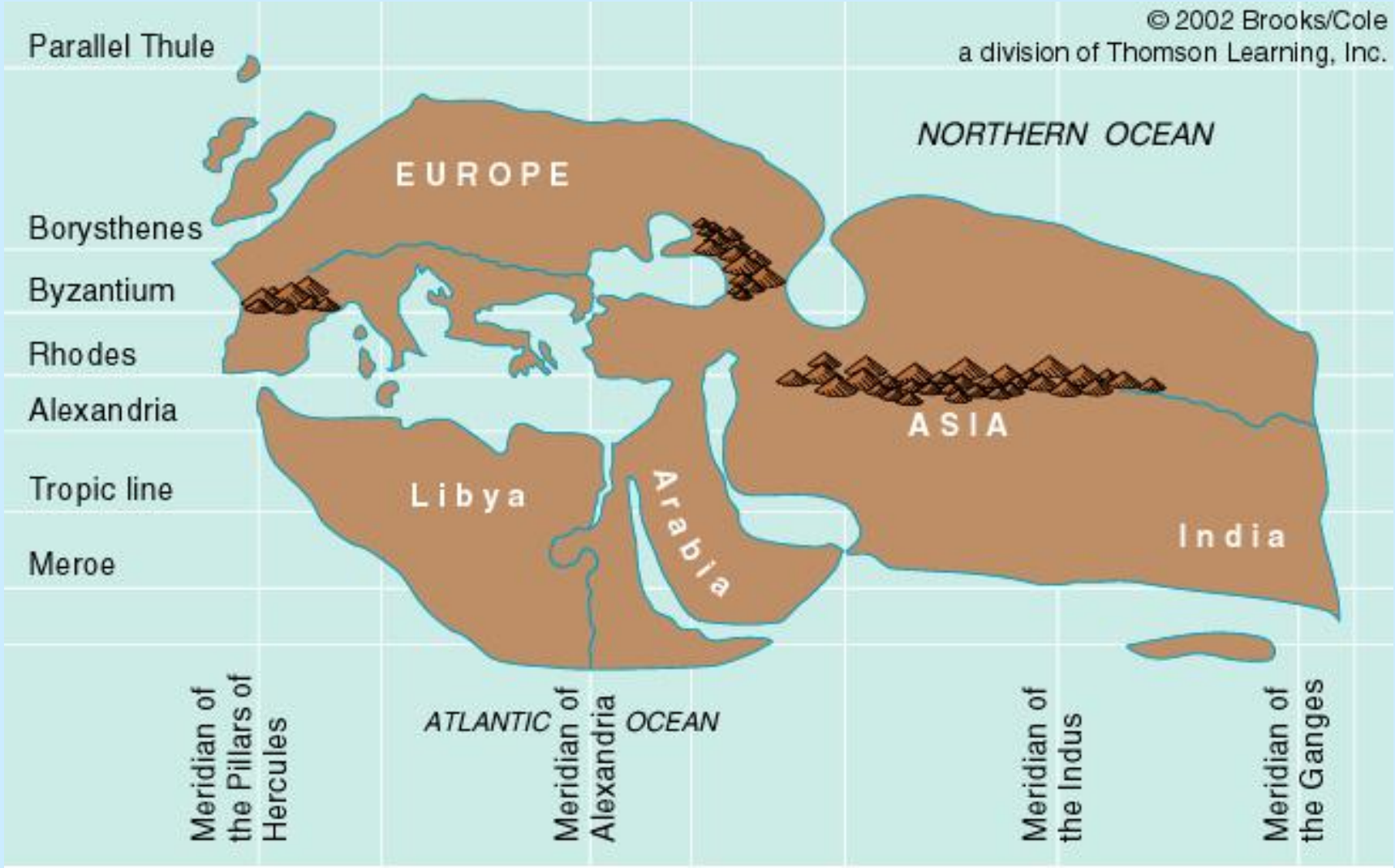
A History of Oceanography
The Western Perspective…

The ancient world:
the **Library of Alexandria** kept scrolls from ships and land caravans.

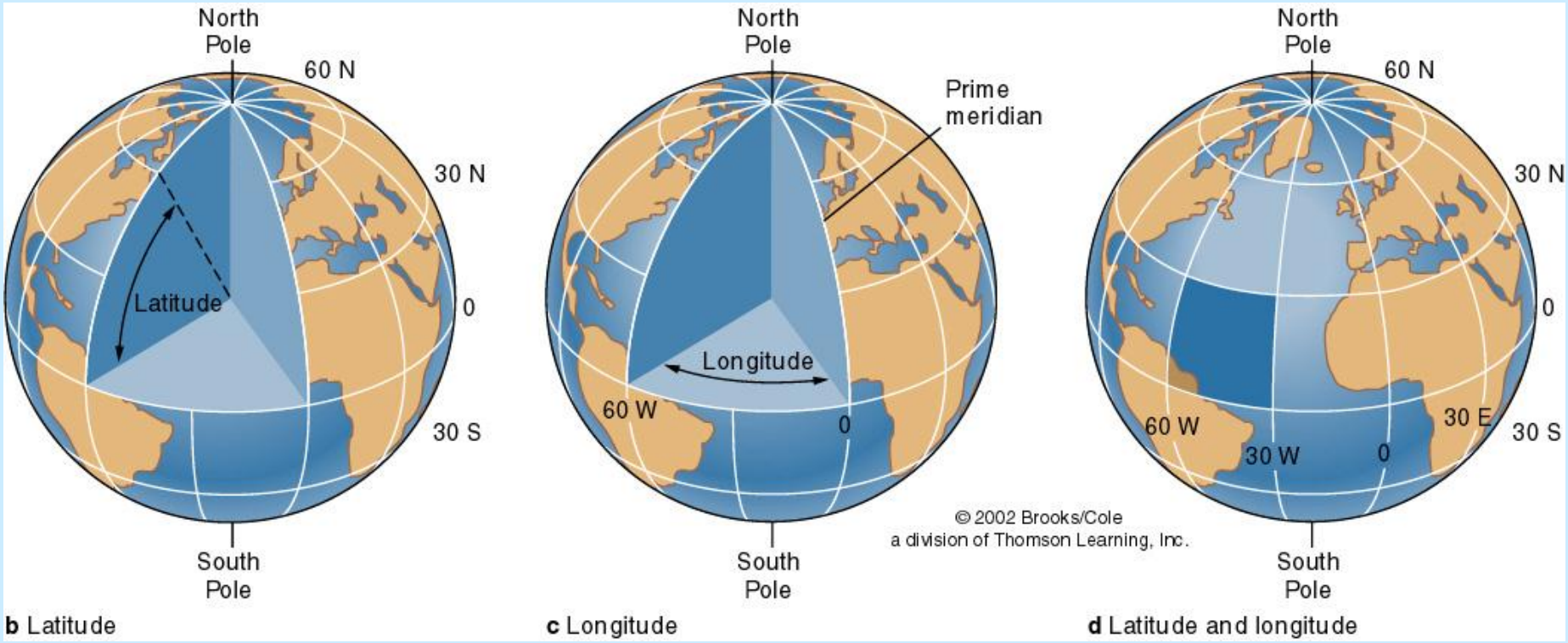
Its second librarian, **Erastothenes** (~200 BC), discovered that the Earth is round and calculated its size to within 8% of the correct value!



This led to a mathematical basis for celestial navigation and map making. The first latitude and longitude lines were based on landmarks… but maps were not accurate



Hipparchus (~ 140 BC) developed 360^{o} system to describe latitude and longitude.



Ptolemy (of epicycle fame, ~ 120 AD) added minutes and seconds and put N at the top.

He recalculated the size of the Earth but **got it wrong!** His error lead to an incorrect view of the size of Earth (30% smaller than it really is) for hundreds of years (oops!)

The last librarian of Alexandria, **Hypatia**, was murdered by a religious mob in 415 AD. The Library was burned and 700,000 scrolls were destroyed.

Earth was considered flat again…

(Earth got flattened by zealots?)

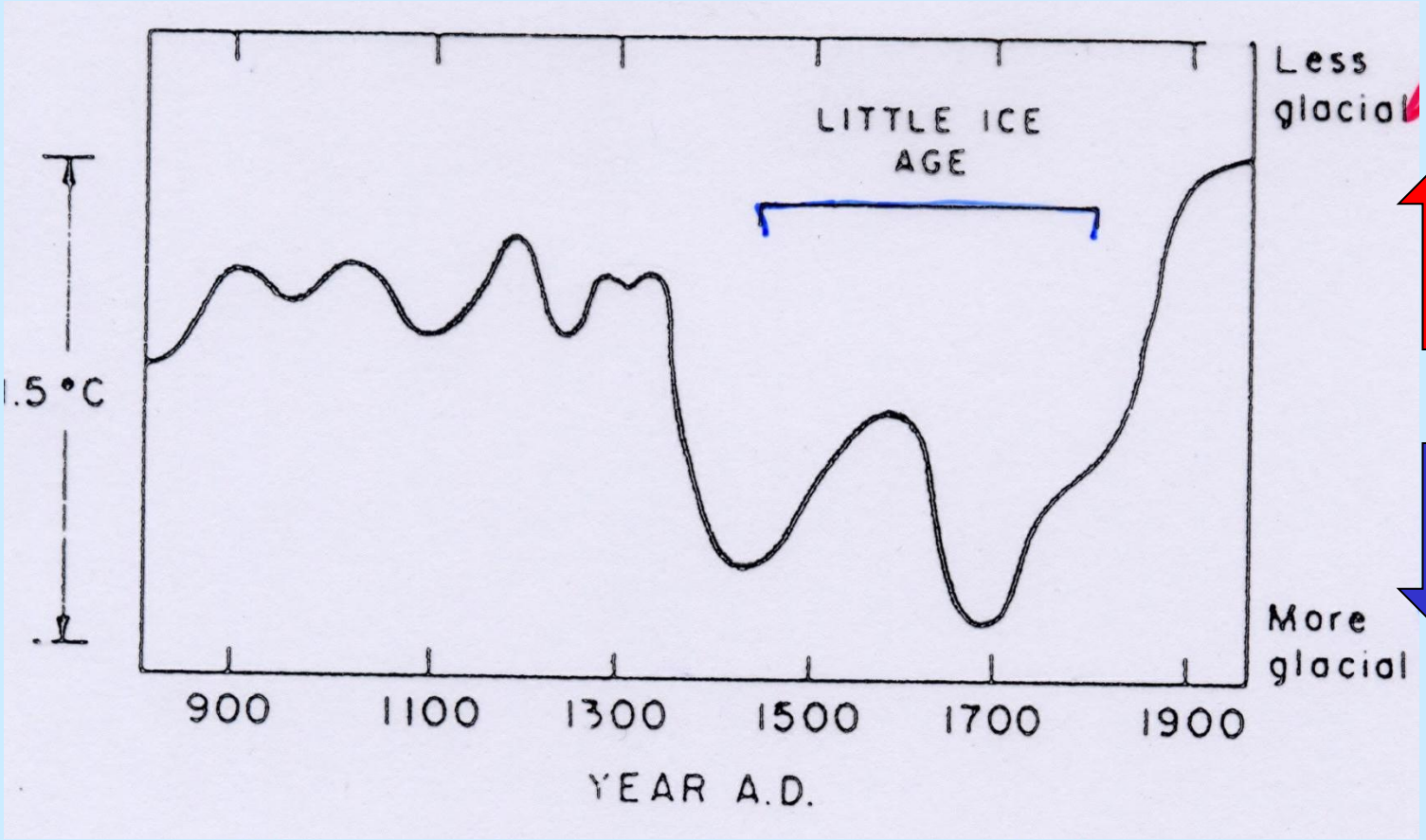
Western Seafaring

The **Vikings** colonized Iceland ~700 AD.

They discovered Greenland and North America ~990 AD.

The Viking empire declined as the climate cooled.

Arctic ice probably made navigation much more difficult.



Columbus (re)discovered North America in 1492 (but he never saw the North American continent!)

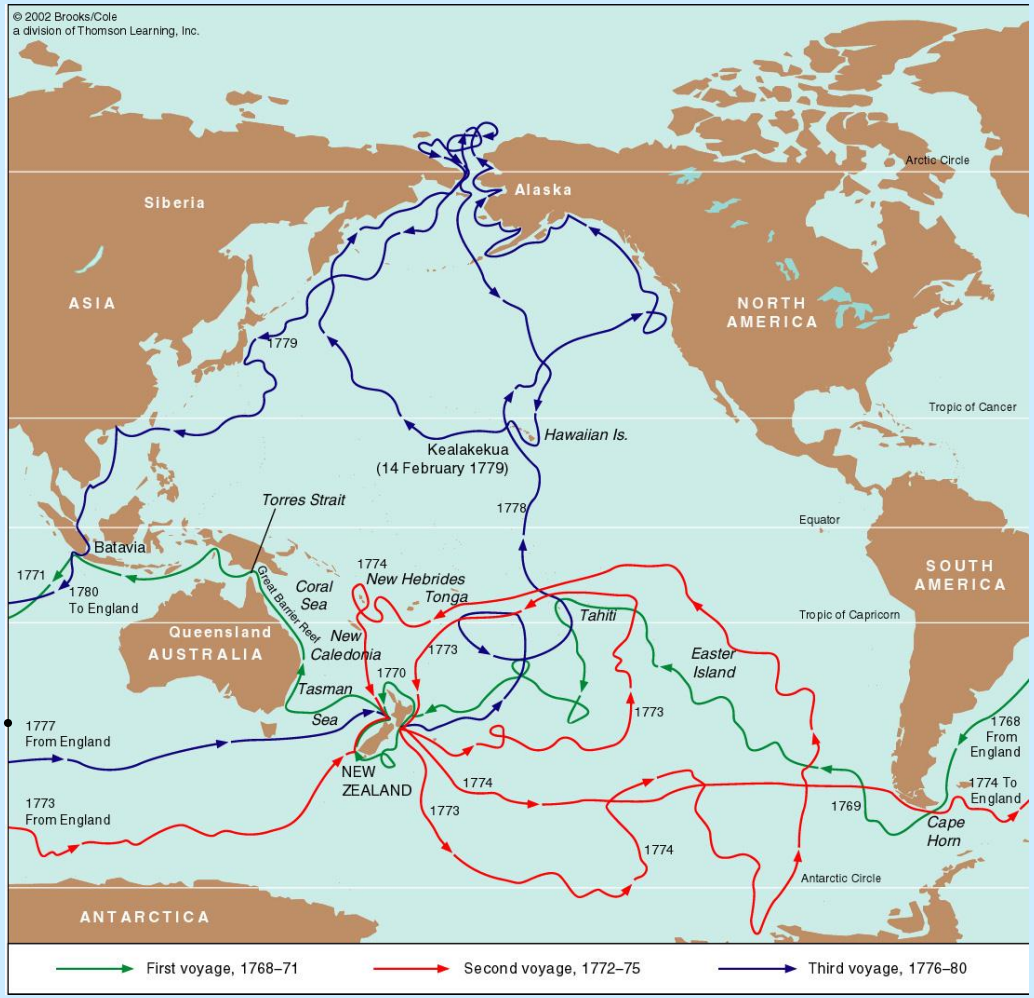
Magellan's ship circumnavigated Earth in 1522, thereby proving it is round. His men discovered the need for a dateline (but only 34 of 260 survived!)

Scientific voyaging

Capt. **James Cook**'s first voyage to the South Pacific, 1768-71, to observe the transit of Venus across the Sun to verify calculations of planetary orbits.

Collected biological samples (Joseph Banks) and reported on geology.

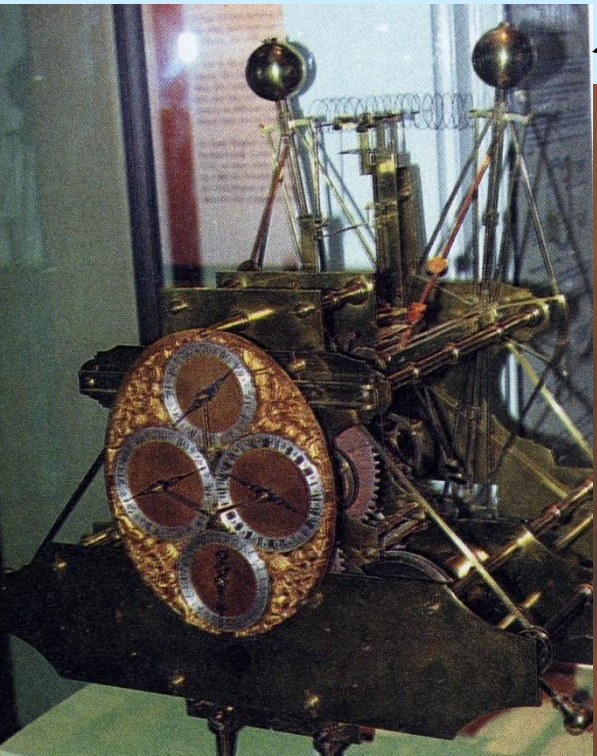
Two more voyages in 1772-73 and 1776-79; Killed on Hawaii in 1778.



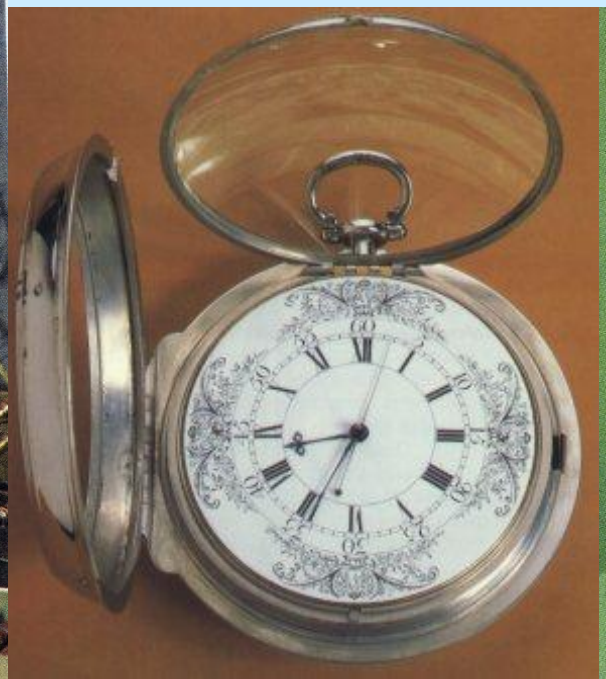
The Longitude Problem

Can fix latitude using the stars (from declination to the Pole Star), but need to know ***time*** to fix longitude. No system for accurate time-keeping at sea! (1657: pendulum)

John Harrison developed first chronometer in 1760 in response to a ~$12M prize from Britain (tested by Cook).



No. 1 (1735)



No. 4 (1760) (diam. = 5")

How to determine longitude at sea

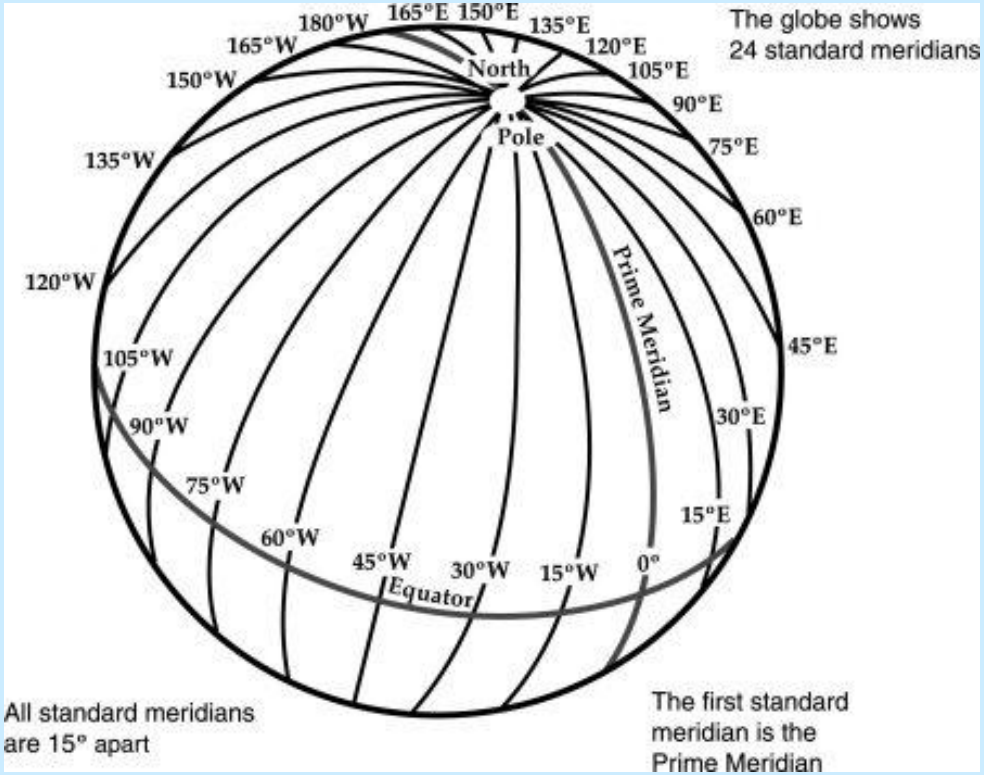
1. Need to know ***time*** where journey started--need a clock!
2. Record time Sun is directly overhead at your ***new*** position.
3. Compare this time to time at starting position.

Every hour later (at new position) than midday at starting position equals 15º of longitude to the West.

Why?

Earth has 360 longitude degrees and rotates once in 24 hours.

Therefore each hour equals 360/24 = 15 degrees



Honolulu: January 14, 2013

Sunrise 7:12 a.m.
Sunset 6:10 p.m.

Day length = 10 h 58 min

Therefore noon = 7:12 + (10:58/2)

= 12:41 p.m.

This is when the sun is directly overhead,
and is called **“local apparent noon”**.

(Different from 12:00 HST because time zones are manipulated!)

Scientific voyaging

Charles Wilkes, USN: circumnavigation (1838-1842)
6 vessels mapping coastal areas, collected specimens for Smithsonian collection.
First to discover Antarctica? (was court-martialed on return)

Matthew Fontaine Maury, USN, 1855:
"Father of Physical Oceanography"

***Challenger* expedition**: circumnavigation, 1872-76
First expedition devoted to entirely to science, directed by scientists. Invented term "Oceanography".
Found life in deep water, disproving Forbes' theory that life could not exist there.

Fridtjof Nansen: first Prof. of Oceanography. Froze specially constructed ship ***Fram*** into the ice, drifted for four years (1893-96). Attempted to ski to the North Pole…

1994 Trans Polar Expedition: First surface ships to cross Arctic Ocean (UH scientist & Prof. Chris Measures was member of the science party).