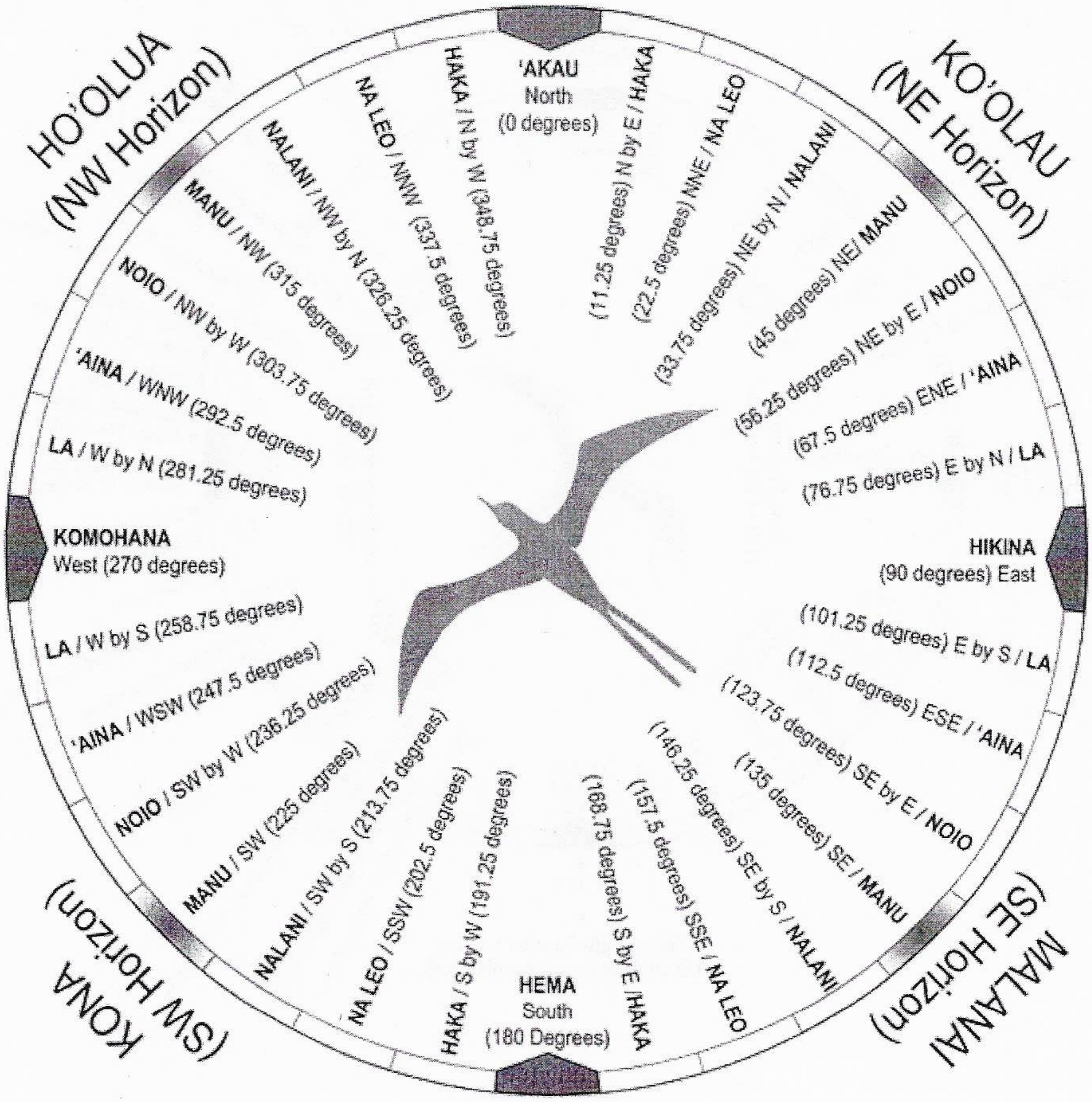
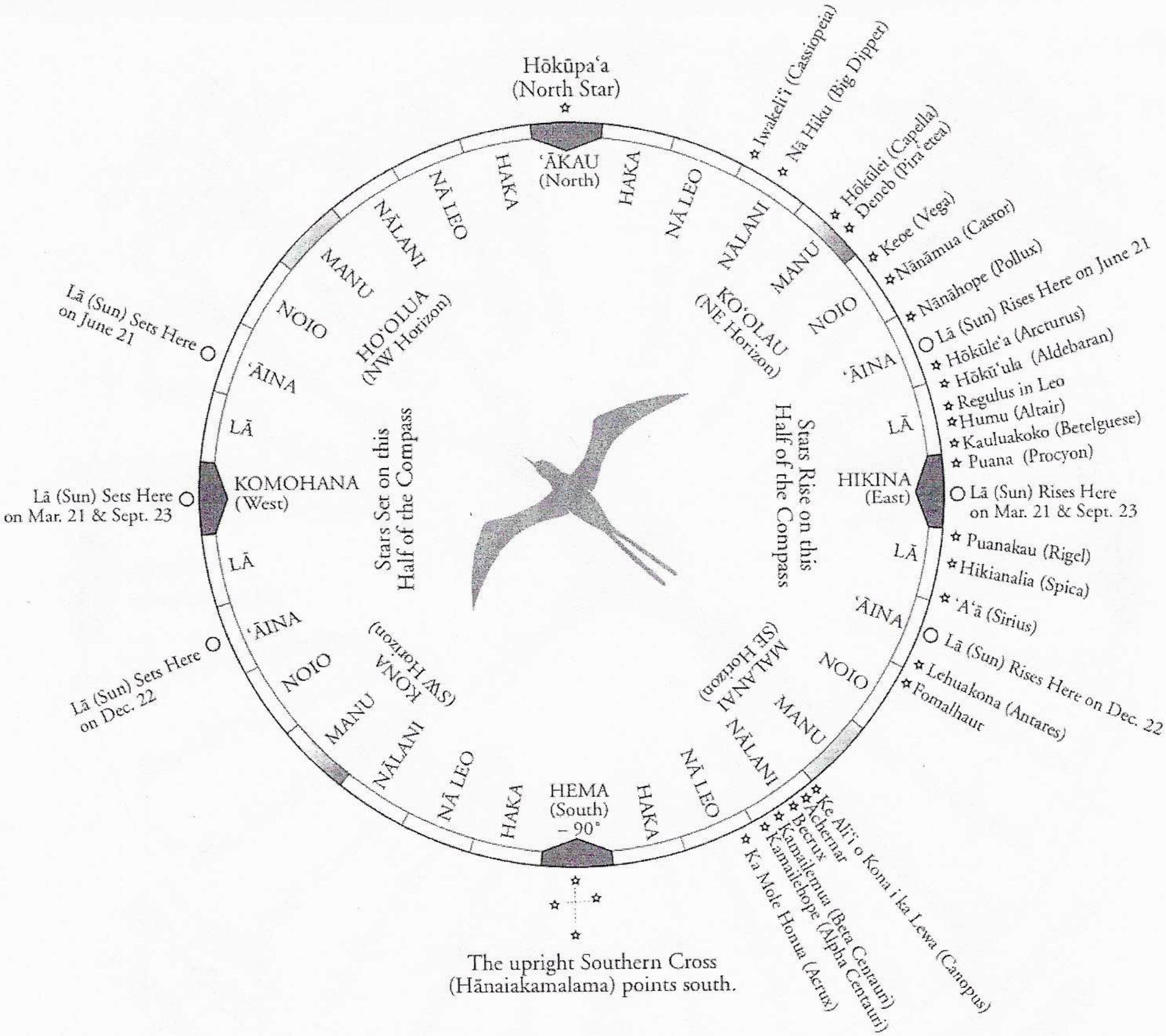
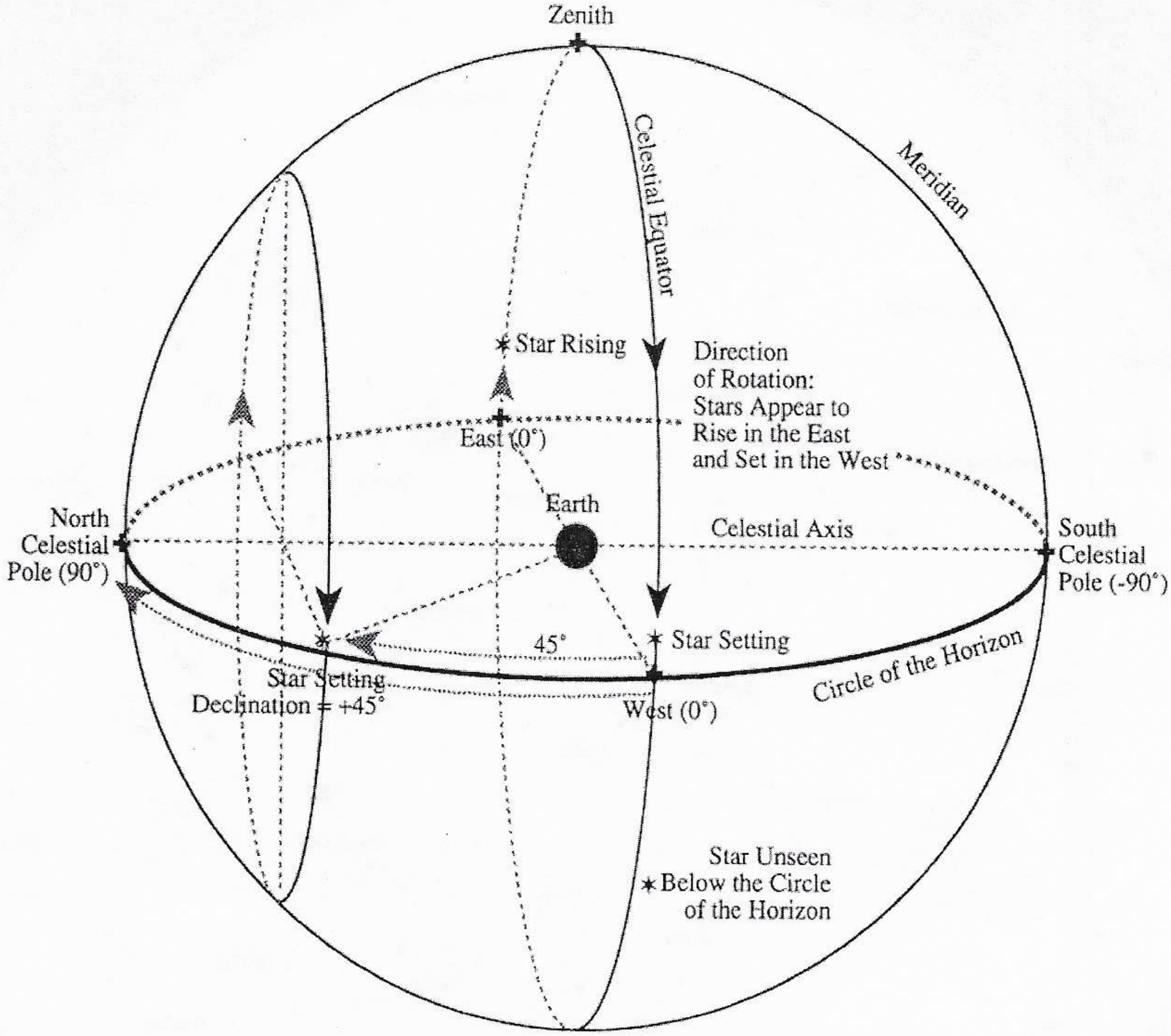


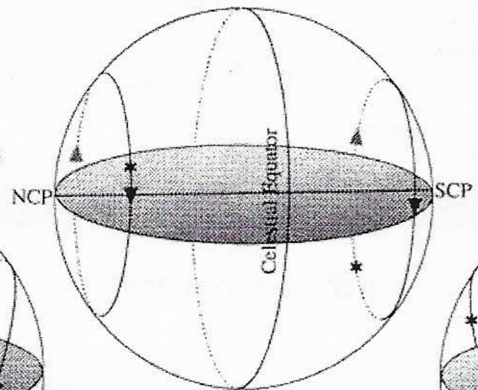
HO'OLUA (NW Horizon)
KO'OLAU (NE Horizon)
KONA (SW Horizon)
MALANAI (SE Horizon)
'AKAU North (0 degrees)
HAKA / N by W (348.75 degrees)
NA LEO / NNW (337.5 degrees)
NALANI / NW by N (326.25 degrees)
MANU / NW (315 degrees)
NOIO / NW by W (303.75 degrees)
'AINA / WNW (292.5 degrees)
LA / W by N (281.25 degrees)
KOMOHANA West (270 degrees)
LA / W by S (258.75 degrees)
'AINA / WSW (247.5 degrees)
NOIO / SW by W (236.25 degrees)
MANU / SW (225 degrees)
NALANI / SW by S (213.75 degrees)
NA LEO / SSW (202.5 degrees)
HAKA / S by W (191.25 degrees)
HEMA South (180 Degrees)
(168.75 degrees) S by E /HAKA
(157.5 degrees) SSE / NA LEO
(146.25 degrees) SE by S / NALANI
(135 degrees) SE / MANU
(123.75 degrees) SE by E / NOIO
(112.5 degrees) ESE / 'AINA
(101.25 degrees) E by S / LA
HIKINA (90 degrees) East
(76.75 degrees) E by N / LA
(67.5 degrees) ENE / 'AINA
(56.25 degrees) NE by E / NOIO
(45 degrees) NE/ MANU
(33.75 degrees) NE by N / NALANI
(22.5 degrees) NNE / NA LEO
(11.25 degrees) N by E / HAKA



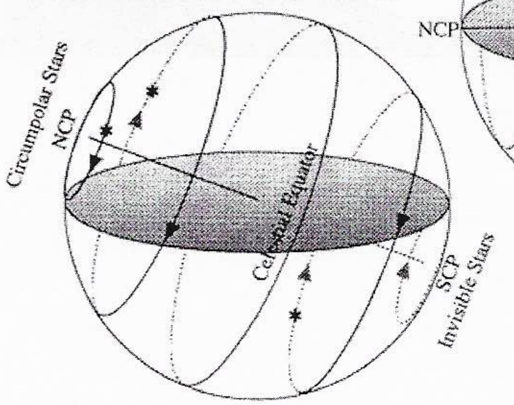
The upright Southern Cross (Hānaiakamalama) points south.



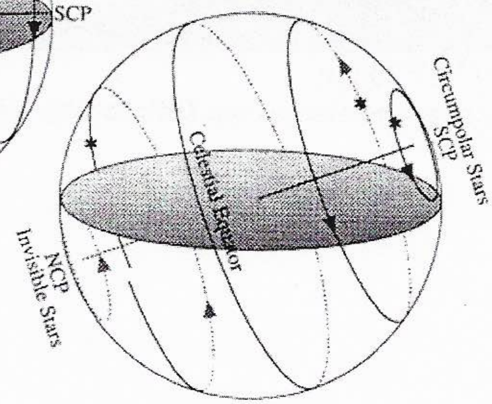
Celestial Sphere at the Equator (0°)

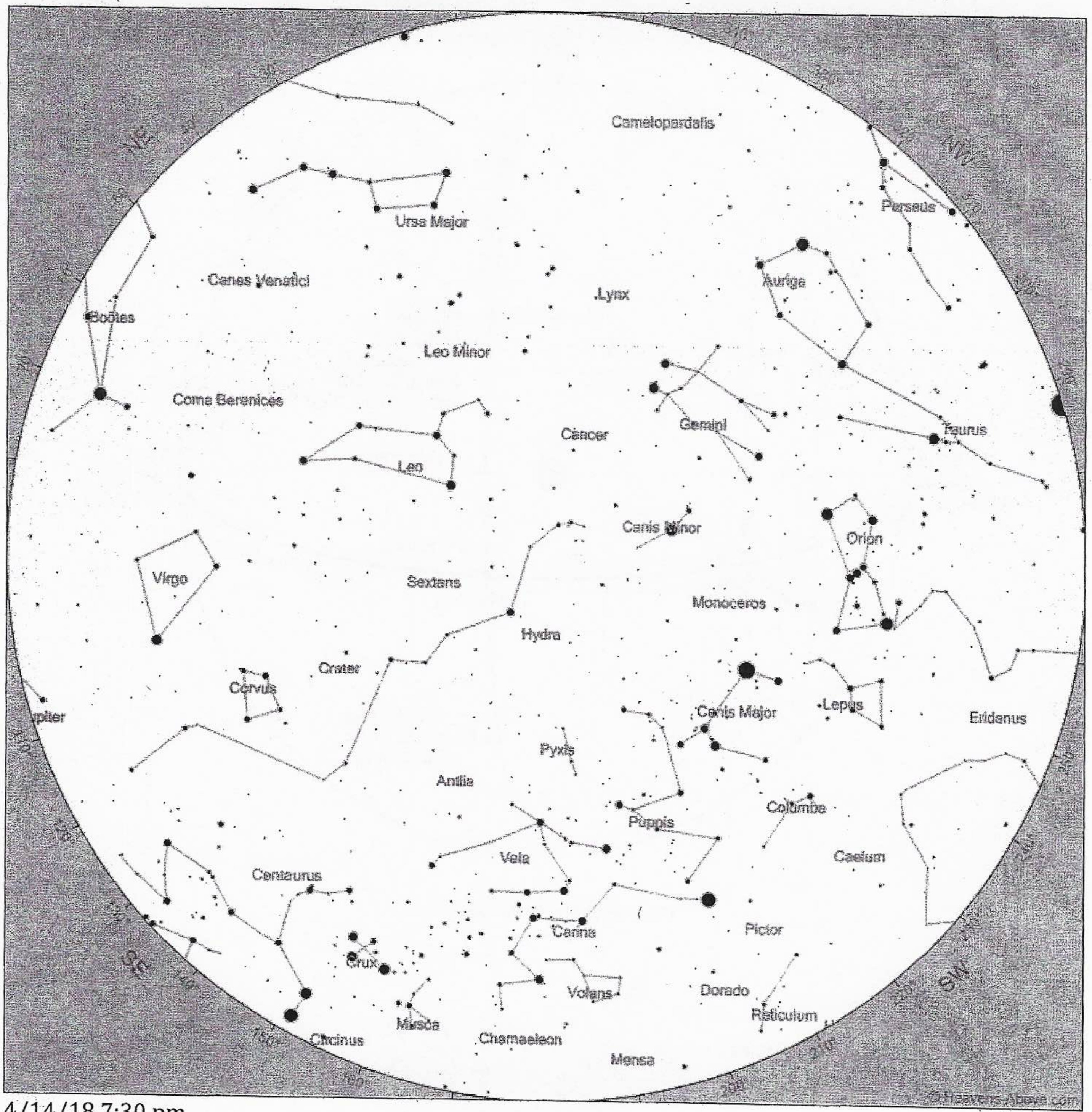


Celestial Sphere at 20° N in Hawai'i

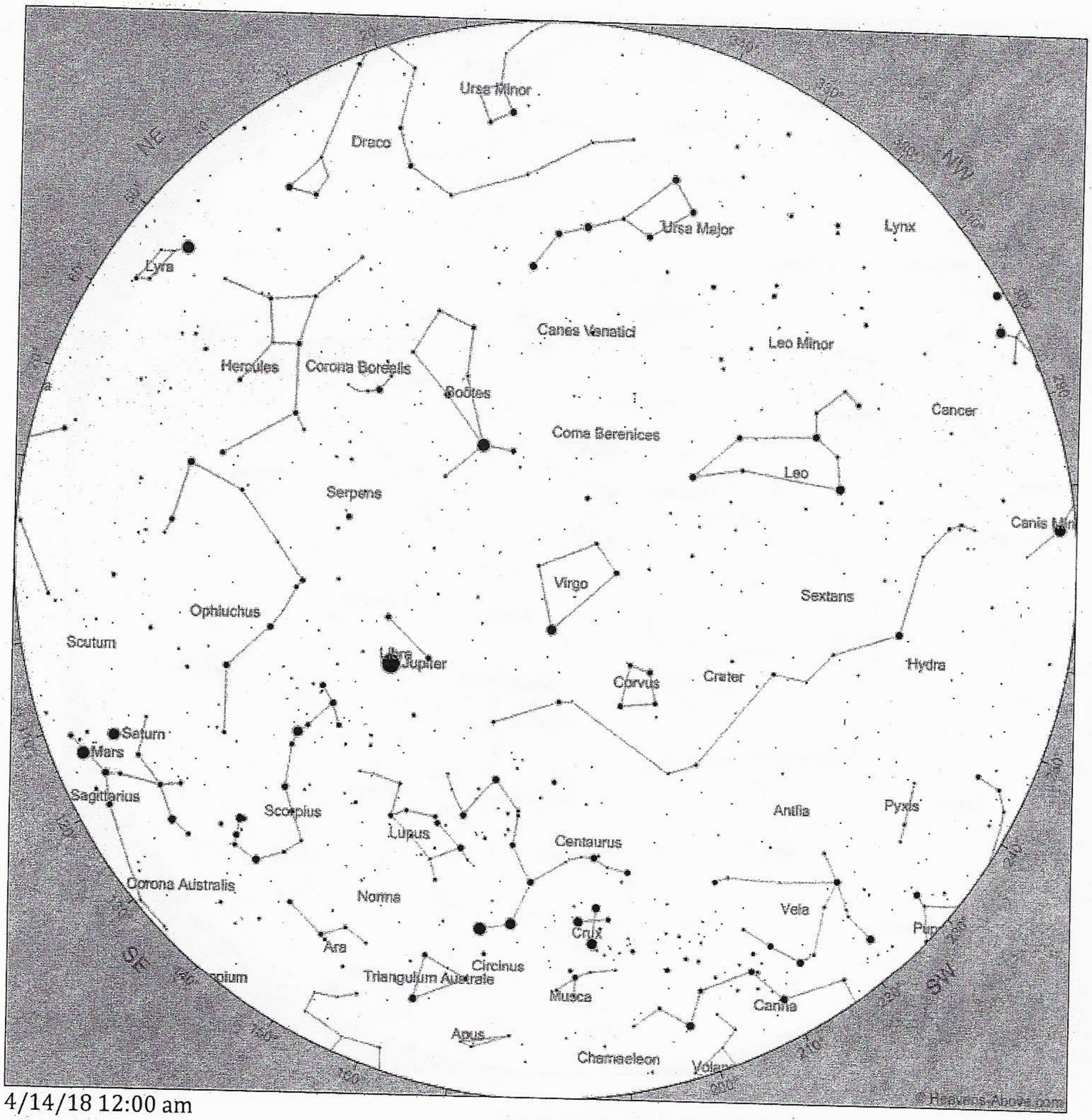


Celestial Sphere at 20° S in 'Ātiu

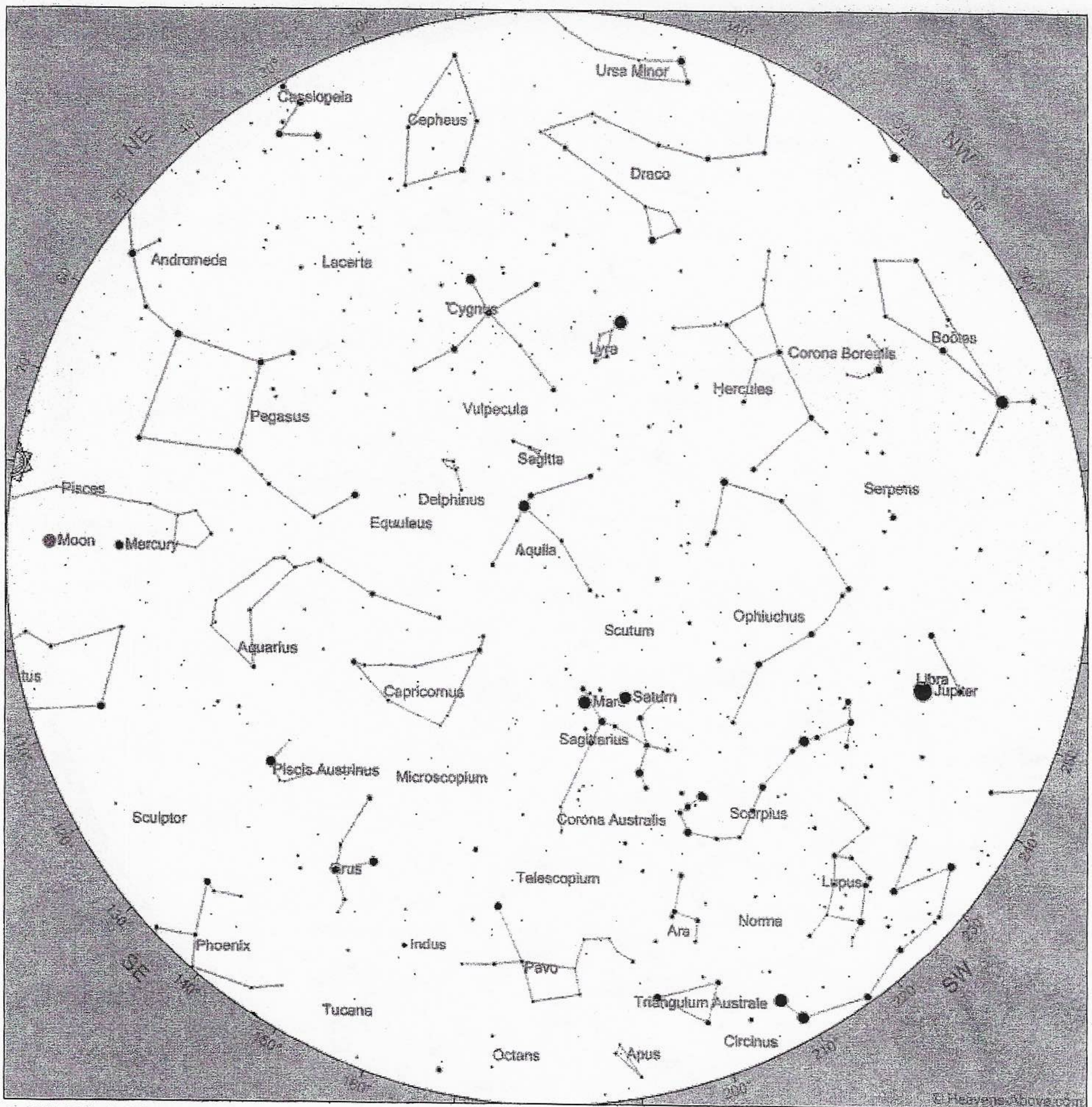




4/14/18 7:30 pm
www.heavens-above.com (interactive sky chart-old version)



4/14/18 12:00 am
www.heavens-above.com (interactive sky chart-old version)



4/15/18 6:00 am
www.heavens-above.com (interactive sky chart-old version)

Our Star Compass revolves around the rising and setting points of the sun, stars, moon, and planets. You orientate yourself by first locating the arriving horizon, East, the side on the horizon celestial bodies arrive at. Next you identify the entering horizon, West, the side on the horizon celestial bodies enter into. The arriving horizon is called *Hikina* and the entering horizon is called *Komohana*, literally "To Arrive" and "To Enter" in Hawaiian. You stand with your back towards Hikina, East, and you face Komohana, West, if you extend your right hand from the side of your body it points to *'Ākau*, which means "Right or North". If you extend your left hand from the side of your body it points to *Hema*, which means "Left or South". These 4 cardinal points break the compass up into 4 quadrants which is named for winds in Hawai'i, *Ko'olau* is the Northeast quadrant and is named for the trade winds, *Kona* lies in the opposite direction and is the Southwest quadrant, *Malanai* is the Southeast quadrant, and *Ho'olua* the Northwest.

The horizon of the compass is broken up into 32 houses, 4 of which are the cardinal points. Each house on the compass is positioned 11.25°apart. The names of the houses are the same in the east as they are in the west and vice versa. Starting in the east and moving northwards and southwards we begin with the first house *Lā* (Sun) which is positioned on either side of *Hikina* (East) and *Komohana* (West). It is followed by *'Āina* (Land), *Noio* (Tern), *Manu* (Bird), *Nālani* (Heavens), *Nāleo* (Voices), and *Haka* (Empty). The celestial bodies move in parallel paths, rising in the East and moving West across the sky and remaining in the same hemispheres. If a star rises in the star house we call *'Āina* in the northeastern quadrant of *Ko'olau* on our compass it will set in the same house, *'Āina*, in the opposite northwestern quadrant of *Ho'olua* and within the same hemisphere. If a star arrives in the star house we call *Nālani* in the southeastern quadrant of *Malanai*, it will arc overhead and set toward the southwestern horizon in the *Kona* quadrant and re-enter the horizon in the same star house, *Nālani*, that it arrived in. All celestial bodies rise and move in parallel tracks as they travel on their daily east to west cycles.

We can also use the wind and ocean swells for telling direction on our star compass. The wind and swells move diagonally across the compass from quadrant to quadrant. If the wind were blowing from the northeast quadrant of *Ko'olau* and from the compass house *Manu*, it would blow in the direction of the southwest quadrant *Kona* and exit the same house, *Manu*, that it blew from. If an ocean swell was to roll in from the compass house *Nāleo* in the northwest quadrant of *Ho'olua* it would continue in a southeasterly direction and exit the compass in the opposite quadrant, *Malanai* and in the same house, *Nāleo*, that it originated from.

This Star Compass system of orientation works particularly well because most of the oceanic islands of the Pacific are located within the tropics. The Tropics is the area on the planet between the margins of 23.5° North latitude, and 23.5° South latitude. The northern limit of the sun's path is known as the Tropic of Cancer, and the southern limit of the sun's path is known as the Tropic of Capricorn. June brings on the summer solstice in the northern hemisphere and the winter solstice in the southern hemisphere. December marks the arrival of the summer solstice in the southern hemisphere and the winter solstice in the northern hemisphere. The solstices occur once per year in both hemispheres. When the sun crosses over the equator it is known as the equinox, which occurs two times a year and creates the summer and winter seasons on the planet.

The star compass also reads the flight path of birds and the direction of waves. It does everything. It is a mental construct to help you memorize what you need to know to navigate.

You cannot look up at the stars and tell where you are. You only know where you are in this kind of navigation by memorizing where you sailed from. That means constant observation. You have to constantly remember your speed, your direction and time. You don't have a speedometer. You don't have a compass. You don't have a watch. It all has to be done in your head. It is easy-in principle-but it's hard to do.

The memorization process is very difficult. Consider that you have to remember those three things for a month-every time you change course, every time you slow down. This mental construct of the star compass with its Hawaiian names is from Mau. The genius of this construct is that it compacts a lot information and enables you to make decisions based on that information.

How do we tell direction? We use the best clues that we have. We use the sun when it is low down on the horizon. Mau has names for the different widths and the different colors of the sun's path on the water.

When the sun is low, the path is narrow, and as the sun rises the path gets wider and wider. When the sun gets too high you cannot tell where it has risen. You have to use other clues.

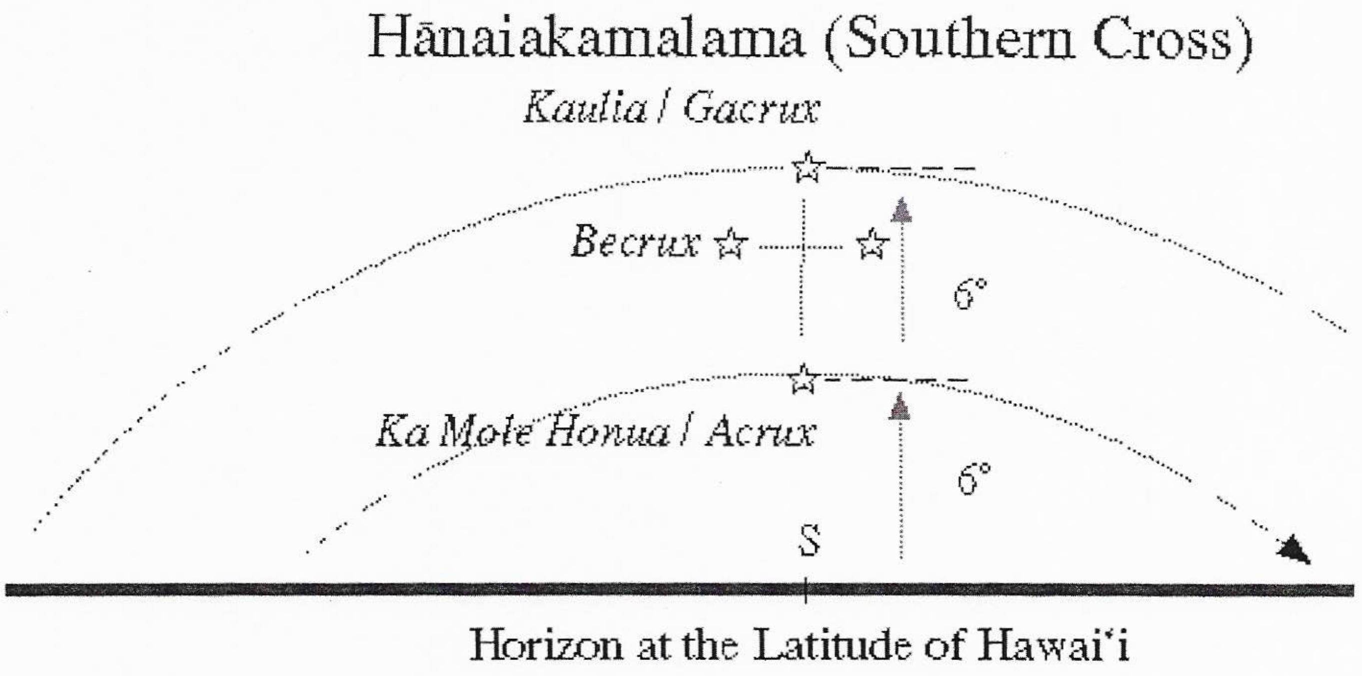
Sunrise is the most important part of the day. At sunrise you start to look at the shape of the ocean-the character of the sea. You memorize where the wind is coming from. The wind generates the waves. You analyze the character of the waves. When the sun gets too high, you steer by the waves. And then at sunset you repeat the process. The sun goes down-you look at the shape of the waves. Did the wind direction change? Did the swell pattern change? At night we use the stars. We use about 220, memorizing where they come up, where they go down.

When it gets cloudy and you can't use the sun or the stars all you can do is rely on the ocean waves. That's why Mau told me once, "If you can read the ocean you will never be lost." One of the problems is that when the sky gets black at night under heavy clouds you cannot see the waves. You cannot even see the bow of the canoe. This is where traditional navigators like Mau are so skilled. Lying inside the hull of the canoe, he can feel the different wave patterns as they come to the canoe, and from them tell the canoe's direction. I can't do that. I think that's what he started learning when he was a child with his grandfather, when he was placed in tide pools to feel the ocean.

Tahiti is smaller than Maui and it is a hard target to hit from 2500 miles away. Even hitting a target as large as the Big Island from that distance is outside of the accuracy of our navigation. When we go down to Tahiti, we have a mental image of our course line plotted for the trip. We try to stay on this course and end up in what I call a box. (See the map of the 1980 voyage to Tahiti.) This box is large enough to compensate for any errors in our navigation. In this box there are many islands. All we have to do is to find one of them, and from that island we can find the others. For example, the target when we sail to Tahiti is a box four hundred miles wide, from Manihi in the Tuamotu islands to Maupiti in the leeward Tahitian islands. The first part of the journey to Tahiti is not trying to get to Tahiti but to make sure that we sail into this box and find an island. On different voyages, we have found Matahiva, Tikehau, and Rangiroa-all islands in the box. Since these are coral atolls it is very difficult to tell one from the other, so sometimes we have to land and ask the people what island it is that we've found. From any of these islands, we know Tahiti is only about 170-180 miles away and our navigation system is accurate enough to find it from that distance.

Now consider another navigational problem-finding Hawai'i from Tahiti. The Hawaiian islands are 315 miles wide, from Ni'ihau to Kumukahi on the Big Island, but if you approach them from the southeast they are a narrow target because they are aligned southeast to northwest. The technique we use is to sail up to the latitude of Hawai'i on the east side of the islands, using the stars to tell our latitude. When we determine we are at the mid-latitude of Hawai'i, 20.5 degrees N, we turn west and try to sail into the islands on this side, 240 miles wide-the sight distance from South Point on the Big Island [18.5 degrees N] to the sight distance from Hanalei on Kaua'i [22.5 degrees N]. Again, our navigation system is accurate enough to hit this target. (See the map of the 1980 voyage to Tahiti.)

The Southern Cross is really important to us in determining latitude. It looks like a kite. The top and bottom stars in the kite always point south-Gacrux on top and Acrux on the bottom. If you are traveling in a canoe and going south, these southern stars are going to appear to be moving higher and higher in the sky. If you went down to the South Pole, these stars are going to be way overhead. If you are sailing from Tahiti north to Hawai'i, the Southern Cross gets lower and lower the farther north you go. At the latitude of Hawai'i, the distance from the top star to the bottom star is the same distance from that bottom star to the horizon about 6 degrees. This configuration only occurs at the latitude of Hawai'i.



If you are in Nukuhiva in the Marquesas Islands and looking at the Southern Cross, the distance between the bottom star in the Southern Cross and the horizon is about nine times the distance between the two stars.

http://www.hokulea.com/education-at-sea/polynesian-navigation/the-star-compass/