HOKULE'A TRAINING PROGRAM

by

Nainoa Thompson

THREE DIVISIONS:

1. Pre-Sail Orientation
2. Rigging and Preparation for Sail
3. Sailing

* * * * * * * * * * *

1. Pre-Sail Orientation - for people not familiar with sailing on the Hōkūle'a.

- Assemble on Hōkūle'a
- Passed out handouts on basic theory on sailing in general and specifically in regards to sailing the Hōkūle'a
- Took crew through quick excursion of the canoe covering the areas of
    a. compartments
    b. holds
    c. hulls
    d. both sails
    e. types of sweeps
    f. steering blads and steering compartments

* Went into a more detailed but still basic discussion of sailing Hōkūle'a by assigning the crew to 5 official stations.

A. Stations 1 and 2: front and back sails. Cover the various parts, their function, and what material they were made of -

a. mast
b. mast step
c. spar
d. boom
e. mast head

Lines -

a. stays
b. shrouds
c. halyards
d. triesting
e. sheets

Sail -

a. design
b. purpose and effectiveness

B. Station 3: steering sweep.

a. its construction (material) and how rigged
b. purpose
c. effectiveness (what is it doing to the canoe)
d. when to use the sweep
e. how to operate it
f. what are its dangers

C. Station 4: steering blade.

a. its construction (material) and how rigged
b. purpose
c. effectiveness (what is it doing to the canoe)
d. under what conditions is it used
e. how to operate the blade within the steering compartment
f. what are its dangers
g. how to use it to supplement the steering sweep

D. Station 5: duties on canoe (a more detailed inspection).

a. pumping compartments/hulls
b. fishing
c. storage of food, water, supplies, equipment
d. 'iakos and lashings/rigging
e. railings
f. towlines
g. anchor and anchor lines
h. man overboard procedures
i. positioning to avoid accidental jibe dangers

Short Discussion on:

1. Maneuvering

a. come about
b. jibe (gybe)

2. Changing direction in respect to wind and swell

a. changes in sail setting
b. changes in steering method
c. performance of canoe
d. description and performance of Hōkūle'a in

. close reach
. beam reach
. broad reach
. running free

2. Rigging and Preparation for Sail

- Assembling of crew
- Raising of sails
- Tying of lines
- Dropping of sails and triesting of sails to make sure operable
- Preparation of steering equipment
- Storage of food, water, safety equipment and medical kit so that everyone knows where these things are
- Organizing crew by dividing them up into 5 groups, one for every station
- PULE

3. Sailing

- Day sail for practical experience, possibly leading to longer or interisland trips

. At each of the 5 stations would be a crew person from either one of the voyages to or from Tahiti to do the instruction of that particular station. The material covered was basically what each instructor felt like teaching.

. The crew was at one particular station to receive instruction similar to the format given the the Pre-Sail Orientation but much more detailed and also actually doing it.

. Each group is rotated after spending approximately 1/2 hour at each station and completing a maneuver (either coming about or gybing) and setting the canoe on its new 'tack'.

. It was also ATTEMPTED but not really possible to have the canoe change its direction in respect to the wind and swell direction under the categories of 'close reach', 'beam reach', 'broad reach', and 'running free' to show the changes in sail setting and steering methods and techniques.

Bringing Canoe Back to Dock: Each group remains at assigned station except for group on Station 5 who prepare mooring lines.

. Whole crew participates in dropping sails, taking care of equipment, and cleaning Hōkūle'a.

POLYNESIAN VOYAGING SOCIETY

BOX 6037 / HONOLULU / HAWAII 96818 / (808) 841-3966

September 28, 1978

TO: MICHAEL A. TONGG

FROM: NAINOA THOMPSON

SUBJECT: NAVIGATION REPORT
September 1-15, 1978

- Class sessions with Will Kyselka at the Planetarium
- Refining and studying with previous data
- Observing and recording of data in night and day skies
- Reading of various texts

HAWAII TAHITI

CENTENNIAL VOYAGE OF REDISCOVERY
HOE AKU I KA WA'A

POLYNESIAN VOYAGING SOCIETY

BOX 6037 / HONOLULU / HAWAII 96818 / (808) 841-3966

September 6, 1978

TO: Michael A. Tongg

FROM: Nainoa Thompson

SUBJECT: Navigation Progress Report
August 15th - September 1st, 1978

1. Planetarium sessions with Will Kyselka
   a. More investigation of ideas
2. Observation of Heavens
   a. Sun's path of movement
   b. Star and Moon
3. Studying

HAWAII TAHITI

BICENTENNIAL VOYAGE OF REDISCOVERY
HOE AKU I KA WA'A

POLYNESIAN VOYAGING SOCIETY

BOX 6037 / HONOLULU / HAWAII 96818 / (808) 841-3966

August 24, 1978

TO: MICHAEL A. TONGG, PRESIDENT

FROM: NAINOA THOMPSON

SUBJECT: PROGRESS REPORT-NAVIGATION
August 1 - August 15, 1978

Academics:

Completed Kealaikeahiki article with Will Kyselka and Ray Lanterman

Continued sessions at the planetarium with Will Kyselka

Refinement of ideas within notebook

Field Work:

Day and nite observations of the heavens

* Continued work on equipment needed for navigational aids.

HAWAII TAHITI

'CENTENNIAL VOYAGE OF REDISCOVERY
HOE AKU I KA WA'A

POLYNESIAN VOYAGING SOCIETY

BOX 6037 / HONOLULU / HAWAII 96818 / (808) 841-3966

August 15, 1978

TO: Michael A. Tongg, President

FROM: Nainoa Thompson

SUBJECT: Navigation Progress Report
July 17-August 1, 1978

A. Developing a plan to organize my studies

B. Continued sessions at planetarium with Will Kyselka dealing with star paths. Sessions lasting two to three hours

C. Observations of heavens (on land) dealing with sessions at Planetarium

D. Working on reports:
1. "Star Navigation"
2. Kealaikahiki

E. Worked on equipment needed for future navigation study

HAWAII TAHITI

BICENTENNIAL VOYAGE OF REDISCOVERY
HOE A KU I KA WA'A

POLYNESIAN VOYAGING SOCIETY

BOX 6037 / HONOLULU / HAWAII 96818 / (808) 841-3966

July 17, 1978

TO: MICHAEL TONGG, PRESIDENT, PVS

FROM: NAINOA THOMPSON - NAVIGATOR

SUBJECT: PROGRESS REPORT
July 1 through July 15, 1978

A. ORGANIZAING A PLAN

A way of going about in an organized manner with the time available to learn about non-instrument navigation in specific terms of a round trip voyage between Hawaii and Tahiti, with the available resources.

B. PLANETARIUM SESSIONS

Meeting with Will Kyselka ten to twelve hours weekly at the planetarium. Discussing, researching and refining ideas, about the possible ways of non-instrument navigation.

Also needed was transcribing and documenting the research done at planetarium.

C. OBSERVATIONS OF THE HEAVENS

Day time observations - watching the sun's path at different time intervals.

Night time observations - Watching the stars, moon and planets in terms of their relationship with the research being done in the non-instrument navigation.

BICENTENNIAL VOYAGE OF REDISCOVERY
HOE AKU I KA WA'A

D. PREPARING EQUIPMENT FOR AIDING IN OBSERVING THE HEAVENS

1. A camper truck
2. A sea ray (24 feet) and also radio installation
3. Plans for possible double hull canoe

E. READING OF RELATED TEXTS IN NON-INSTRUMENT NAVIGATION

POLYNESIAN
VOYAGING SOCIETY

CERTIFICATION OF CREW

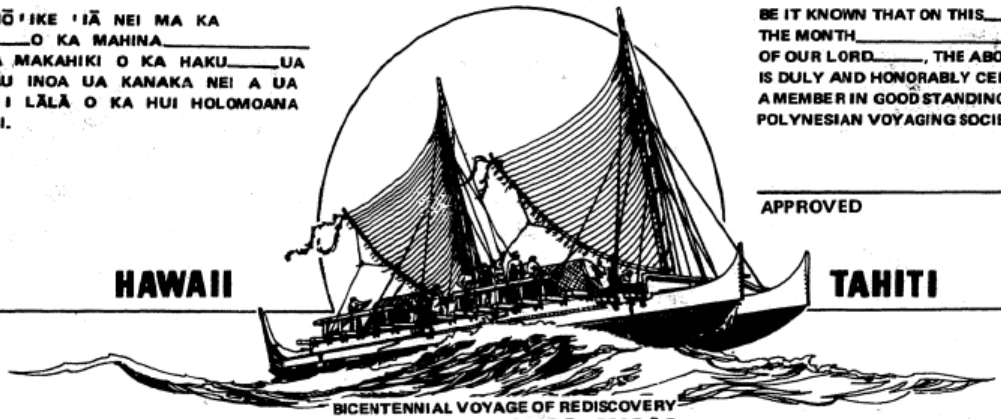
HEREBY APPOINTED TO

_____

IN THE RESPECTED POSITION OF

_____

KE HŌ'IKE 'IĀ NEI MA KA LĀ_____O KA MAHINA_____ O KA MAKAHIKI O KA HAKU_____UA KĀKAU INOA UA KANAKA NEI A UA LILO I LĀLĀ O KA HUI HOLOMOANA MAOLI.



BE IT KNOWN THAT ON THIS_____DAY OF THE MONTH_____OF THE YEAR OF OUR LORD_____, THE ABOVE MEMBER IS DULY AND HONORABLY CERTIFIED AS A MEMBER IN GOOD STANDING OF THE POLYNESIAN VOYAGING SOCIETY.

_____

APPROVED

HAWAII **TAHITI**

BICENTENNIAL VOYAGE OF REDISCOVERY

HOE AKU I KA WA'A

APPLICATION TO SAIL IN HAWAIIAN WATERS ABOARD HOKULEA

Here is an opportunity to gain, by personal experience, an awareness of the skills and attitudes of our Polynesian ancestors--the world's first ocean explorers and navigators.

Men and women of Hawaii who wish to sail aboard a performance-accurate replica of an ancient voyaging wa'a kaulua (double canoe) are invited to apply. During 1975 Hokulea will call at ports in Oahu, Kauai, Hawaii, Maui and Molokai. In each port scheduled sailing excursions and lectures will be held as well as special training for those who wish to learn ancient Hawaiian seamanship. Before departing, a crew of men and women will be selected for the voyage to the next port, where the program will be repeated. Those who are selected for these voyages are expected to contribute to provisioning costs and provide their own transportation home. All who sail aboard Hokulea must become members of the Polynesian Voyaging Society, and thus become part-owners of the vessel. ($2 if you're under 17, and $5 of you're older). The Society is a non-profit educational membership organization and all donations are tax-exempt. For members who are minors, applications to sail must also be signed by a parent or guardian.

Applicants will be notified of a selection of schedules. After a date is confirmed, those who do not show up will not be invited to sail again.

NAME: _____ SIGNATURE: _____
(please print)
(applicant will sail at his or her own risk)

SIGNATURE OF PARENT OR GUARDIAN (minors only): _____

ADDRESS: _____
(street) (town) (state) (zip)

PHONE: _____

For advance scheduling check your nearest port: ___Honolulu, ___Poka'i Bay, ___Kaneohe Bay, ___Hanalei, ___Wailua-Nawiliwili, ___Waimea, ___Hilo, ___Keauhou, ___Kailua-Kona, ___Kawaihae, ___Lahaina, ___Kaunakakai

Please check if you are interested in: ___supporting membership only, ___conducted sailing excursion, ___serious training

My choice of supporting membership:

- ____ $2 Aukukui (canoe maker apprentice) (under 17)
- ____ $5 Hoe wa'a (paddler)
- ____ $15 Holokahiki (sailor)
- ____ $25 Kalai wa'a (canoe maker)
- ____ $50 Uli (steersman)
- ____ $100 Ho'okele wa'a (navigator)
- ____ $250 Kahuna Kalai wa'a (canoe designer)
- ____ $500 A'o hoku (astronomer)
- ____ $1,000 Makua mea lokomaika'i (benefactor)

In 1976 a number of persons who made the port-to-port voyages in 1975 will be selected for intensive training of the 1976 Bicentennial Voyage to Tahiti and return. Since the Tahitian voyage will both recreate and celebrate the acheivements of the Polynesian navigators who first discovered and settled Hawaii, the Society is particularly interested in having Hawaiians of Polynesian ancestry make up the majority of the crew. Qualifications for the Tahiti voyage will be:

1.) A good heart: Aloha, good humor, generosity, and a charitable reguard for one's shipmates and for the canoe itself.
2.) Courage and strength: Mental and physical fortitude and endurance.
3.) Water skills: We prefer those who have an attitude of respect for the sea based on knowledge.
4.) Dedication.
5.) Maturity: Men and women who have had sufficient life experiences to enable them to endure unexpected difficulities.

As the crew committee, Polynesian Voyaging Society, we offer you a canoe and voyage. Aloha pumehana,

Herb Kawainui Kane | Charles Thomas Holmes | Kimo Hugo

Polynesian Voyaging Society, P.O. Box 6037 (Bishop Museum), Honolulu 96818

Herb Kane, [redacted]

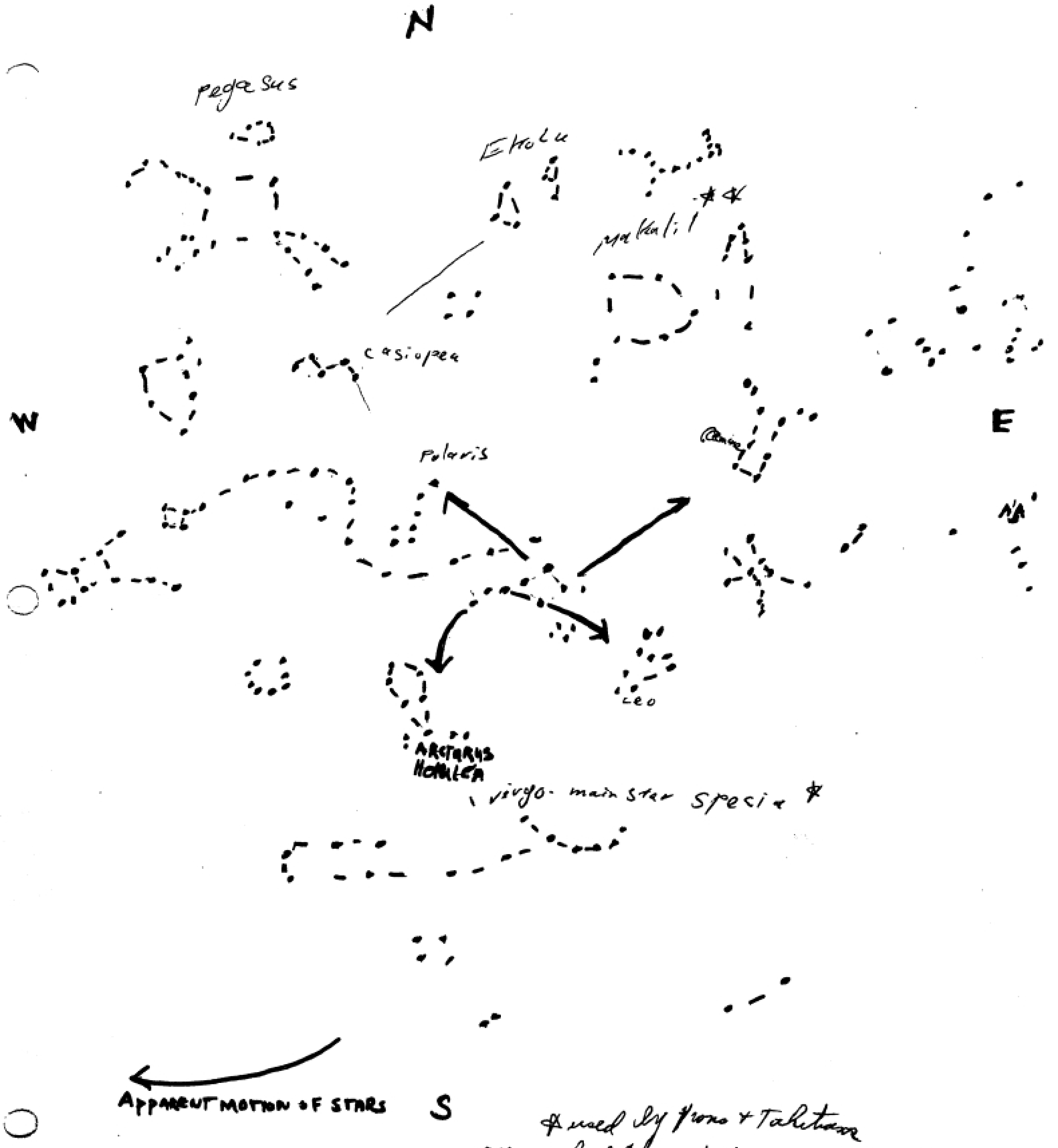
STEERING BY STARS AND THE SEA

The Planetarium of the Bishop Museum has become the first instrument of its kind to be used for teaching ancient Polynesian non-instrument navigation. For members of the Polynesian Voyaging Society, [redacted]. Louis Valier, Navigation Instructor at the Planetarium, has begun a series of lectures dealing with the movements of stars which can be used as directional guides and as latitude indicators during the experimental double-canoe voyage which will be made -- without instruments or charts -- round-trip to Tahiti in 1976. Working with members of the Society, a course of study will be developed this year which may be opened to the public at some future time.

After the new canoe is completed, navigation training will be continued at sea in Hawaiian waters. "Ground training" at the Planetarium will simulate the movements of useful stars which may be seen between Hawaii and Tahiti from March through July, the months of the voyage. Star charts from Stars over Hawaii, by E.H. Bryan, Jr., 1955 (out of print) will be used for this first phase of training.

The "compass" of the Polynesians was their knowledge of the rising and setting places of about 150 stars. As the canoe moves southward, these positions will shift. Therefore, after the navigation trainees have learned the rising and setting places of useful stars at the latitude of Hawaii, they will concentrate on how these positions will shift with changes of latitude.

FINDING CONSTELLATIONS USING CIRCUMPOLAR STARS



* used by ... + Tahitians
** Makalii / start on ... appear - horizon - -

Tai Crouch

Hokule'a Navigation Class

Course Outline

6 SEP 78 WEDS	Introduction Definition of Coastal Piloting Definition of Celestial Navigation Basic Navigational Terms
13 SEP 78 WEDS	The Chart Using the Chart with the Navigators Instruments Various Exercises The Magnetic Compass; methods of use, errors, and adjustments
20 SEP 78 WEDS	The Chart and Compass continued The Coast Pilot & The Pilot Charts The Light List & Local Notice to Mariners Tides, Currents, & Weather
27 SEP 78 WEDS	Coastal Piloting Review Celestial Navigation: Basic Overview & History Why does it work ? Sun, Moon, Planets, & Stars
4 OCT 78 WEDS	Coastal Line of Position vs. Celestial Circle of Position The Celestial Fix Problem #1 The Sun for Noon Latitude Problem #2 The Sun for Afternoon Line of Position (s) Problem #3 Using #1 & #2 to determine The Celestial Fix
11 OCT 78 WEDS	More Celestial Problems and Solutions: Using the Sun, Moon, Planets, and Stars
18 OCT 78 WEDS	A Day in the Life of a Navigator What to Pack if YOU are the Navigator How to do without certain pieces of equipment Special Navigational Situations Celestial Navigation Review

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All classes will begin at 7:00 p.m. on Wednesday evenings.

There will be at least one short quiz held during the course.

Our meeting place will be in the classroom building next to the Canoe Shop at the Kamehameha School.

Please call Steve Somsen at [redacted] at any time if you have any questions.

MARINE NAVIGATION: four types

1. Dead Reckoning
2. Coastal Piloting
3. Celestial Navigation
4. Electronic Navigation

THE EARTH: in the shape of a sphere

most accurate representation by a globe, but a globe is not a convenient item to store on a vessel.

THE CHART is most often used by the navigator. While it suffers some distortion, it does have definite advantages;

a. Can be stored flat
b. a course line will appear as a straight line on a Mercator chart.
c. distances can be measured using the latitude scale.

LATITUDE & LONGITUDE:

a grid system on the surface of the earth that can be used to describe any point on the earth.

parallels of latitude: all circles running around the earth in an east - west direction and parallel to the equator. measured north (and south) from the equator. equator is 0 degrees latitude north pole is 90 deg. N. lat.

meridians of longitude: these circles around the globe run in a north - south direction and are all considered "great circles". Any one line of longitude is a north - south line, but the lines are measured west (and east) from Greenwich, England. LINES OF LONGITUDE CAN NOT BE USED FOR MEASURE IN THE SAME WAY AS LATITUDE BECAUSE ALL LINES OF LONGITUDE CONVERGE TO A POINT AT THE NORTH (AND SOUTH) POLES.

LATITUDE & LONGITUDE for describing location:

examples: 38 deg. N. Lat, 122 deg. W. Long. = San Francisco
21 deg. N. Lat, 158 deg. W. Long. = Honolulu
22 deg. N. Lat, 115 deg. E. Long. = Hong Kong
18 deg. S. Lat, 149 deg. W. Long. = Tahiti

LATITUDE for measure:

1 degree of Latitude = 60 minutes of Lat. = 60 Naut. Miles
1 minute of Latitude = 1 Nautical Mile = 6080 feet
1 min. of Lat. = 60 seconds of Lat. = 1 Naut. Mile
1 min. of Lat. = 10 X .1 minute of Lat.
.1 minute of Latitude = .1 Nautical Mile = 608 feet

Symbols: degree °
minute '
second "

DEAD RECKONING: (originally from deduced reckoning)
a method of position determination using the following:

COURSE DIRECTION

SPEED of vessel (Speed & Direction of Wind & Current may have to be considered at times)

TIME TRAVELED

DISTANCE TRAVELED (from Speed & Time)

SPEED - TIME - DISTANCE formula:

SPEED = DISTANCE/TIME

TIME = DISTANCE/SPEED

DISTANCE = SPEED X TIME

examples: Travel for 3 hours at 5 Knots
What Distance? _____

OR

You have traveled 24 miles in 4 hours
What was your speed ? _____

DIRECTION: Circle = 360°
Half Circle = 180°
North = 000° and/or 360°
East = 090
South = 180
West = 270
North = 360

Use of Navigators Tools:

PROTRACTOR: for angles from 001 to 180 lay the straight edge of the protractor on your left and along any meridian of longitude. (OR USE YOUR PARALLEL RULE TO MAKE SURE THE PROTRACTOR IS ALIGNED NORTH AND SOUTH.)

for angles from 180 to 359 lay the straight edge of the protractor to your right and along any meridian of longitude. Then ADD 180 degrees to any reading that you have.

PARALLEL RULER: for transfering course lines to the "Compass Rose" located at various places on the chart. Also can be used with the protractor. See above.

PENCIL COMPASS: for measuring distances, usually distance traveled or the length of a proposed course line. Also can be used for drawing arcs of visibility for lighthouses.

EQUIPMENT LIST FOR THE NAVIGATOR

Coastal Navigation

On board the vessel	What to bring along as Navigator
Compass	Charts (study chart catalog)
Depth sounder or Lead line	Plotting Equipment:
Knotmeter or Log	Pencils (& erasers)
V.H.F. Radio:	Protractor
for local weather	Parallel Rules
for communication	Dividers
R.D.F.	Pencil Compass
	Watch
	Binoculars
	Hand Bearing Compass
	Light List
	Tide & Current Tables
	Coast Pilot
	Log Book

Celestial Navigation

On board the vessel	What to bring along as Navigator
All of the above	All of the above
plus	plus
Chronometer	Pilot Charts
Short Wave Radio:	Sextant
for time ticks	Nautical Almanac
for ocean wide weather	H.O. 249 (or H.O. 229)
Barometer	Worksheets
Spare Compass	Plotting Sheets
	List of Formula
	Thermometer
	"Bowditch"

Hokule'a Navigation Class

Required Materials

Sharpened pencil with a good eraser

Paper

Folder for notes and handouts

Pencil Compass

Protractor

CHART OF THE HAWAIIAN CHAIN #19004 (4102)	$ 3.25
PARALLEL RULERS	$ 6.95
CELESTIAL NAVIGATION BY H.O. 249 (textbook)	$ 4.00

Optional Materials

NAUTICAL ALMANAC FOR 1979	$ 7.50
H.O. 249 VOLUME II	$ 5.30
DIVIDERS, (Weems and Plath 6")	$ 6.25
NAUTICAL ALMANAC FOR 1978	$ 8.30

The above listed and priced materials appearing in CAPITAL LETTERS are available at:

Yacht Systems
1700 Ala Moana Blvd.
Honolulu, Hawaii

947-3722

(across from Kaiser Hospital, near the Ala Wai Boat Harbor)

Name: _____

NAVIGATION QUIZ

1. One degree of latitude equals _____. (What distance ?)

2. One minute of latitude equals _____. (What distance ?)

3. The approximate latitude and longitude location of Honolulu is :

   a. 38 deg. N. Lat., 122 deg. W. Long.
   b. 21 deg. S. Lat., 158 deg. W. Long.
   c. 21 deg. S. Lat., 158 deg. E. Long.
   d. 21 deg. N. Lat., 158 deg. W. Long.
   e. 21 deg. N. Lat., 158 deg. E. Long.

4. Which of the following is NOT correct ?

   a. North = 000
   b. West = 270
   c. East = 090
   d. Southeast = 135
   e. South = 180
   f. Northwest = 305
   g. North = 360

5. If the VARIATION was 011 degrees East and you wanted to steer a course of 180 degrees True, what would be the proper course to steer on your magnetic compass, assuming the DEVIATION was 000 degrees ?

   a. 169
   b. 180
   c. 191
   d. 011
   e. 000

6. Five knots means:

   a. five nautical miles in distance
   b. a speed of five nautical miles per hour
   c. a depth of thirty feet
   d. a speed of five nautical miles per day
   e. none of the above

7. A current that is said to "set" west is flowing from the west.

   a. true
   b. false

8. An occulting white light with a period of ten seconds would be abbreviated OCC 10 sec on the chart and at night you would actually see a light that:

   a. is on for ten seconds, then off
   b. is on for one second and off for nine seconds
   c. is on for nine seconds and off for one second
   d. flashes on once every ten seconds

9. A seabreeze is a _____ _____ flow of air caused by relatively _____ air moving towards land to replace warm air rising off the land.

   a. nighttime seaward ..... warm
   b. daytime landward ..... cool
   c. daytime seaward ..... warm
   d. nighttime landward..... cool

10. Using your hand bearing compass you determine that a bearing to Makapuu Point Lighthouse is 244 degrees Magnetic, and that a bearing to Molokai Light is 105 degrees Magnetic.
With this information, and with the use of the proper nautical chart, you will be able to determine which of the following ?

   a. The distance to the Molokai Light
   b. The position of your vessel
   c. The distance to Makapuu Point Lighthouse
   d. All of the above
   e. Only a and b
   f. None of the above

Please feel free to comment about the course in the space below. You might have a suggestion for an improvement or perhaps you might indicate some topic that you would especially like to have covered before the last week of class.

USE CHART # 19004, Hawaiian Islands, TO ANSWER THE FOLLOWING QUESTIONS:

1. What is the north - south length of the chart ? _____
2. What is the east - west length of the chart ? _____
3. Give the number of COASTAL lights or lighthouses on these islands:

Hawaii	_____
Molokini	_____
Maui	_____
Kahoolawe	_____
Lanai	_____
Molokai	_____
Oahu	_____
Kauai	_____
Niihau	_____
Lehua	_____

4. What is the latitude and longitude of Cape Kumukahi Light, Hawaii Island ?

   _____
5. What is the latitude and longitude of Kilauea Point Light, Kauai ?

   _____
6. What is the distance from Barbers Point Lt. to Diamond Head Lt., Oahu ?

   _____
7. One foot on this chart would equal how many feet on the earths surface ?

   _____
8. According to the list of abbreviations, what is the difference between the following letters used to describe lights or lighthouses ?

   F = _____
   Fl = _____
   Occ = _____
9. If you use one edge of your parallel ruler to line up the Eastern extremity of Molokai with the Western extremities of Maui and Kahoolawe, what conclusion can you come to about this particular alignment ? _____
10. What is the range of the light on the Kalaupapa Peninsula, Molokai ? _____
11. What is the water depth 20 miles South of Makapuu Pt. Lt. ? _____
12. What is the quality of the bottom just Southeast of that location ? _____
13. What is the color of the Flashing light at Lahaina, Maui ? _____
14. What is the name of the channel between Oahu and Molokai ? _____

TIME	ACTION &/OR LOCATION	COURSE	DISTANCE
1500	Depart Hilo Harbor Entrance Lighted Bell Buoy, # 1. Fl. G. 2.5 sec light	011 T	15 miles
1800	D.R. & Course Change	293 T	11.3 miles
2015	D.R. Laupahoehoe Point Light on beam, Fl. W. 2.5 sec light	293 T	21.2 miles
0030	FIX Bearing 164.5 M to Kukuihaele Pt. Lt. Bearing 271 M to Kauhola Pt. Lt.	293 T	53 miles
1106	D.R. & Course Change: Hanamanaioa Lt. on beam (S of Kanahena)	333.5 T	6 miles
1218	D.R. & Course Change: Molokini Lt. on beam	353 T	9 miles
1406	Anchored Maalaea Bay	-	

In this problem we will assume a speed of 5 knots.

QUESTIONS:

1. Assuming that your 1800 DR is correct, how far are you from shore ? _____
2. Assuming that your 2015 DR is correct, how far are you from shore ? _____
3. At your 0030 FIX, what is the distance to Kukuihaele Lt.? _____
4. At your 0030 FIX, what is the water depth ? _____
5. Assuming that your 1106 DR is correct, you should be on or near what depth curve ? _____.
6. What is the water depth at your anchorage in Maalaea Bay ? _____
7. What is the meridian of longitude at your anchorage ? _____

NOTE: Use pencil only on your chart, plot all lines as neatly as you can.
Remember the RECIPROCAL of any direction is different by 180 degrees.
When measuring course lines or bearing lines with a protractor, you can extend the line until it crosses either a line of longitude or latitude for better reference.

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8. What was the total elapsed time of the trip ? _____
9. What was the total distance traveled ? _____

CELESTIAL NAVIGATION WORKSHEET

In working with the sextant, you will be measuring the height of a celestial body like the sun, in a number of degrees above the horizon. The reading from the sextant will be called H_s or the Height as measured by the sextant. As you will see there are a number of corrections that will have to be applied to the H_s before it can be used in finding our position at sea. The first correction is for the sextant itself. It is normally called I.C. for Index Correction. The second correction is for DIP or the height of eye. This refers to the height your eye is above the horizon at the time you use the sextant. In this first situation, let us assume that there is no Index Correction. But let's see what the various corrections will be in the following cases.

ANSWERS in Milligan Text Page 17, figure 13 OR in Nautical Almanac.

Find the "Height of eye" or "DIP" correction for the following. Assume that your height of eye above sea level is :

Height of Eye	Correction
12 feet	- 3.4'
10 feet	_____
20 feet	_____
6 meters	_____
2 meters	_____
4 feet	_____

By applying the corrections of I.C. and DIP to the H_s we get the H_a or the apparent Height. We need to apply a further correction for refraction. Let us assume we are dealing with the sun in September. If we "shoot" the "lower limb" of the sun what is the correction if the H_a is:
ANSWERS: Milligan text page 18.

H_a	Correction
84° 57.3'	+ 15.8'
51° 14.1'	_____
37° 38.0'	_____
19° 20.0'	_____
46° 11.0'	_____
27° 09.3'	_____

By applying this correction to our H_a we can now get the correct and true Observed Height or H_o. An example:

Height of sun as measured by sextant	H_s	75° 12.1'
allowing for no I.C. but a height of eye of 10 feet	I.C./DIP	- 3.1'
	H_a	75° 09.0'
correction for refraction	corrn	+ 15.7'
Height of sun as actually observed	H_o	75° 24.7'

Now let's determine the G.H.A. (Greenwich Hour Angle) of the Sun for the following whole hours of G.M.T. (Greenwich Mean Time). Assume the year is 1972. ANSWERS in Milligan Text: pages 48 & 49, figures 30 & 31.

GMT	GHA Sun
Aug. 20th 1100 hours	344° 10.5'
Aug. 21st 1900 hours	
Aug. 19th 0000 hours	
Aug. 19th 1200 hours	
Aug. 21st 2200 hours	

Now let's try it to the minute and the second. All you need to do is to consult the page entitled "increments and Corrections" for the appropriate extra minute and second under the column: Sun & Planets. Simply add what you find there to the value given for the whole hour of GMT. (ignore for now the column labeled "DEC.")

GMT	GHA Sun	DEC
Aug. 19 day 17 hr 41 min 24 sec	84° 28.8'	
Aug. 21 day 23 hr 40 min 02 sec		
Aug. 19 day 03 hr 40 min 51 sec		
Aug. 20 day 19 hr 41 min 18 sec		

Using the same dates and times listed above, determine the DEC or declination of the Sun. The Declination will either be North or South, so be sure to indicate that too. All that is required here is to find the DEC for the whole hour and then add (or subtract) the "d" value as indicated at the bottom of the daily column and then inspecting the appropriate "minute" page under increments and corrections to see what value should actually be added or subtracted. You will know whether or not to add or subtract simply by checking the next whole hour of GMT to see if the DEC value is getting larger or smaller. If it is getting larger then add the "d" value.

Bonus Questions:

1. What is the time of sunrise at 10 degrees North Latitude on August 20th ?
2. How "old" is the moon in days on the 19th of August ?
3. What is the time of sunset at 60 degrees South Latitude on Aug. 21st?

SHIP _____ VOYAGE _____ DATE _____

COURSE _____ WIND DIR. _____ FORCE _____ MADE GOOD _____

LOG _____ WEATHER _____ LAST TOTAL _____

Index Corr ____' | Dead Reckoned Lat. ° ' | TRUE LAT. ° ' | NEW TOTAL _____

" " Long. ° ' | " LONG. ° ' | MILES TO GO _____

H.E. ____ BODY _____	H.E. ____ BODY _____	H.E. ____ BODY _____
H_s ° '	H_s ° '	H_s ° '
I.C. & H.E. '	I.C. & H.E. '	I.C. & H.E. '
H_a ° '	H_a ° '	H_a ° '
corr. '	corr. '	corr. '
H_o ° '	H_o ° '	H_o ° '

TIMES OF OBSERVATIONS

CHRON. d h m s	CHRON. d h m s	CHRON. d h m s
corr. slow + / fast − s	corr. slow + / fast − s	corr. slow + / fast − s
GMT d h m s	GMT d h m s	GMT d h m s

From Nautical Almanac DECLINATIONS OF BODIES

Month, Day & Hour	Month, Day & Hour	Month, Day & Hour
Code d= Corr. ± ° '	Code d= Corr. ± ° '	Code d= Corr. ± ° '
DEC. when Obsv'd ° '	DEC. when Obsv'd ° '	DEC. when Obsv'd ° '

RULE FOR LHA: West Long. GHA − Long. In East Long, GHA + Long. At Noon: GHA = Long and LHA = C

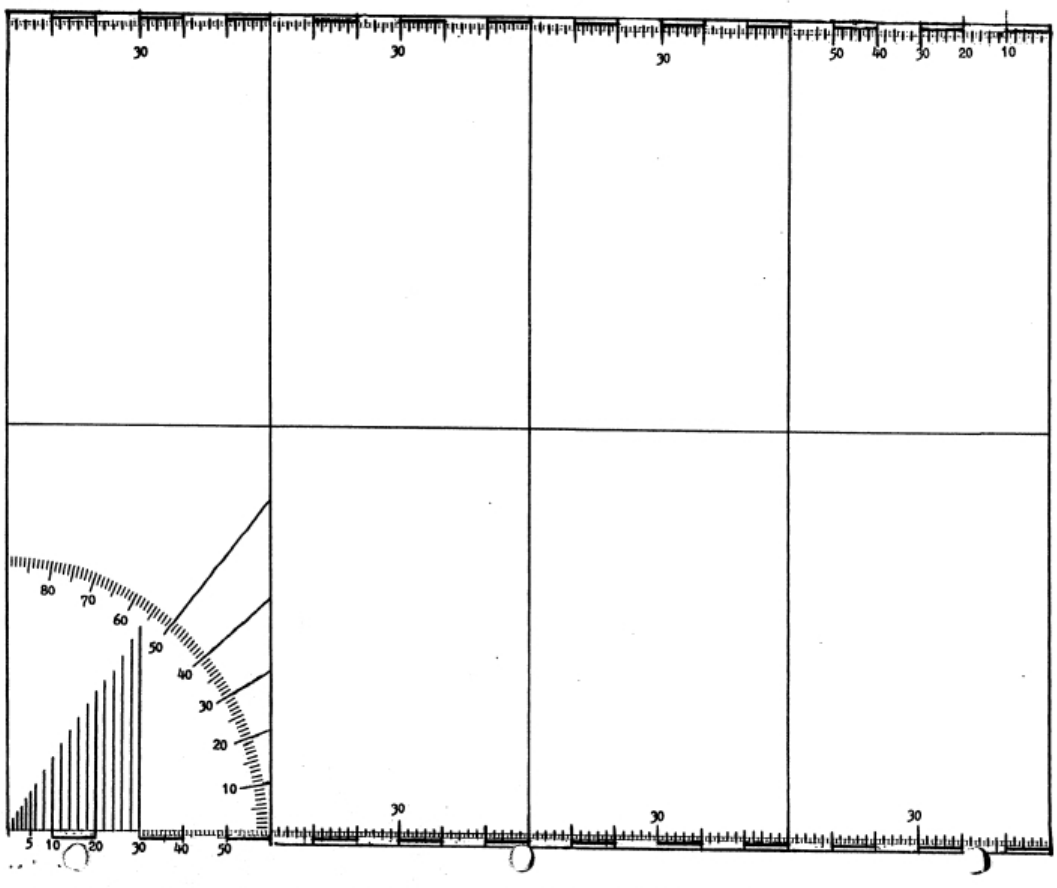
GHA Day & Hour ° '	GHA Day & Hour ° '	GHA Day & Hour ° '
From Almanac Min & Sec ° '	*From Almanac* Min & Sec ° '	*From Almanac* Min & Sec ° '
SHA + /γ corr ° '	SHA + /γ corr ° '	SHA + /γ corr ° '
GHA ° '	GHA ° '	GHA ° '
If needed, ±360° °	If needed, ±360° °	If needed, ±360° °
GHA ° '	GHA ° '	GHA ° '
Assumed Long ° '	Assumed Long ° '	Assumed Long ° '
From HO 249 LHA ° 00'	From HO 249 LHA ° 00 '	From HO 249 LHA ° 00 '
Same or Assm'd Lat ° N S	Same or Assm'd Lat ° N S	Same or Assm'd Lat ° N S
Contrary " Dec ° N S	Contrary " Dec ° N S	Contrary " Dec ° N S
Dec. diff. '	Dec. diff '	Dec. diff. '

H_c ° ' d Z	H_c ° ' d Z	H_c ° ' d Z
corr. + / − '	corr. + / − '	corr. + / − '
H_c ° '	H_c ° '	H_c ° '
H_o − ° '	H_o − ° '	H_o − ° '
Mi. + Away − Toward	Mi. + Away − Toward	Mi. + Away − Toward

H.E. ____ BODY _____	LAT. FORMULA* 89 ° 60 '	D.R. Long. ° '
H_s ° '	Subtract H_c − ° '	Nearest GHA in Almanac − ° ' = h GMT
I.C. & H.E. '	Zenith Dist. ° '	Difference ° ' nearest minutes m
H_a ° '	DEC ± ° '	Zone Time E. Long + / W. Long − h m
corr. '	LATITUDE ° '	TIME OF LOCAL NOON = h m
H_o ° '		

* *In SOUTH LATITUDES, Add Declination when sign is − in Almanac and Subtract it when sign is + in Almanac.*

Plotting Worksheet



USE CHART # 19004, Hawaiian Islands, TO ANSWER THE FOLLOWING QUESTIONS:

1. What is the north - south length of the chart ? _____

2. What is the east - west length of the chart ? _____

3. Give the number of COASTAL lights or lighthouses on these islands:

Hawaii	_____
Molokini	_____
Maui	_____
Kahoolawe	_____
Lanai	_____
Molokai	_____
Oahu	_____
Kauai	_____
Niihau	_____
Lehua	_____

4. What is the latitude and longitude of Cape Kumukahi Light, Hawaii Island ?

_____

5. What is the latitude and longitude of Kilauea Point Light, Kauai ?

_____

6. What is the distance from Barbers Point Lt. to Diamond Head Lt., Oahu ?

_____

7. One foot on this chart would equal how many feet on the earths surface ?

_____

8. According to the list of abbreviations, what is the difference between the following letters used to describe lights or lighthouses ?

F = _____
Fl = _____
Occ = _____

9. If you use one edge of your parallel ruler to line up the Eastern extremity of Molokai with the Western extremities of Maui and Kahoolawe, what conclusion can you come to about this particular alignment ? _____

10. What is the range of the light on the Kalaupapa Peninsula, Molokai ? _____

11. What is the water depth 20 miles South of Makapuu Pt. Lt. ? _____

12. What is the quality of the bottom just Southeast of that location ? _____

13. What is the color of the Flashing light at Lahaina, Maui ? _____

14. What is the name of the channel between Oahu and Molokai ? _____

SHIP _____ VOYAGE _____ DATE _____

COURSE _____ WIND DIR. _____ FORCE _____ MADE GOOD _____

LOG _____ WEATHER _____ LAST TOTAL _____

Index Corr ____' | Dead Reckoned Lat. N 21° 17' | TRUE LAT. ° ' | NEW TOTAL _____

" " Long. W 157° 5' | " LONG. ° ' | MILES TO GO _____

	H.E. -3.1' BODY ☉	H.E. ____' BODY _____	H.E. ____' BODY _____
H_s	46° 58.5'	° '	° '
I.C. & H.E.	3.1'	'	'
H_a	46° 55.4'	° '	° '
corr.	15.3'	'	'
H_o	47° 10.7'	° '	° '

MAR (1)

TIMES OF OBSERVATIONS

	d h m s	d h m s	d h m s
CHRON.			
corr. slow + / fast −	s	s	s
GMT	4 0 56 1		

From Nautical Almanac — DECLINATIONS OF BODIES

Month, Day & Hour			
Code d= Corr.	± '	± '	± '
DEC. when Obsv'd	° '	° '	° '

RULE FOR LHA: West Long. GHA −Long. In East Long. GHA + Long. At Noon. GHA = Long and LHA = 0

GHA Day & Hour	° '	° '	° '
From Almanac Min & Sec	° '	° '	° '
SHA ● /♈ corr	° '	° '	° '
GHA	° '	° '	° '
If needed, ±360°	°	°	°
GHA	° '	° '	° '
Assumed Long	° '	° '	° '
From HO 249 LHA	° 00'	° 00'	° 00'
Same or Assm'd Lat	° N S	° N S	° N S
Contrary " Dec	° N S	° N S	° N S
Dec. diff.	'	'	'

	H_c d Z	H_c d Z	H_c d Z
corr. + −	° '	° '	° '
H_c	° '	° '	° '
H_o −			
	Mi. + Away − Toward	Mi. + Away − Toward	Mi. + Away − Toward

H.E. ____ BODY _____		LAT. FORMULA*	89° 60'
H_s	° '	Subtract H_c	− ° '
I.C. & H.E.	'	Zenith Dist.	° '
H_a	° '	DEC + −	° '
corr.	'	LATITUDE	° '
H_o	° '		

D.R. Long. ° ' Nearest GHA in Almanac ° ' = h GMT

Difference ° ' nearest minutes m

Zone Time E. Long + / W. Long − h m

TIME OF LOCAL NOON = h m

* In SOUTH LATITUDES, Add Declination when sign is − in Almanac and Subtract it when sign is + in Almanac.

Const Pilot

I. General info.
II. Navigation Reg.
XIV. Hawaii
Appendix
Tables.

SHIP _____ VOYAGE _____ DATE _____

COURSE _____ WIND DIR. _____ FORCE _____ MADE GOOD _____

LOG _____ WEATHER _____ LAST TOTAL _____

Index Corr ____' | Dead Reckoned Lat. N21° 17' | TRUE LAT. ° ' | NEW TOTAL _____

" " Long. W157° 5' | " LONG. ° ' | MILES TO GO _____

H.E. -31' BODY ☉	H.E. ____' BODY _____	H.E. ____' BODY _____
H_s 46° 58.5'	H_s ° '	H_s ° '
I.C. & H.E. 3.1'	I.C. & H.E. '	I.C. & H.E. '
H_a 46° 55.4'	H_a ° '	H_a ° '
corr. 15.3'	corr. '	corr. '
MAR (.) H_o 47° 10.7'	H_o ° '	H_o ° '
TIMES OF OBSERVATIONS		
CHRON. d h m s	CHRON. d h m s	CHRON. d h m s
corr. slow + fast − s	corr. slow + fast − s	corr. slow + fast − s
GMT 9 0 56	GMT d h m s	GMT d h m s
From Nautical Almanac DECLINATIONS OF BODIES		
Month, Day & Hour	Month, Day & Hour	Month, Day & Hour
Code d= Corr. ± '	Code d= Corr. ± '	Code d= Corr. ± '
DEC. when Obsv'd ° '	DEC. when Obsv'd ° '	DEC. when Obsv'd ° '
RULE FOR LHA: West Long. GHA −Long. In East Long. GHA + Long. At Noon. GHA = Long and LHA = 0		
GHA Day & Hour ° '	GHA Day & Hour ° '	GHA Day & Hour ° '
From Almanac Min & Sec ° '	From Almanac Min & Sec ° '	From Almanac Min & Sec ° '
SHA + /v corr ° '	SHA + /v corr ° '	SHA + /v corr ° '
GHA ° '	GHA ° '	GHA ° '
If needed, ±360° °	If needed, ±360° °	If needed, ±360° °
GHA ° '	GHA ° '	GHA ° '
Assumed Long ° '	Assumed Long ° '	Assumed Long ° '
From HO 249 LHA ° 00'	From HO 249 LHA ° 00'	From HO 249 LHA ° 00'
Same or Assm'd Lat ° N S	Same or Assm'd Lat ° N S	Same or Assm'd Lat ° N S
Contrary " Dec ° N S	Contrary " Dec ° N S	Contrary " Dec ° N S
Dec. diff. '	Dec. diff '	Dec. diff. '
H_c d Z	H_c d Z	H_c d Z
corr. + − '	corr. + − '	corr. + − '
H_c ° '	H_c ° '	H_c ° '
H_o − ° '	H_o − ° '	H_o − ° '
Mi. + Away − Toward	Mi. + Away − Toward	Mi. + Away − Toward
H.E. ____' BODY _____	LAT. FORMULA* 89° 60'	D.R. Long. ° '
H_s ° '	Subtract H_c − ° '	Nearest GHA in Almanac − ° ' = h GMT
I.C. & H.E. '	Zenith Dist. ° '	Difference ° ' nearest minutes m
H_a ° '	DEC + − ° '	Zone Time E. Long + W. Long − h m
corr. '	* LATITUDE ° '	TIME OF LOCAL NOON = h m
H_o ° '		

In SOUTH LATITUDES, Add Declination when sign is − in Almanac and Subtract it when sign is + in Almanac.

Page 2 Z 90°

Term: on the meridion

12 GMT	2200 GMT
02 HST	1200 HST

For Hawaii add 10 hrs. to obtain what time in Greenwich.

15° longitude = 1 hr. of time
Therefore 1° longitude / 4 minutes
Sun is directly over on the meridion at 12 noon but another 36 minutes to get overhead in Honolulu.
GHA measured west of greenwich
" starts from 0 and increased to 360°
Declination of stars remain constant throughout year where sun varies every 6 mos.
Pg. 99 shows latitude formula.
Lat = 90° − observed (corrected reading) of sextant
+ same or − contrary declination

Errors with sextant

H_s height of sun taken by a sextant

Index correction inherent errors w/ sextant

Dip or H.E. height of eye correction

H_s 61°

Index corr. (0)

Dip(10') − 3.1'

H_a 60° 56.9' H_a apparent height

Example of refraction correction p. 18 of text

+ 15.4

61° 12.3'

p. 17 gives Dip corrections

Bring text

21°N Lat 158 W Long
← always first

MARINE NAVIGATION: four types

deduced reckoning

1. Dead Reckoning
2. Coastal Piloting
3. Celestial Navigation
4. Electronic Navigation

THE EARTH: in the shape of a sphere

most accurate representation by a globe, but a globe is not a convenient item to store on a vessel.

THE CHART is most often used by the navigator. While it suffers some distortion, it does have definite advantages;

a. Can be stored flat
b. a course line will appear as a straight line on a Mercator chart.
c. distances can be measured using the latitude scale.

LATITUDE & LONGITUDE:

a grid system on the surface of the earth that can be used to describe any point on the earth.

parallels of latitude: all circles running around the earth in an east - west direction and parallel to the equator. measured north (and south) from the equator. equator is 0 degrees latitude north pole is 90 deg. N. lat.

meridians of longitude: these circles around the globe run in a north - south direction and are all considered "great circles". Any one line of longitude is a north - south line, but the lines are measured west (and east) from Greenwich, England. LINES OF LONGITUDE CAN NOT BE USED FOR MEASURE IN THE SAME WAY AS LATITUDE BECAUSE ALL LINES OF LONGITUDE CONVERGE TO A POINT AT THE NORTH (AND SOUTH) POLES.

LATITUDE & LONGITUDE for describing location:

examples: 38 deg. N. Lat, 122 deg. W. Long. = San Francisco
21 deg. N. Lat, 158 deg. W. Long. = Honolulu
22 deg. N. Lat, 115 deg. E. Long. = Hong Kong
18 deg. S. Lat, 149 deg. W. Long. = Tahiti

LATITUDE for measure:

1 degree of Latitude = 60 minutes of Lat. = 60 Naut. Miles
1 minute of Latitude = 1 Nautical Mile = 6080 feet
1 min. of Lat. = 60 seconds of Lat. = 1 Naut. Mile
1 min. of Lat. = 10 X .1 minute of Lat.
.1 minute of Latitude = .1 Nautical Mile = 608 feet

Symbols: degree °
minute '
second "

Knots = nautical miles per hour

DEAD RECKONING: (originally from deduced reckoning)
a method of position determination using the following:

COURSE DIRECTION

SPEED of vessel (Speed & Direction of Wind & Current may have to be considered at times)

TIME TRAVELED

DISTANCE TRAVELED (from Speed & Time)

SPEED - TIME - DISTANCE formula:

Traveling 3 hrs at Speed of 5 Knots.

SPEED = DISTANCE/TIME
TIME = DISTANCE/SPEED
DISTANCE = SPEED X TIME

examples: Travel for 3 hours at 5 Knots
What Distance? 15 knots

OR

You have traveled 24 miles in 4 hours
What was your speed ? 6 knots.

DIRECTION: Circle = 360°
Half Circle = 180°
North = 000° and/or 360°
East = 090
South = 180
West = 270
North = 360

Use of Navigators Tools:

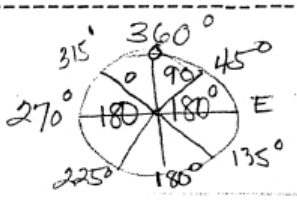
PROTRACTOR: for angles from 001 to 180 lay the straight edge of the protractor on your left and along any meridian of longitude. (OR USE YOUR PARALLEL RULE TO MAKE SURE THE PROTRACTOR IS ALIGNED NORTH AND SOUTH.)

for angles from 180 to 359 lay the straight edge of the protractor to your right and along any meridian of longitude. Then ADD 180 degrees to any reading that you have.

PARALLEL RULER: for transfering course lines to the "Compass Rose" located at various places on the chart. Also can be used with the protractor. See above.

PENCIL COMPASS: for measuring distances, usually distance traveled or the length of a proposed course line. Also can be used for drawing arcs of visibility for lighthouses.

Reciprocal —



Straight up is true — right up to North Pole.

Arc	Time
0	Hours
′	Min
″	Sec.

Lines of Position

CELESTIAL NAVIGATION WORKSHEET

In working with the sextant, you will be measuring the height of a celestial body like the sun, in a number of degrees above the horizon. The reading from the sextant will be called H_S or the Height as measured by the sextant. As you will see there are a number of corrections that will have to be applied to the H_S before it can be used in finding our position at sea. The first correction is for the sextant itself. It is normally called I.C. for Index Correction. The second correction is for DIP or the height of eye. This refers to the height your eye is above the horizon at the time you use the sextant. In this first situation, let us assume that there is no Index Correction. But let's see what the various correction s will be in the following cases.

ANSWERS in Milligan Text Page 17, figure 13 OR in Nautical Almanac.

Find the "Height of eye" or "DIP" correction for the following. Assume that your height of eye above sea level is :

Height of Eye	Correction
12 feet	- 3.4'
10 feet	
20 feet	
6 meters	
2 meters	
4 feet	

By applying the corrections of I.C. and DIP to the H_S we get the H_a or the apparent Height. We need to apply a further correction for refraction. Let us assume we are dealing with the sun in September. If we "shoot" the "lower limb" of the sun what is the correction if the H_a is:
ANSWERS: Milligan text page 18.

H_a	Correction
84° 57.3'	+ 15.8'
51° 14.1'	
37° 38.0'	
19° 20.0'	
46° 11.0'	
27° 09.3'	

By applying this correction to our H_a we can now get the correct and true Observed Height or H_o. An example:

Height of sun as measured by sextant allowing for no I.C. but a height of eye of 10 feet	H_S	75° 12.1'
	I.C./DIP	- 3.1'
	H_a	75° 09.0'
correction for refraction	corr'n	+ 15.7'
Height of sun as actually observed	H_o	75° 24.7'

Now let's determine the G.H.A. (Greenwich Hour Angle) of the Sun for the following whole hours of G.M.T. (Greenwich Mean Time). Assume the year is 1972. ANSWERS in Milligan Text: pages 48 & 49, figures 30 & 31.

GMT	GHA Sun
Aug. 20th 1100 hours	344° 10.5'
Aug. 21st 1900 hours	
Aug. 19th 0000 hours	
Aug. 19th 1200 hours	
Aug. 21st 2200 hours	

Now let's try it to the minute and the second. All you need to do is to consult the page entitled "increments and Corrections" for the appropriate extra minute and second under the column: Sun & Planets. Simply add what you find there to the value given for the whole hour of GMT. (ignore for now the column labeled "DEC.")

GMT	GHA Sun	DEC
Aug. 19 day 17 hr 41 min 24 sec	84° 28.8'	
Aug. 21 day 23 hr 40 min 02 sec		
Aug. 19 day 03 hr 40 min 51 sec		
Aug. 20 day 19 hr 41 min 18 sec		

Using the same dates and times listed above, determine the DEC or declination of the Sun. The Declination will either be North or South, so be sure to indicate that too. All that is required here is to find the DEC for the whole hour and then add (or subtract) the "d" value as indicated at the bottom of the daily column and then inspecting the appropriate "minute" page under increments and corrections to see what value should actually be added or subtracted. You will know whether or not to add or subtract simply by checking the next whole hour of GMT to see if the DEC value is getting larger or smaller. If it is getting larger then add the "d" value.

Bonus Questions:

1. What is the time of sunrise at 10 degrees North Latitude on August 20th ?

2. How "old" is the moon in days on the 19th of August ?

3. What is the time of sunset at 60 degrees South Latitude on Aug. 21st?

Name: jolene

NAVIGATION QUIZ

1. One degree of latitude equals 60. (What distance ?)

2. One minute of latitude equals 60. (What distance ?)

3. The approximate latitude and longitude location of Honolulu is :

   a. 38 deg. N. Lat., 122 deg. W. Long.
   b. 21 deg. S. Lat., 158 deg. W. Long.
   c. 21 deg. S. Lat., 158 deg. E. Long.
   d. 21 deg. N. Lat., 158 deg. W. Long.
   (e). 21 deg. N. Lat., 158 deg. E. Long.

4. Which of the following is NOT correct ?

   a. North = 000
   b. West = 270
   c. East = 090
   d. Southeast = 135
   e. South = 180
   (f) Northwest = 305
   g. North = 360

5. If the VARIATION was 011 degrees East and you wanted to steer a course of 180 degrees True, what would be the proper course to steer on your magnetic compass, assuming the DEVIATION was 000 degrees ?

   a. 169
   b. 180
   c. 191
   (d). 011
   e. 000

6. Five knots means:

   a. five nautical miles in distance
   (b). a speed of five nautical miles per hour
   c. a depth of thirty feet
   d. a speed of five nautical miles per day
   e. none of the above

7. A current that is said to "set" west is flowing from the west.

   a. true
   (b) false

8. An occulting white light with a period of ten seconds would be abbreviated OCC 10 sec on the chart and at night you would actually see a light that:

   a. is on for ten seconds, then off
   b. is on for one second and off for nine seconds
   (c). is on for nine seconds and off for one second
   d. flashes on once every ten seconds

9. A seabreeze is a _____ _____ flow of air caused by relatively _____ air moving towards land to replace warm air rising off the land.

   a. nighttime seaward ..... warm
   b. daytime landward ..... cool
   c. daytime seaward ..... warm
   d. nighttime landward..... cool

10. Using your hand bearing compass you determine that a bearing to Makapuu Point Lighthouse is 244 degrees Magnetic, and that a bearing to Molokai Light is 105 degrees Magnetic.
With this information, and with the use of the proper nautical chart, you will be able to determine which of the following ?

   a. The distance to the Molokai Light
   b. The position of your vessel
   c. The distance to Makapuu Point Lighthouse
   d. All of the above
   e. Only a and b
   f. None of the above

Please feel free to comment about the course in the space below. You might have a suggestion for an improvement or perhaps you might indicate some topic that you would especially like to have covered before the last week of class.

TIME	ACTION &/OR LOCATION	COURSE	DISTANCE
1500	Depart Hilo Harbor Entrance Lighted Bell Buoy, # 1. Fl. G. 2.5 sec light	011 T	15 miles
1800	D.R. & Course Change	293 T	11.3 miles
2015	D.R. Laupahoehoe Point Light on beam, Fl. W. 2.5 sec light	293 T	21.2 miles
0030	FIX Bearing 164.5 M to Kukuihaele Pt. Lt. Bearing 271 M to Kauhola Pt. Lt.	293 T	53 miles
1106	D.R. & Course Change: Hanamanaioa Lt. on beam (S of Kanahena)	333.5 T	6 miles
1218	D.R. & Course Change: Molokini Lt. on beam	353 T	9 miles
1406	Anchored Maalaea Bay	-	

In this problem we will assume a speed of 5 knots.

QUESTIONS:

1. Assuming that your 1800 DR is correct, how far are you from shore ? _____
2. Assuming that your 2015 DR is correct, how far are you from shore ? _____
3. At your 0030 FIX, what is the distance to Kukuihaele Lt.? _____
4. At your 0030 FIX, what is the water depth ? _____
5. Assuming that your 1106 DR is correct, you should be on or near what depth curve ? _____.
6. What is the water depth at your anchorage in Maalaea Bay ? _____
7. What is the meridian of longitude at your anchorage ? _____

NOTE: Use pencil only on your chart, plot all lines as neatly as you can.

Remember the RECIPROCAL of any direction is different by 180 degrees.

When measuring course lines or bearing lines with a protractor, you can extend the line until it crosses either a line of longitude or latitude for better reference.

---

8. What was the total elapsed time of the trip ? _____
9. What was the total distance traveled ? _____

Name: Willem Waylani Bell

NAVIGATION QUIZ

1. One degree of latitude equals 60 (true, but ⟶ (What distance ?)

2. One minute of latitude equals 60 (true, but ⟶ (What distance ?)

3. The approximate latitude and longitude location of Honolulu is :

   a. 38 deg. N. Lat., 122 deg. W. Long.
   b. 21 deg. S. Lat., 158 deg. W. Long.
   c. 21 deg. S. Lat., 158 deg. E. Long.
   → d. 21 deg. N. Lat., 158 deg. W. Long. (158 degrees west of Greenwich, England)
   e. 21 deg. N. Lat., 158 deg. E. Long.

4. Which of the following is NOT correct ?

   a. North = 000
   b. West = 270
   c. East = 090
   d. Southeast = 135
   e. South = 180
   f. Northwest = 305
   g. North = 360

5. If the VARIATION was 011 degrees East and you wanted to steer a course of 180 degrees True, what would be the proper course to steer on your magnetic compass, assuming the DEVIATION was 000 degrees ?

   → a. 169
   b. 180
   c. 191
   d. 011
   e. 000

   ↓ DOWN ADD WEST

   T 180°
   V 011° EAST
   M 169°
   D 000°
   C 169°

   ↑ UP ADD EAST

6. Five knots means:

   a. five nautical miles in distance
   b. a speed of five nautical miles per hour
   c. a depth of thirty feet
   d. a speed of five nautical miles per day
   e. none of the above

7. A current that is said to "set" west is flowing from the west.

   a. true
   b. false

8. An occulting white light with a period of ten seconds would be abbreviated OCC 10 sec on the chart and at night you would actually see a light that:

   a. is on for ten seconds, then off
   b. is on for one second and off for nine seconds
   → c. is on for nine seconds and off for one second an example is MAKAPUU POINT LIGHT.
   d. flashes on once every ten seconds

9. A seabreeze is a _____ _____ flow of air caused by relatively _____ air moving towards land to replace warm air rising off the land.

a. nighttime seaward ..... warm
(b) daytime landward ..... cool
c. daytime seaward ..... warm
d. nighttime landward..... cool

10. Using your hand bearing compass you determine that a bearing to Makapuu Point Lighthouse is 244 degrees Magnetic, and that a bearing to Molokai Light is 105 degrees Magnetic.
With this information, and with the use of the proper nautical chart, you will be able to determine which of the following ?

a. The distance to the Molokai Light
b. The position of your vessel
c. The distance to Makapuu Point Lighthouse
(d.) All of the above
e. Only a and b
f. None of the above

(7)

Please feel free to comment about the course in the space below. You might have a suggestion for an improvement or perhaps you might indicate some topic that you would especially like to have covered before the last week of class.

Sept 8th — Hilo
Sat 9th Hilo to Hamakua Coastline
Camp for 3 days in Waipio Valley

Wed or Thurs depending on weather — fly to Maui — explore Maui coastline

~~Fri - Sat Sun~~ — Molokai — Sun. exp c.l.

may go to Kahoolawe or Lanai

Sun — Sun — Molokai - Lanai - Kahoolawe

Hakio —

paper will know about it after Hana

map - Kahanuikaha

lips closed to

Top of lecture

Why Celestial works because stars planets rise in east set in west due to globe shape and rotation

1 Dead Reckoning
must know where you are to start with

2 Height or angle of sun above horizon

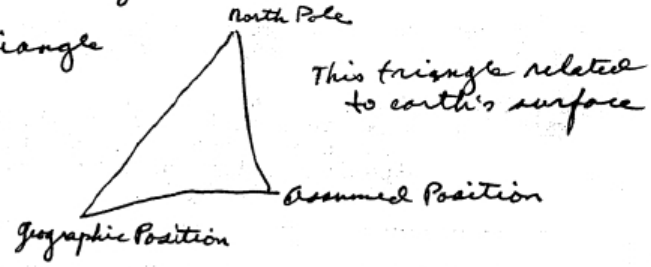
3 Time to be accurate to nearest sec.

4 G.P. ~~of~~ Location of Sun (GHA + DEC)
Geographic Position of direct sunlight
Greenwich Hour Angle
Declination

5 Distance + Direction From G.P. of Sun
LOP + Fix
Line of position

Nautical Almanac gives GHA + Dec

Navigation Triangle



Another triangle related to night sky surface

Horizon to be 0°

Zenith point 90°

Sextant aligns an image of the sun on the horizon Scale yields ~~latitude~~ ~~position~~ angle of sun or height of sun

Steve Somsen

Hokule'a Navigation Class

Course Outline

6 SEP 78 WEDS	Introduction Definition of Coastal Piloting Definition of Celestial Navigation Basic Navigational Terms
13 SEP 78 WEDS	The Chart Using the Chart with the Navigators Instruments Various Exercises The Magnetic Compass; methods of use, errors, and adjustments
20 SEP 78 WEDS	The Chart and Compass continued The Coast Pilot & The Pilot Charts The Light List & Local Notice to Mariners Tides, Currents, & Weather
27 SEP 78 WEDS	Coastal Piloting Review Celestial Navigation: Basic Overview & History Why does it work ? Sun, Moon, Planets, & Stars
4 OCT 78 WEDS	Coastal Line of Position vs. Celestial Circle of Position The Celestial Fix Problem #1 The Sun for Noon Latitude Problem #2 The Sun for Afternoon Line of Position (s) Problem #3 Using #1 & #2 to determine The Celestial Fix
11 OCT 78 WEDS	More Celestial Problems and Solutions: Using the Sun, Moon, Planets, and Stars
18 OCT 78 WEDS	A Day in the Life of a Navigator What to Pack if YOU are the Navigator How to do without certain pieces of equipment Special Navigational Situations Celestial Navigation Review

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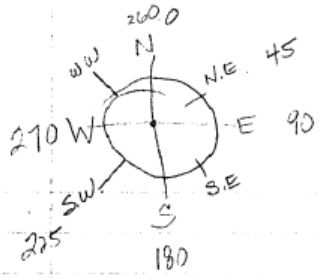
All classes will begin at 7:00 p.m. on Wednesday evenings.

There will be at least one short quiz held during the course.

Our meeting place will be in the classroom building next to the Canoe Shop at the Kamehameha School.

Please call Steve Somsen at [redacted] at any time if you have any questions.



Compass

LONGITUTE
LATITUDE

N } 90 } latitude
S }
O. E }

21° N. LAT.
158° W LONG.

6,080 ft = nautical mile
each degree of latitude = 60 nautical miles

1° LAT = 60 n.m
1° 60' = 60 N.M

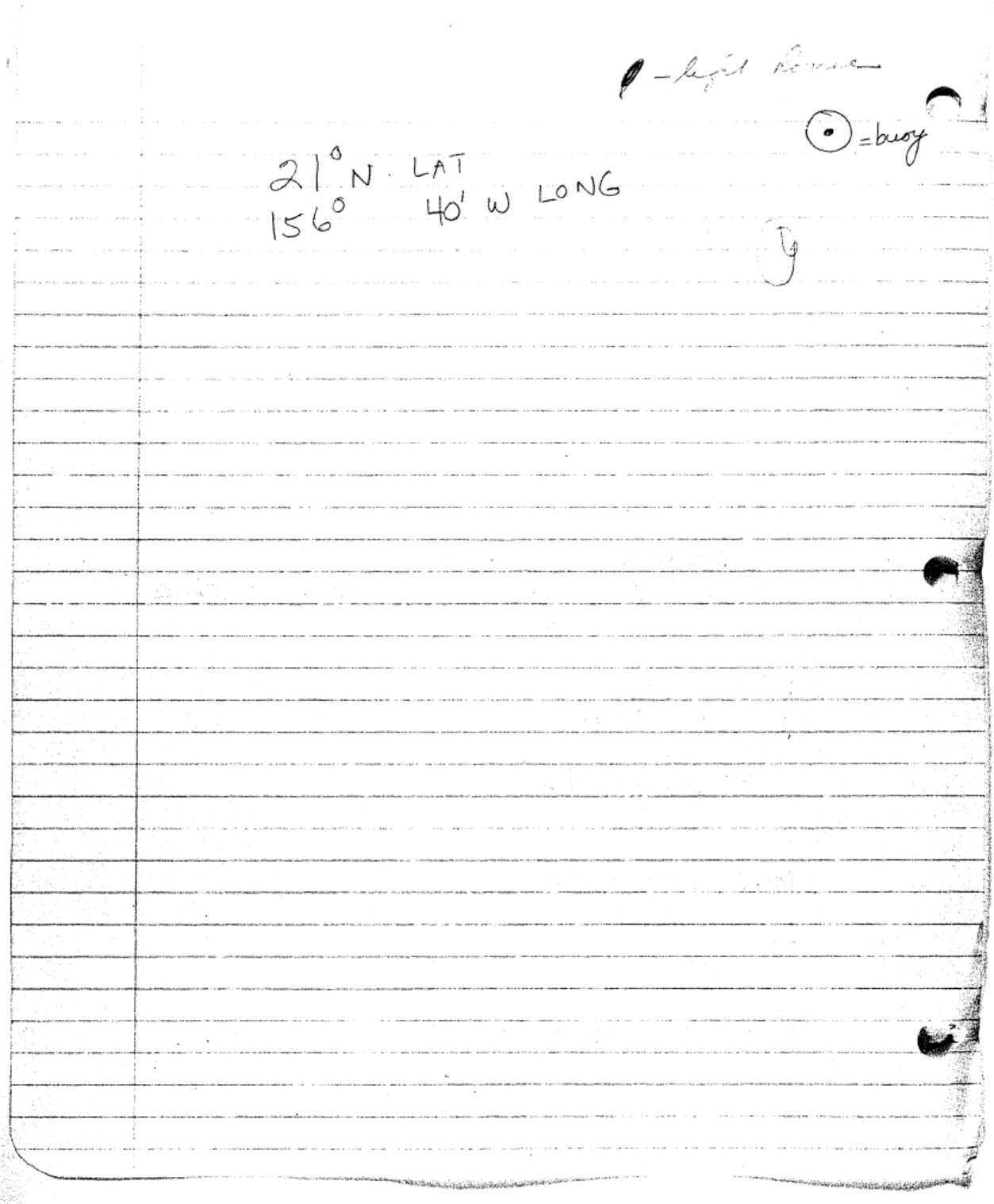
1 minute of latitude = 1 n. mile

DEAD RECKONING

280° T — T = plot your course

5 — knots x 3 hours = 15 miles

12:00 — noon


= light house
= buoy
21° N. LAT
156° 40' W LONG