

M E M O R A N D U M

February 12, 1980

TO: ALL CREW MEMBERS  
FROM: MAR  
SUBJ: NAVIGATION/CREW TRAINING

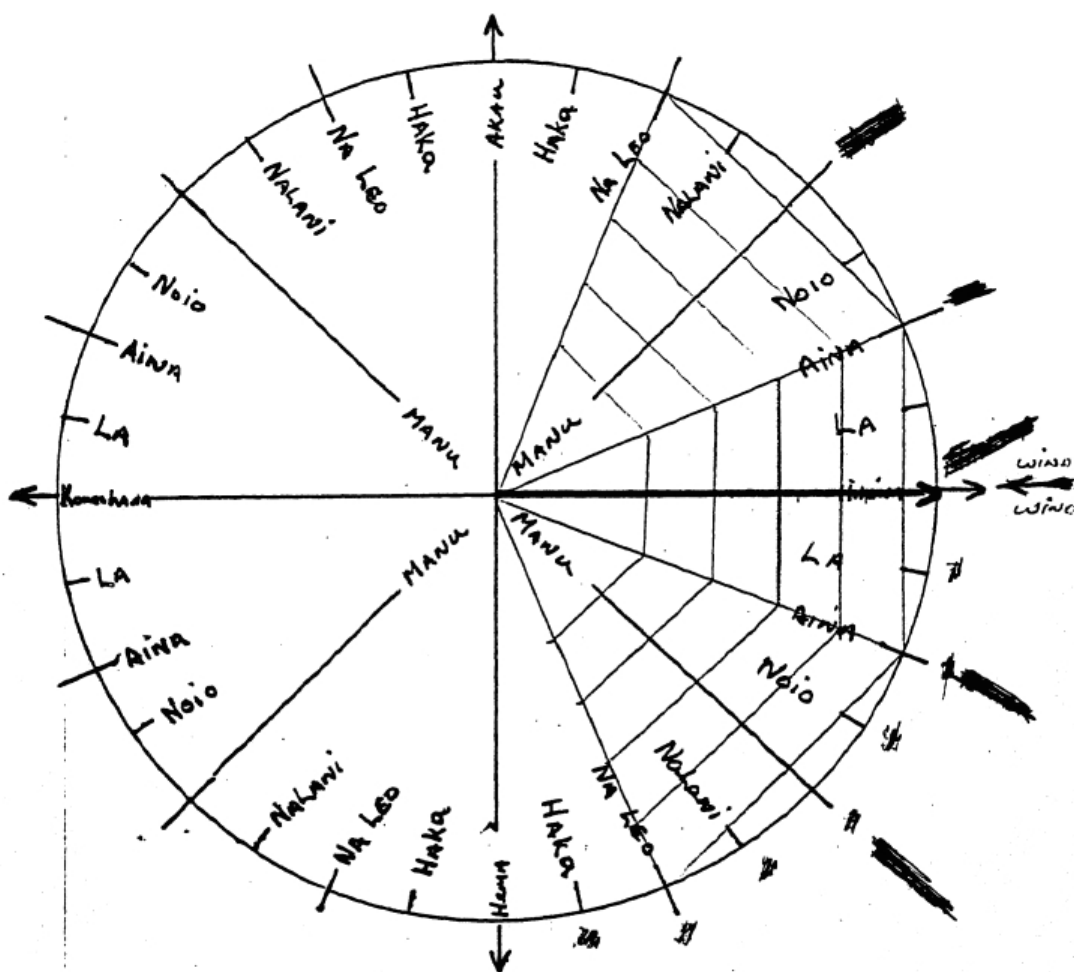
- a) Star identification session for all crew on Friday, February 15, 1980, 8:00 P.M., at the Bishop Museum Planetarium. (meet outside)
- b) Please study the enclosed star compass. Review and know the positions of the 30 stars shown on the compass.
- c) A crew training sail for all selected crew members is scheduled for 7:00 A.M. on Saturday, February 16, 1980. Meet at Pier 12 Honolulu, regardless of the weather conditions.

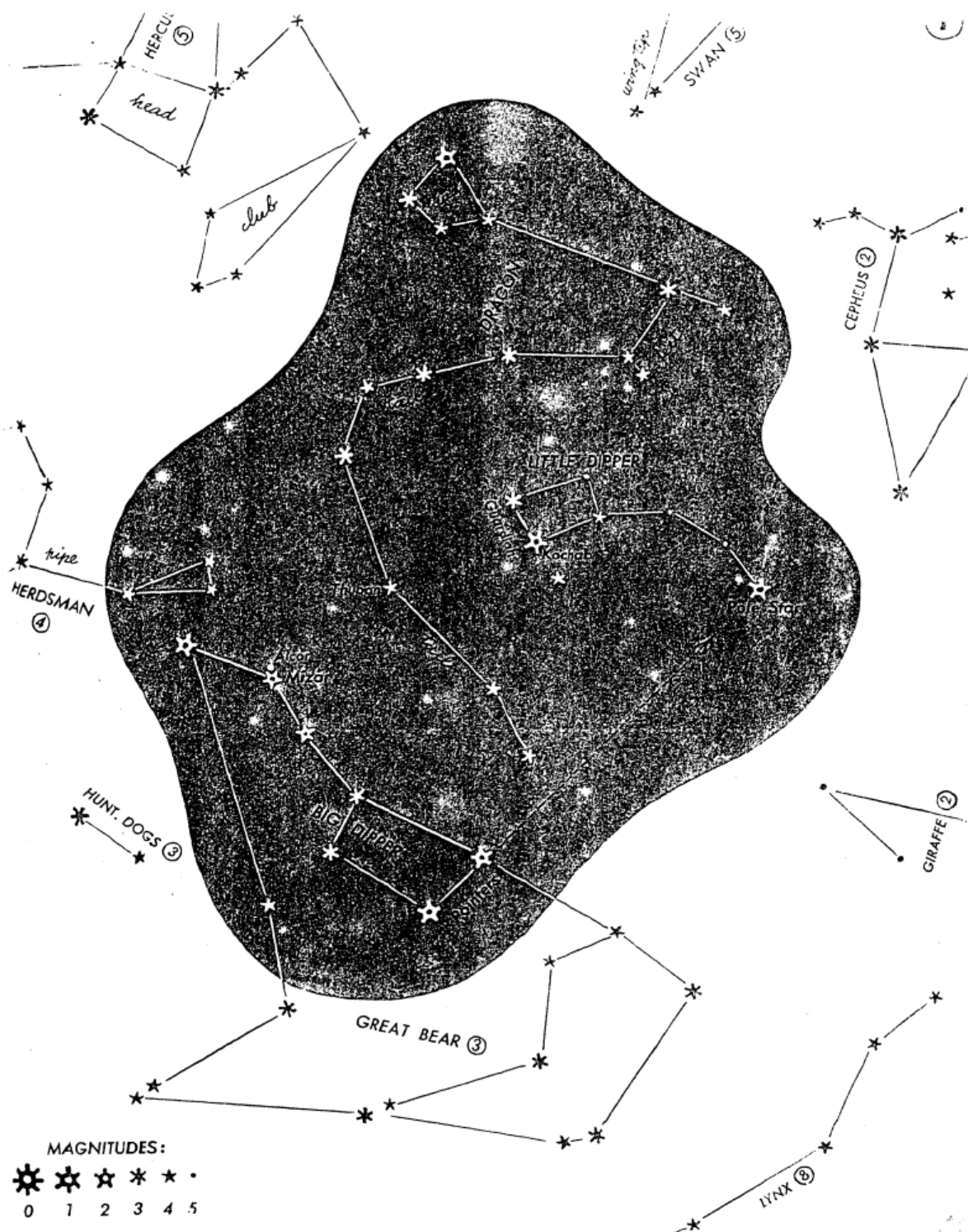
If you have any questions feel free to call me at the office 841-3966 or at home [REDACTED]

Mahalo.

*MAR*

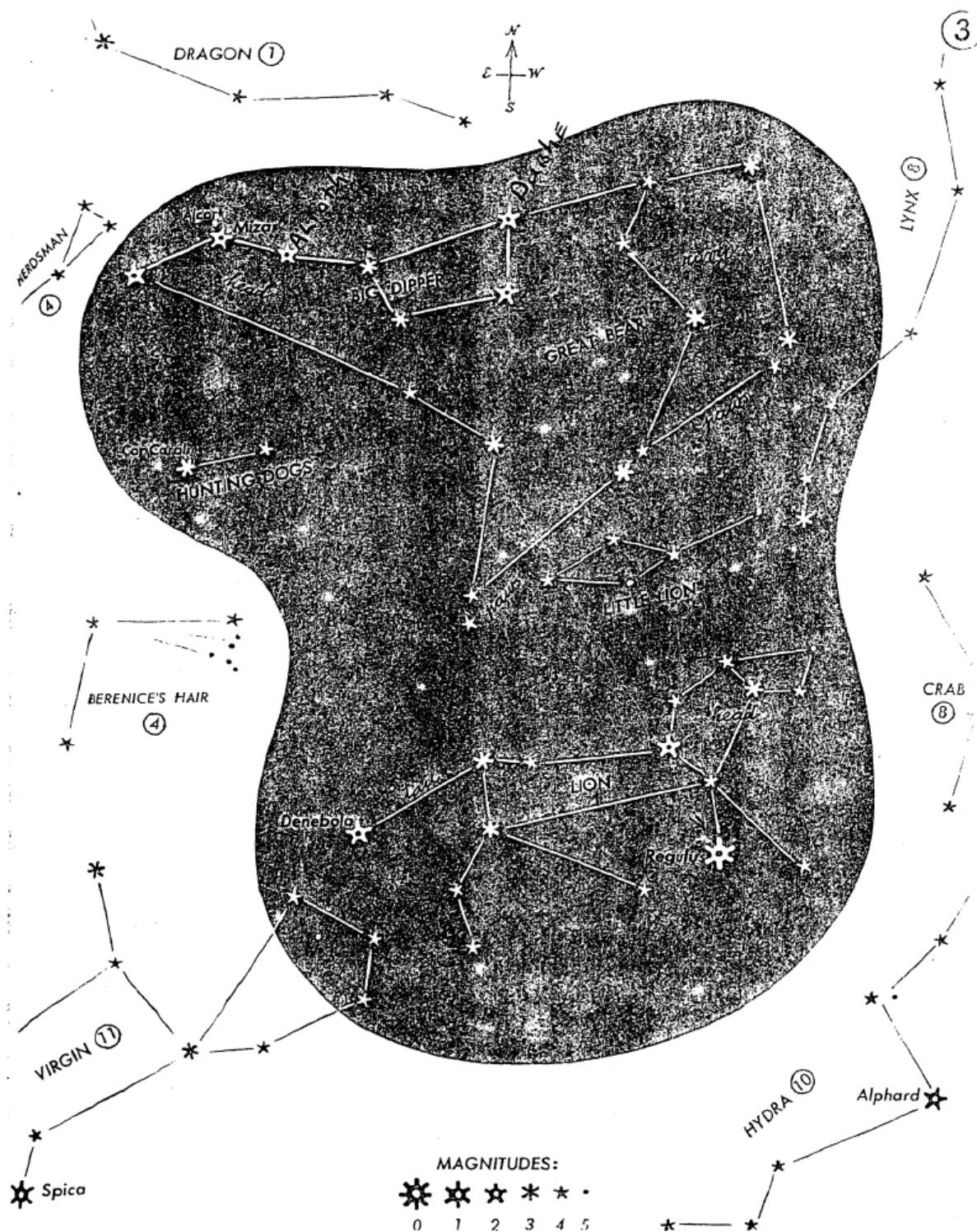
WAVE Compass Example

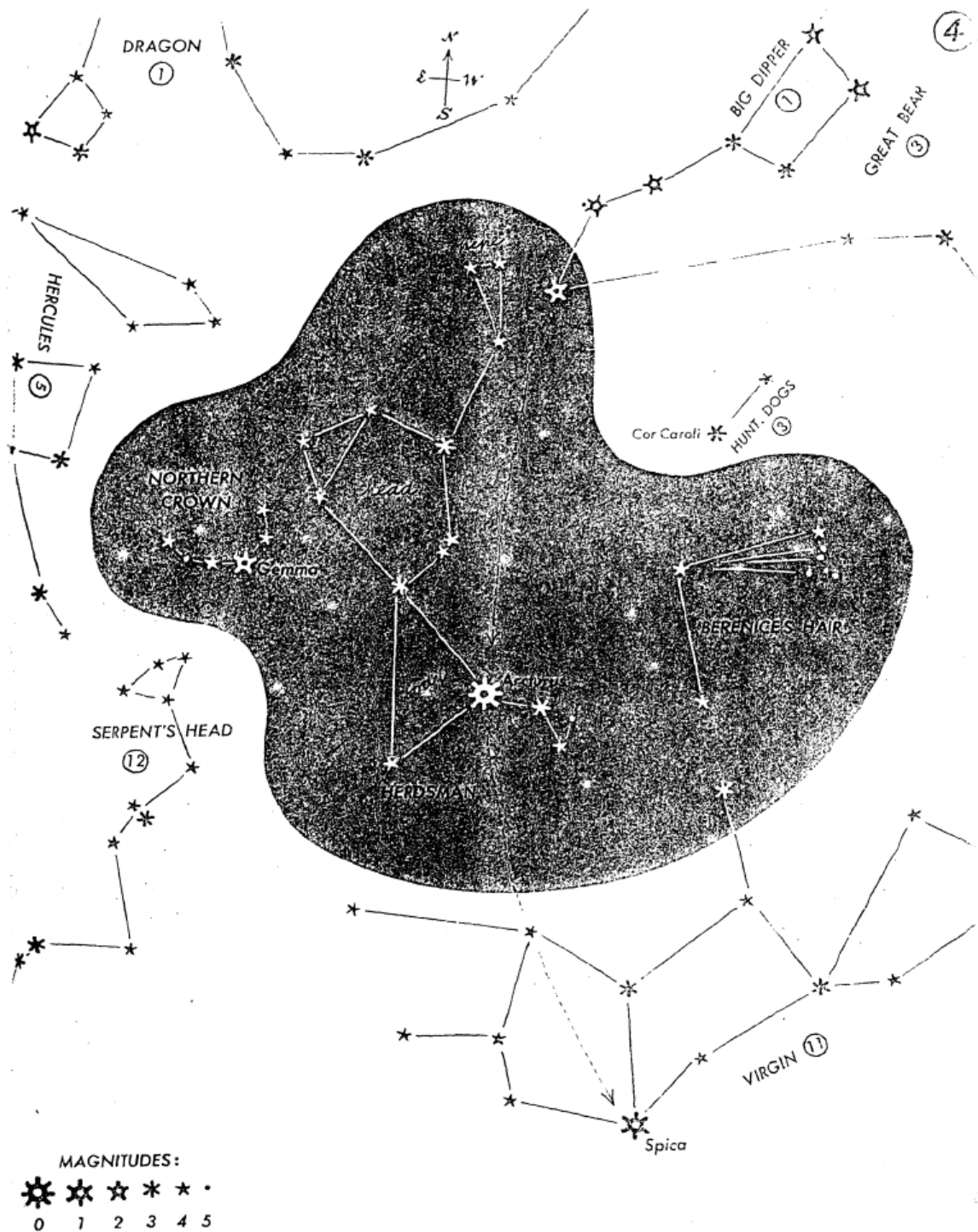


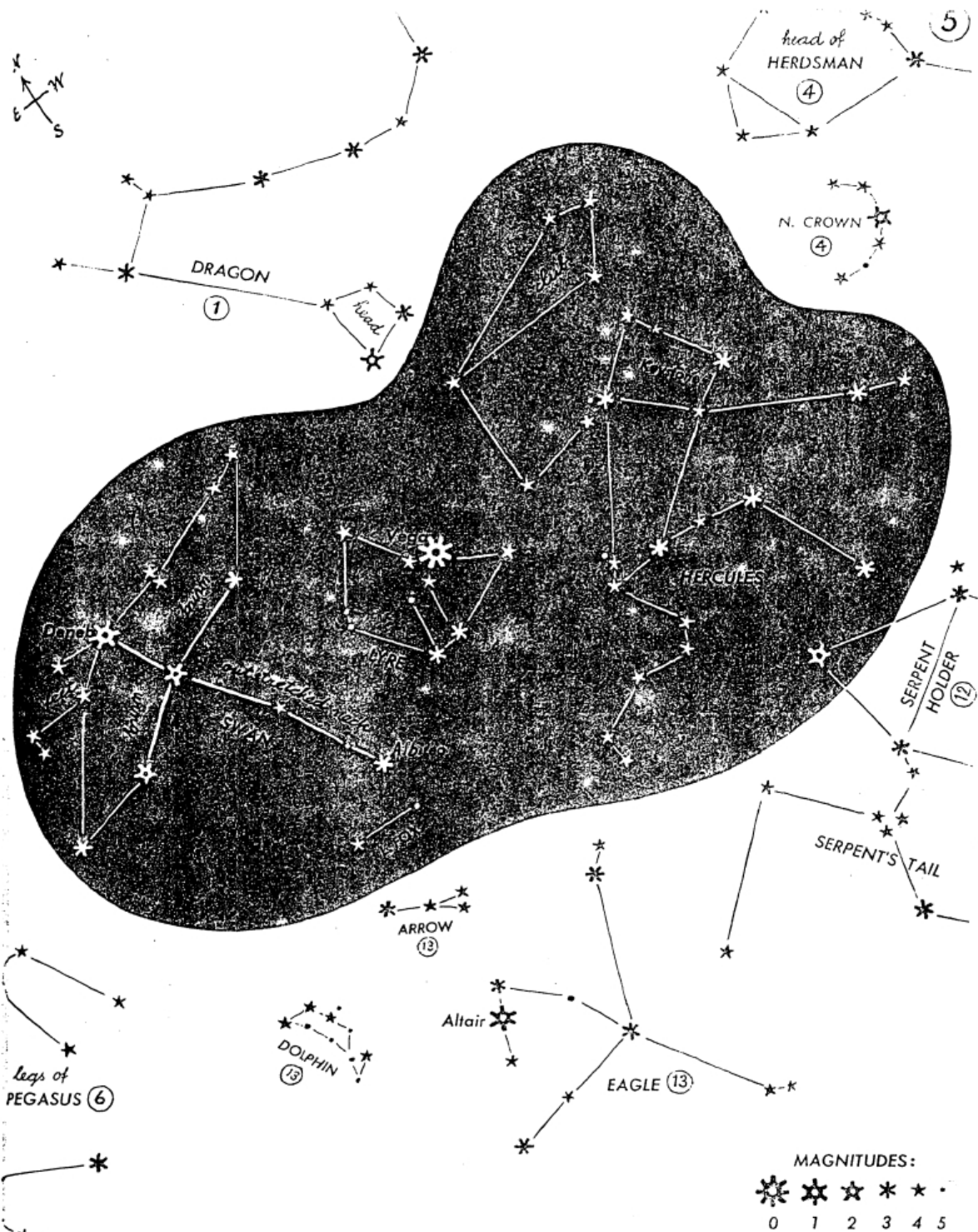




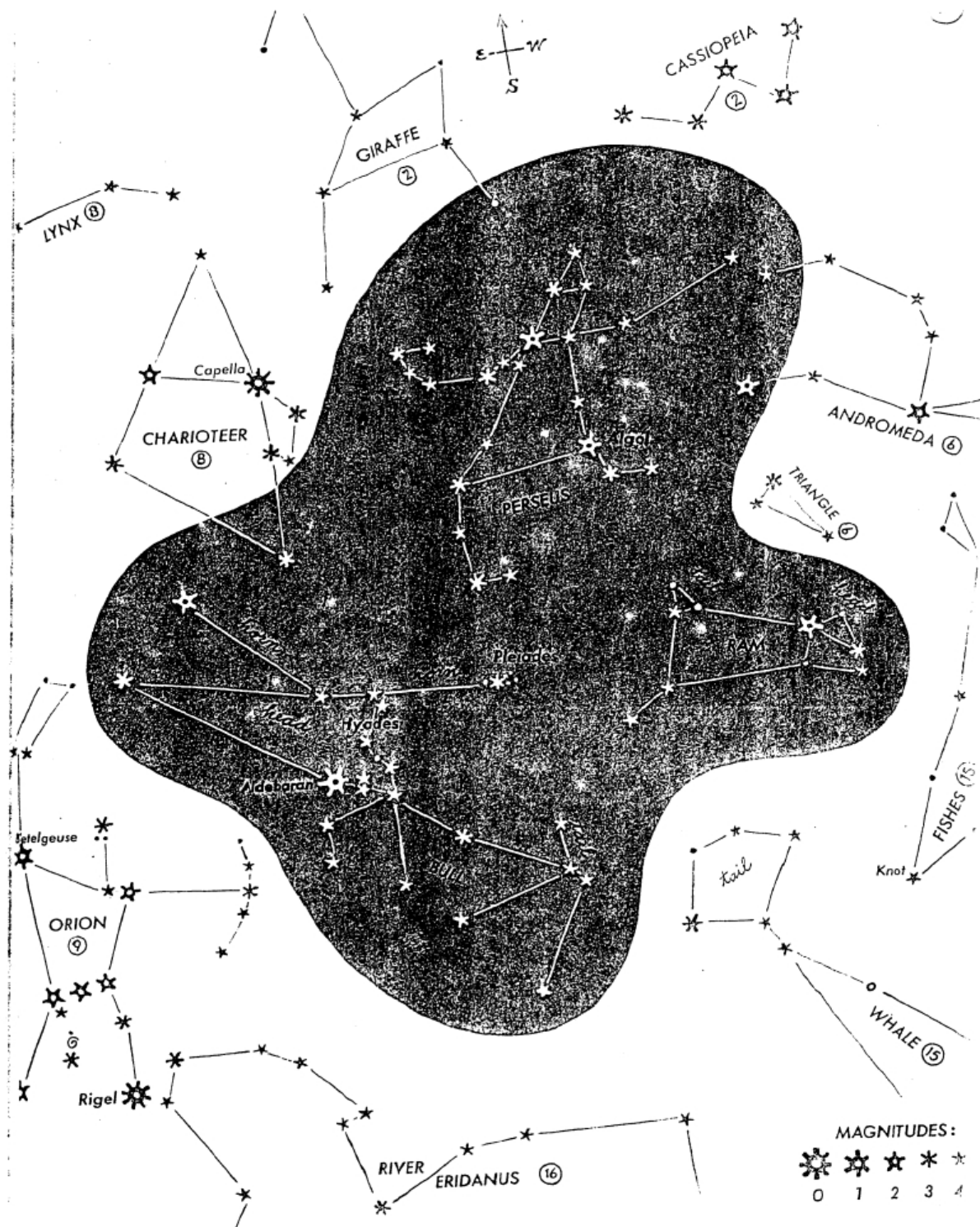




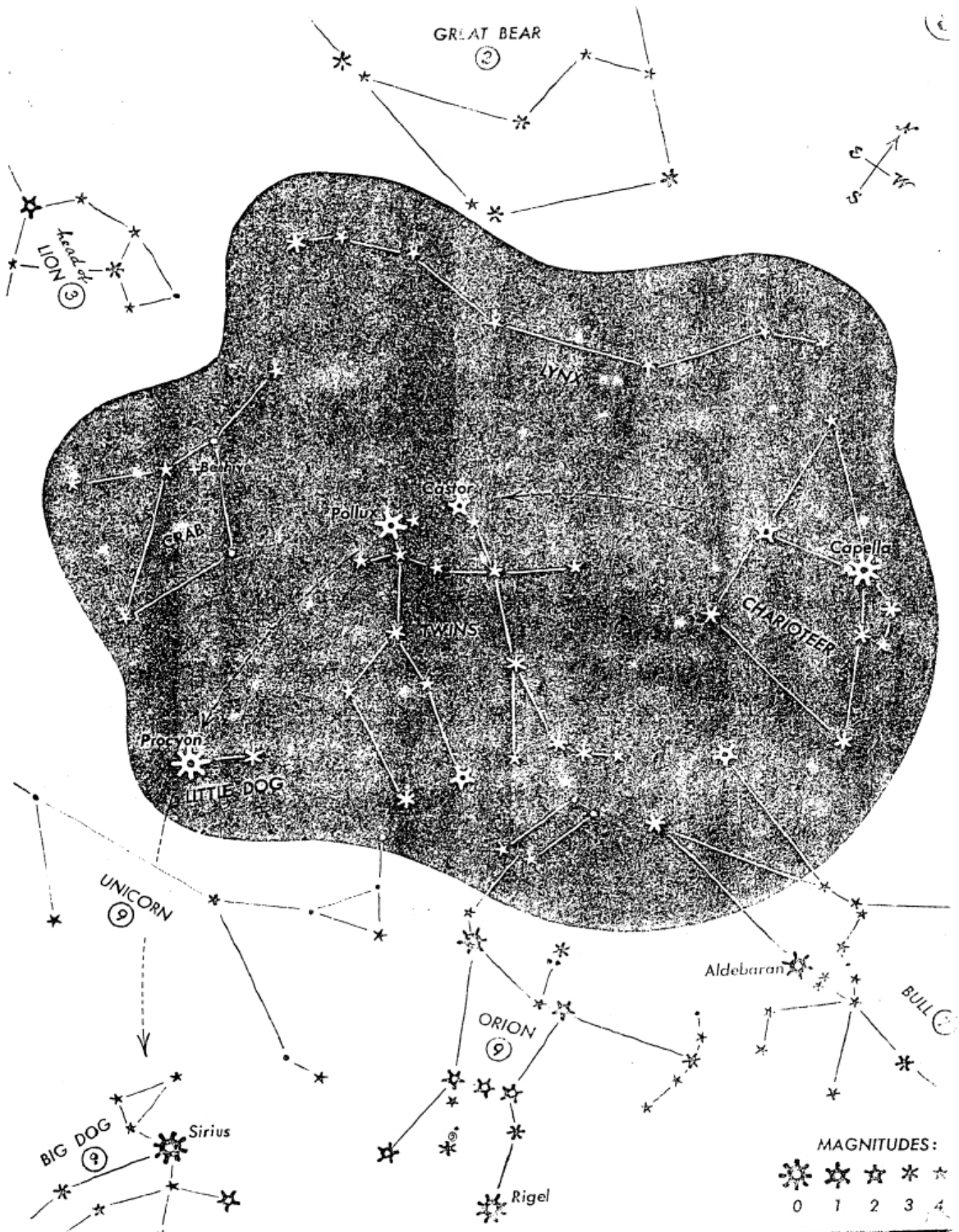








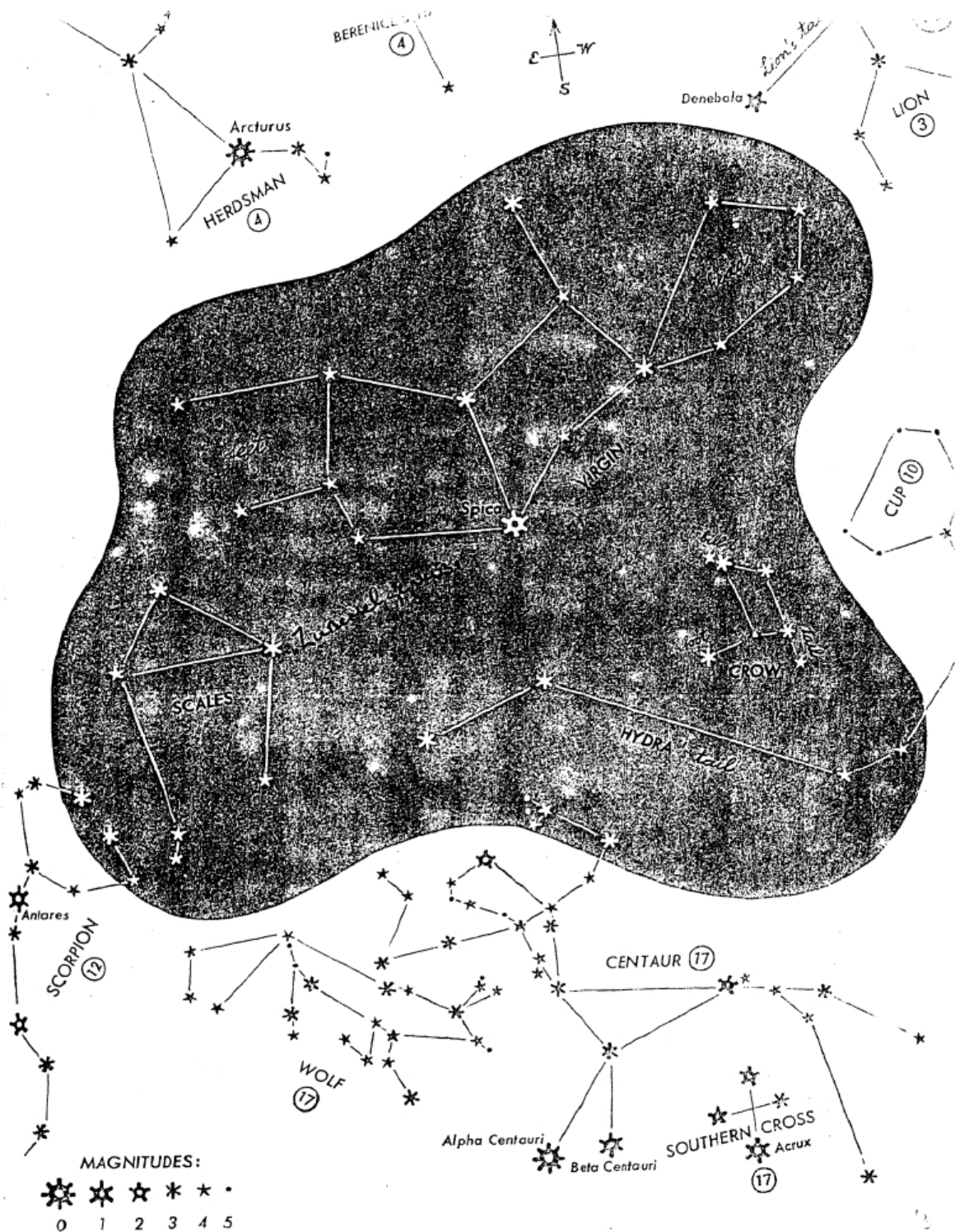


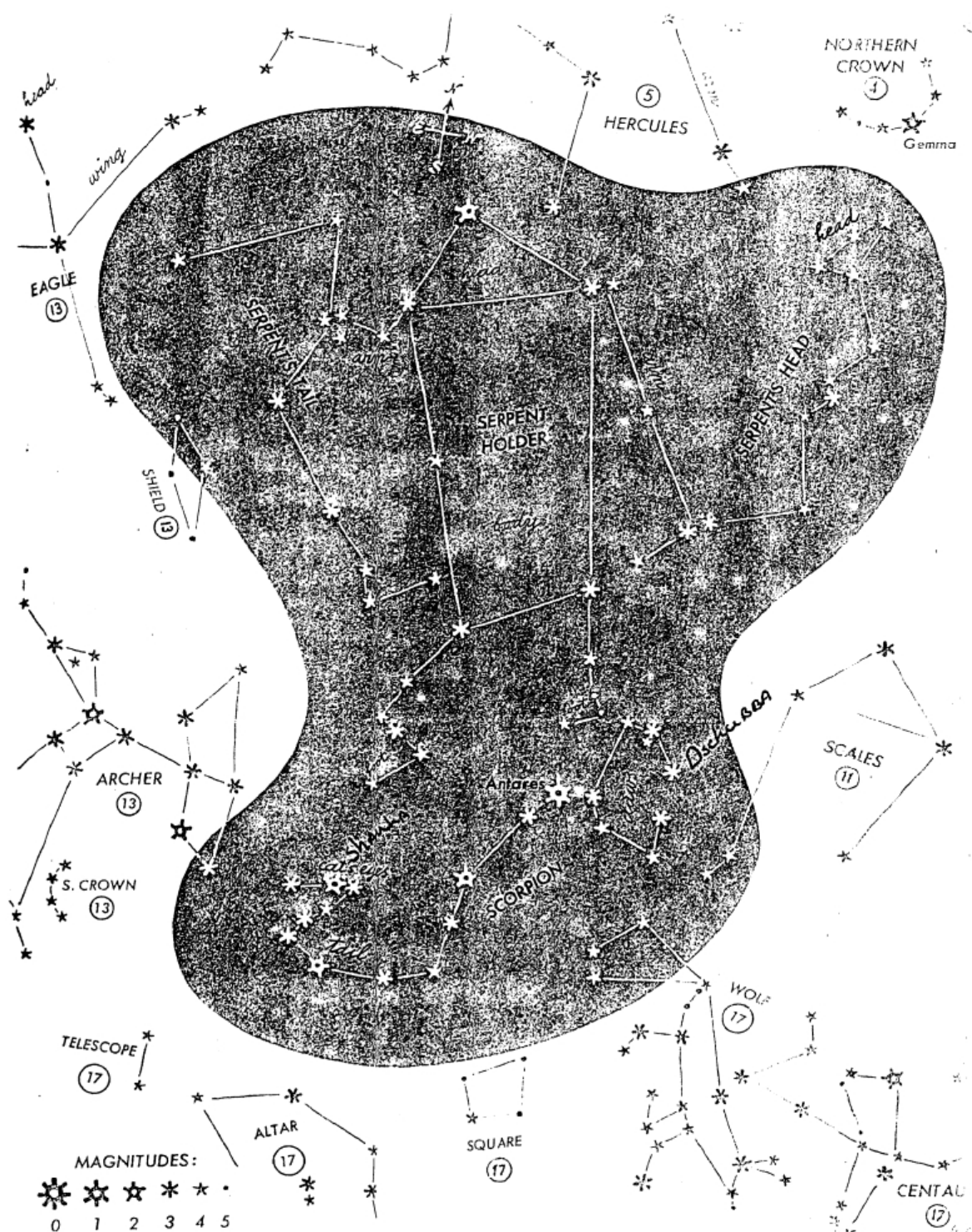




















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*Navigator*

March 12, 1979

TO: NAINOA THOMPSON  
FROM: MAR  
SUBJ: TENTATIVE SCHEDULE  
March, April, May

Aloha Nainoa,

At your earliest convenience, could you please give me a tentative schedule for Hokule'a during March, April and May. I hope to facilitate better communication with the Board and committee members by putting together a calendar on the schedule for Hokule'a during these months. I am aware that sailing time is dependent on the weather, and I will indicate this.

Mahalo for your help and I wish you lots of luck on your training program. If you need help, call.



January 2, 1979

TO: MICHAEL A. TONGG  
FROM: NAINOA THOMPSON  
SUBJECT: PROGRESS REPORT  
Non-Instrument Navigation  
December 15 - 30, 1978

Planetarium and Planning sessions with  
Will Kyselka

Ocean Studies both day and night

Theoretical Research

Study

December 19, 1978

TO: MICHAEL TONGG  
FROM: NAINOA THOMPSON  
SUBJECT: PROGRESS REPORT  
NON-INSTRUMENT NAVIGATION REPORT  
December 1-15, 1978

1. Planetarium sessions with Will Kyselka
2. Planning meetings with Will Kyselka
3. Ocean Studies
4. Theoretical research
5. Study
6. Worked on needed equipment.

December 5, 1978

TO: MICHAEL TONGG  
FROM: NAINOA THOMPSON  
SUBJECT: PROGRESS REPORT-NON INSTRUMENT  
NAVIGATION REPORT  
November 1 - 30, 1978

Planetarium and research meetings with Will  
Kyselka

Development of theoretical ideas

Field Studies

- ocean
- sun
- stars

Academic studies

November 1, 1978

TO: MICHAEL A. TONGG  
FROM: NAINOA THOMPSON  
SUBJECT: PROGRESS REPORT  
October 15-31st 1978

1. Planetarium and discussion session with Will Kyselka
2. Research into "precession"
3. Developing ideas in study of star groups
4. Production of charts
5. Ocean study
6. Academic study
8. Working on equipment needed for research

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October 15, 1978

TO: Michael A. Tongg  
FROM: Nainoa Thompson  
SUBJECT: PROGRESS REPORT  
October 1 - 15, 1978

No report, due to canoe training for the Molokai  
to Oahu race.

October 16, 1978

TO: Michael A. Tongg  
FROM: Nainoa Thompson  
SUBJECT: Progress Report  
September 15 - September 30, 1978

Planetarium Sessions with Will Kyselka

Continued reading and studying

Observations of both day and night celestial bodies,  
(particularly the moon).

Observations of ocean swells

# POLYNESIAN VOYAGING SOCIETY

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

September 28, 1978

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JOHN KRUSE

FRANCIS KAINOA LEE

GORDON PIIANAIA

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

BICENTENNIAL VOYAGE OF REDISCOVERY  
HOE AKU I KA WA'A

# POLYNESIAN VOYAGING SOCIETY

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

September 6, 1978

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REVEREND

JOHN KRUSE

FRANCIS KAINOA LEE

GORDON PIANAIA

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

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FRANCIS KAINOA LEE

GORDON PIIANAIA

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.

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HOE AKU I KA WA'A

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August 15, 1978

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FRANCIS KAINOA LEE

GORDON PIANAIA

**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

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HOE AKU I KA WA'A

# POLYNESIAN VOYAGING SOCIETY

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

July 17, 1978

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REVEREND

JOHN KRUSE

FRANCIS KAINOA LEE

GORDON PI'IANAIA

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, re-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.

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BICENTENNIAL VOYAGE OF REDISCOVERY  
HOE AKU I KA WA'A

Page Two  
PROGRESS REPORT  
NAINOA THOMPSON - NAVIGATOR

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

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 nights and day skies
- Reading of various texts

SEPTEMBER 6, 1978

TO: MICHAEL TONGG  
FROM: NAINOA THOMPSON  
SUBJECT: PROGRESS REPORT  
AUGUST 15TH - SEPTEMBER 1, 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

August 24, 1978

TO: Michael A. Tongg  
FROM: Nainoa Thompson  
SUBJECT: Progress Report for non-instrument navigation  
August 1 - August 15, 1978

ACADEMICS:

Completed Kealahou article with W. Kyselka  
and Ray Lanterman

Continued sessions at the Planetarium with Kyselka

Refinement of ideas within notebook

FIELD WORK:

Day and night observations of the heavens

- Continued work on equipment needed for navigational aids.

Progress report for Non-Instrument Navigation  
Aug. 1<sup>st</sup> - Aug. 15<sup>th</sup>

Headsman:

- (1) Completed Heale, Ishiki article with Will  
Hyselbs and Ray Lontannan
- (2) Continued session at the planetarium with  
Hyselbs
- (3) Refinement of ideas within notebook.

Field work:

- (1) Day and Night observation of the Heavens

\* Continued work on equipment needed for  
Navigation aids.



To Marlene

Thanks

Nacion

August 15, 1978

TO: Michael A. Tongg  
FROM: Nainoa Thompson  
SUBJECT: July 17 - August 1, 1978 Report

- 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

To Crew Candidates:

All crew must know the information given in compass:

stars  
constellation  
the cardinal direction they are in  
paths of sun, moon, and planet

Extensive training in the use of this information in relation to navigation will be given to the final crew members. But the above information must be known by mid September

\* It must be understood that the principle job of crew members in relation to navigation is to hold a steady course, this requires a certain amount of knowledge in terms of the usage of the Heaven: by night and the sun and the sea by day. The day navigation training will be done at sea on Hokulea.

Resources:

- 1) Books (list given)
- 2) Planetarium classes (5)
- 3) Night classes (2 to 4)
- 4) Will Kyselka, [REDACTED] Nainoa Thompson, [REDACTED], Steve Somsen, [REDACTED]

\* (If in your own study you are having problems you can't solve call one of the above).

\* Tentitive scheduled night class will be Saturday night June 30th (all night) location not yet decided.

June 20, 1979

TO: CREW CANDIDATES  
FROM: MAR  
SUBJ: NAVIGATION

The following are books that you will need to purchase for your study in navigation:

NORTHERN STAR TO SOUTHERN CROSS by Will Kyselka	\$ 4.95
FIND THE CONSTELLATIONS by H. E. Rey	3.95
THE STAR by H. E. Rey	5.95
STARS OVER HAWAII by E. H. Bryan	3.50
12 SKY MAPS FROM NORTHERN STAR TO SOUTHERN CROSS	<u>10.00</u>

TOTAL \$28.35

PROPOSED NONINSTRUMENTAL NAVIGATION  
TRAINING PROGRAM

The crew members of Hokule'a need to know the principles and specifics of holding a particular course, set by the navigator. Such competency depends upon a knowledge of the stars as well as the ways of the sea.

Noninstrumental Celestial Navigation

Crew members will become familiar with the terms and concepts relating to the stars.

1. Sidereal compass and the rising and setting places of principal stars.
2. The sun, and its eastward movement among the stars of about one degree a day. The sun's apparent path on the celestial sphere (ecliptic)
3. Relationship of the sun and full moon in the sky relative to the ecliptic.
4. The planets and their motions among the stars and relationship to the ecliptic.
5. Changes in the sky due to daily, annual, and precessional motions.
6. Changes in the azimuths of rising and setting stars with a change in latitude.
7. Steering stars for March through July as well as the stars for backsighting.
8. The solar and sidereal day as well as the synodic and sidereal month.

PROPOSED NONINSTRUMENTAL NAVIGATION TRAINING PROGRAM (continued)

9. Major zenith stars of Polynesia.
10. Terms: celestial equator, declination, meridian.

Training

Training in the Planetarium and at sea as well as the knowledge to be gained through books will provide crew members the information they need to perform their steering tasks.

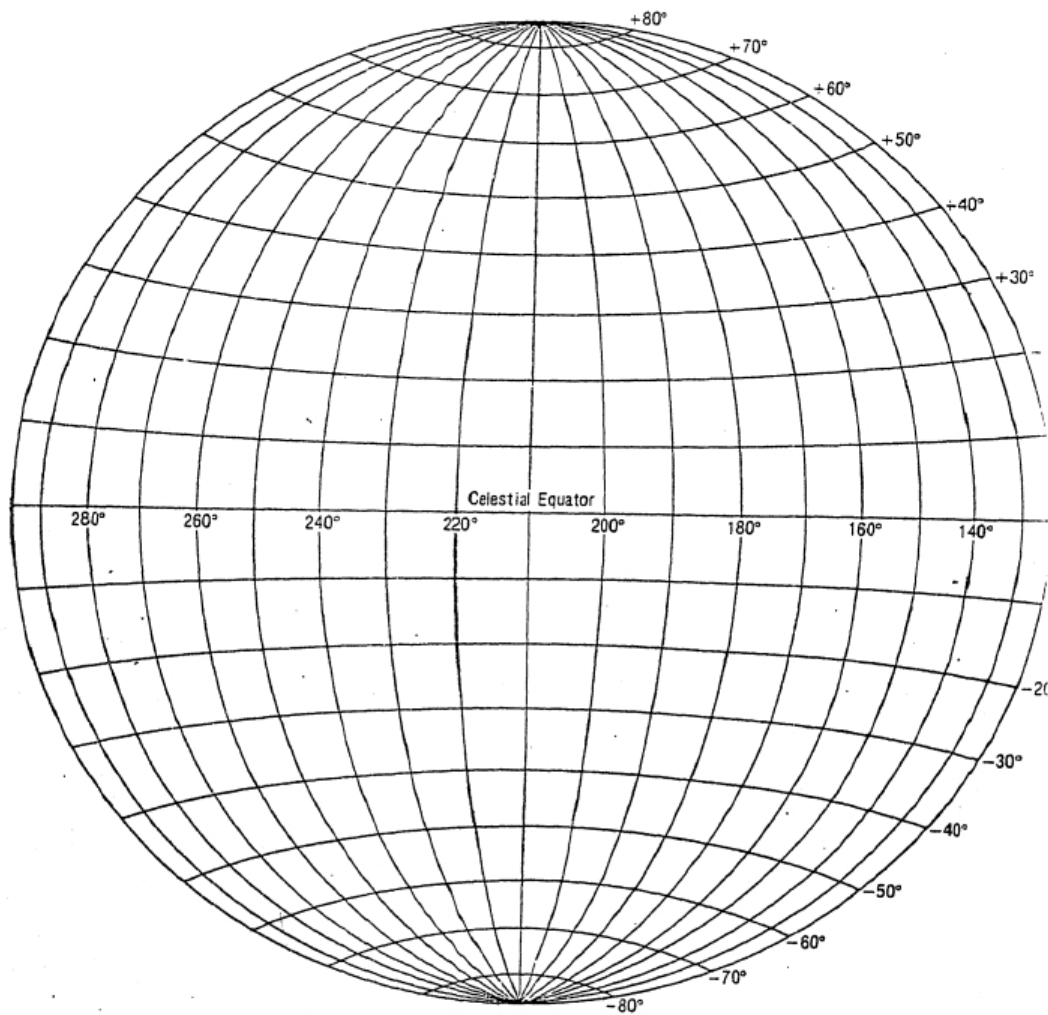
Five two-hour sessions in the Planetarium by Thompson/Kyselka will provide background information on the needed terms, concepts, and movements in the celestial sphere. Cost of training: \$50.00 per hour Planetarium fee. However, since the Bishop Museum views Polynesian voyaging with its domain of research, the fee is waived. Mention is to be made of the Museum's support of such research in pertinent publicity releases.

Crew members are expected to further their own knowledge through such sources as the following: STARS OVER HAWAII, Ed Bryan; STARS, H. L. Rey' NORTH STAR TO SOUTHERN CROSS, Kyselka/Lantermann; TWELVE SKY MAPS, Lantermann/Kyselka; POLYNESIAN STARS AND MEN, Kyselka/Bunton; and the articles BY STARS TO TAHITI, Kyselka/Thompson, and KEALAIKAHIKI, Kyselka/Thompson.

June 1

Star Name & Pronunciation	Constellation	Distance from	
		V.E. (°)	Equator (°)
Alphard, al' fard	Hya	142	-09
Regulus, reg' u-lus	Leo	152	+12
Merak, me' rak	UMa	165	+56
Dubhe, dub' e	UMa	166	+62
Denebola, de-neb' o-la	Leo	177	+15
Phocda, fek' da	UMa	178	+54
Megrez, me' grez	UMa	183	+57
Acrux, a' kruks	Cru	186	-63
Gacrux, ga' kruks	Cru	188	-57
Becrux, be' kruks	Cru	192	-60
Alioth, al' i-oth	UMa	193	+56
Cor Caroli, kor kar' ol-i	Com	194	+38
Mizar, mi' zer	UMa	201	+55
Spica, spi' ka	Vir	201	-11
Alkaid, al-kad	UMa	207	+49
Hadar, ha' dar	Cen	211	-60
Arcturus, ark-tu' rus	Boo	214	+19
Rigil Kent, ri' jil	Cen	220	-61
Zubenelgenubi, zu-ben'el-ji-nu'be	Lib	223	-16
Antares, an-ta' rez	Sco	247	-26
Ras-Algethi, ras' al-je' the	Her	258	+14
Shaula, shaw' la	Sco	263	-37
Rasalhague, ras' al-ha' gwe	Oph	264	+13
Eltanin, el-ta nin	Dra	269	+51
Vega, ve' ga	Lyr	279	+39
Nunki, nun' ke	Sgr	284	-26
Albireo, al-bir'e-o	Cyg	293	+8
Altair, al-tar'	Aql	298	9
Deneb, den' eb	Cyg	310	+14

PV



JUNE

August 1	131	+18
Sept 1	160	+08
Oct 1	187	-03
Nov 1	216	-14
Dec 1	247	-22
Jan 1	281	-23

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~~Procyon~~  
~~Polaris~~  
~~Megrez~~  
~~Acruux~~  
~~Canruux~~  
 Recruux

177  
 177  
 182  
 186  
 188  
 192

P.V.  
 July

Star Name and Pronunciation	Constellation	ANGULAR Distance from	
		V.E. (°)	Equator (°)
Alioth, al' i-oth	UMa	193	+56
Cor Caroli, kor kar' ol-i	Com	194	+38
Mizar, mi' zer	UMa	210	+55
Spica, spi' ka	Vir	201	+11
Alkaid, al-kad	UMa	207	+49
Hadar, ha' der	Cen	211	-60
Arcturus, ark-tu' rus	Boo	214	+19
Rigel Kent, ri' jil kent	Cen	219	-61
Zubenelgenubi, zu-ben' el-ji- <sup>nu' be</sup>	Lib	222	-16
Antares, an-ta' rez	Sco	247	-26
Ras-Algethi, ras' al-je' the	Her	258	+14
Shaula, shaw' la	Sco	263	-37
Rasalhague, ras' al-ha' gwe	Oph	263	+13
Eltanin, el-ta' nin	Dra	269	+51
Kaus Australis, kos os-tra' lis	Sgr	276	-34
Vega, ve' ga	Lyr	279	+39
Nunki, nun' ke	Sgr	284	-26
Albireo, al-bir' e-o	Cyg	292	+28
Altair, al-tar'	Aql	297	+ 9
Deneb, den' eb	Cyg	310	+14
The Sun's path among the stars-- the ecliptic		160	+ 8
		187	- 3
		216	-14
		247	-22
		281	-23
		314	-17

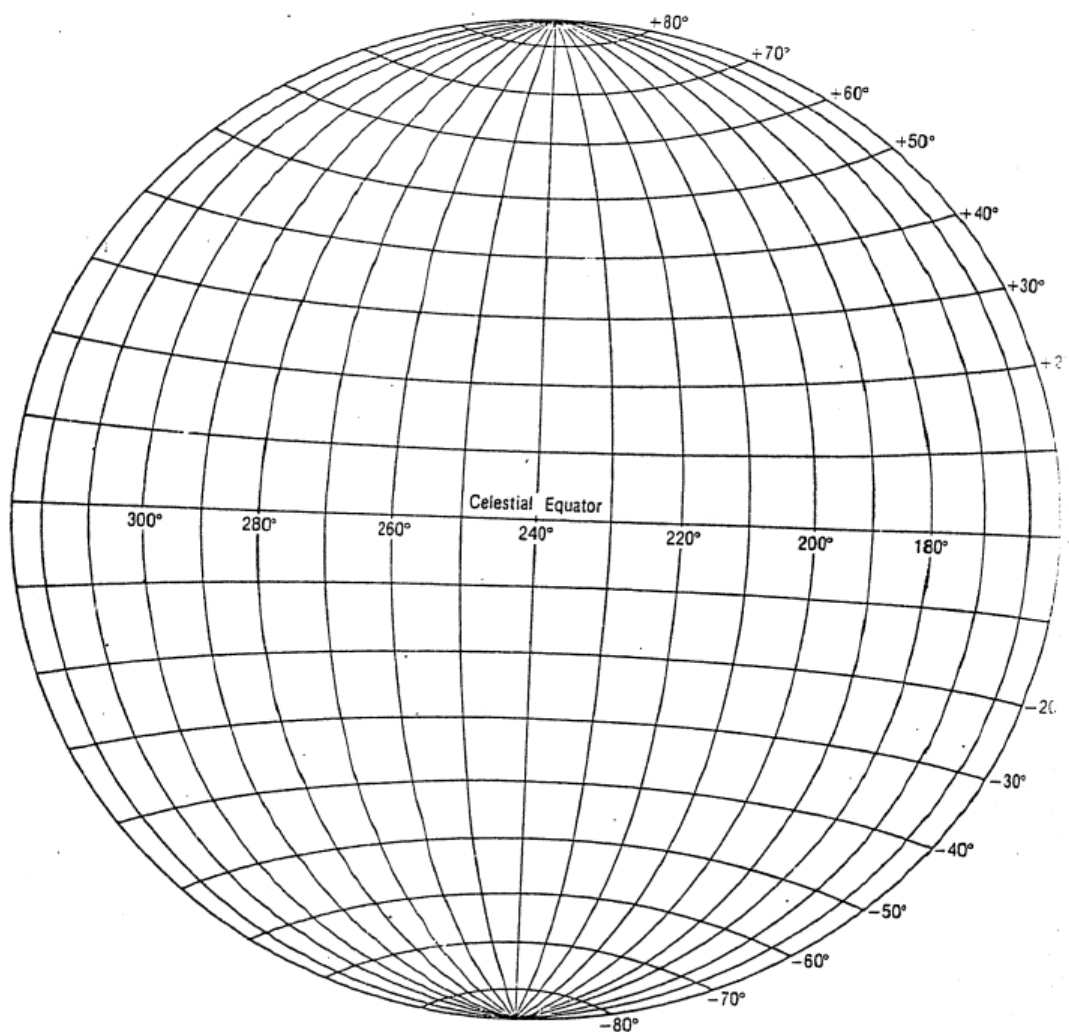
The sun's annual path among the stars is the *ecliptic*.

Plot the data in the table onto the celestial sphere grid, connect the points, and the ecliptic appears.

The autumnal equinox is in the direction of *Virgo*.

PV  
July

Sept 1	160	+08
Oct 1	187	-03
Nov 1	216	-14
Dec 1	247	-22
Jan 1	281	-23
Feb 1	314	-17

PV  
July

Sept 1	160	+08
Oct 1	187	-03
Nov 1	216	-14
Dec 1	247	-22
Jan 1	281	-23
Feb 1	314	-17

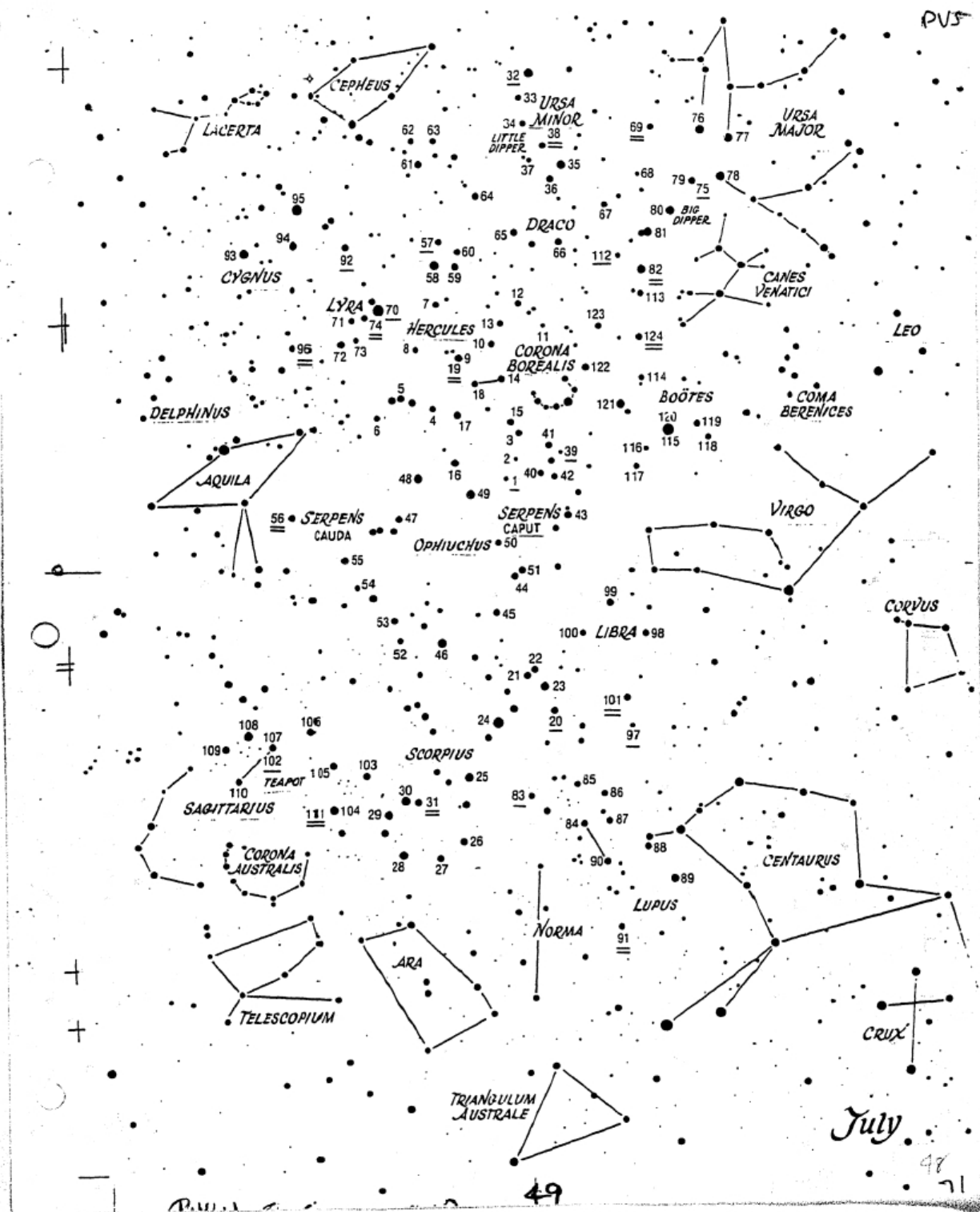
Originals

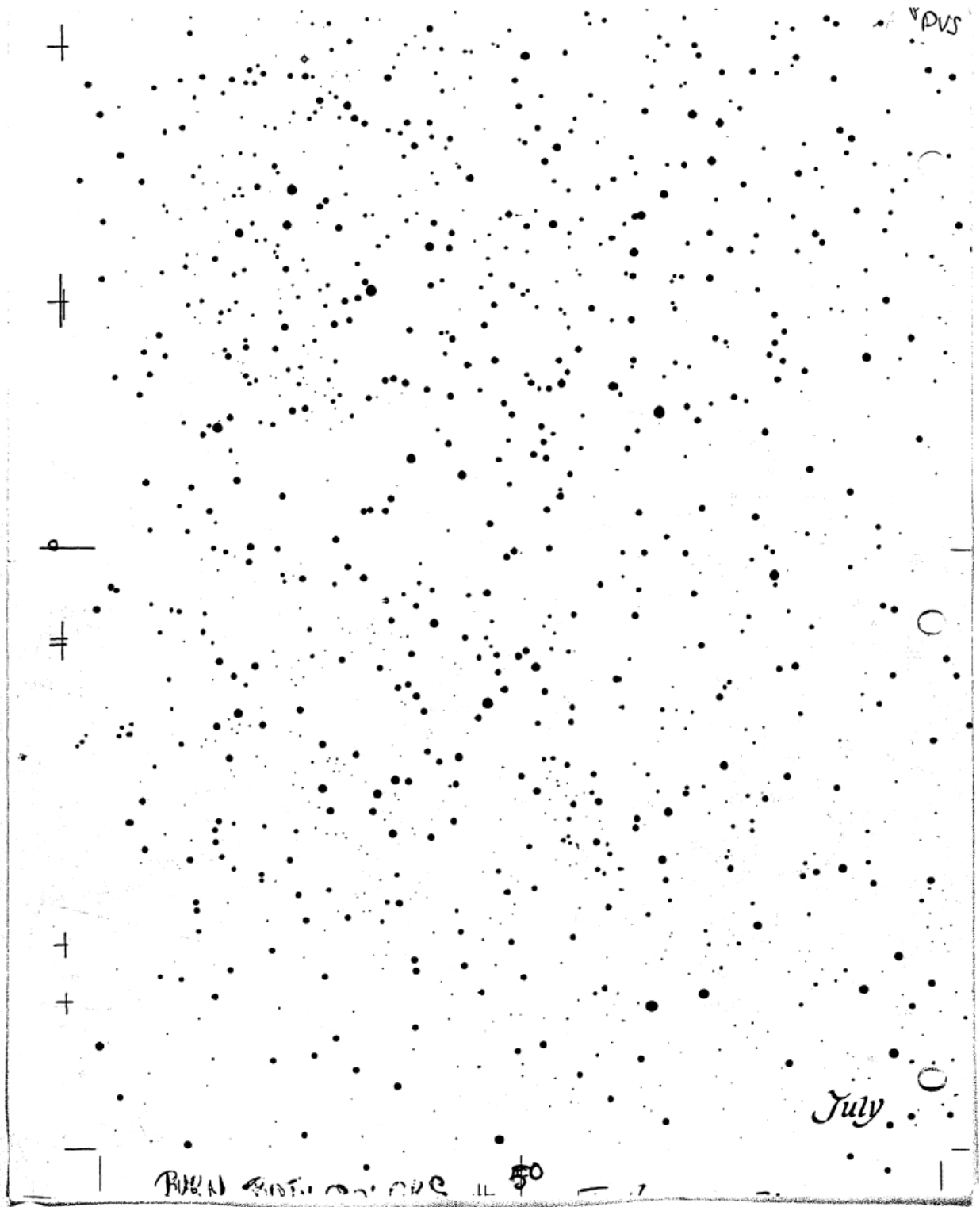
## **POLYNESIAN VOYAGING SOCIETY**



### **the year of the voyage is here...**

Just two short years ago the Polynesian Voyaging Society was formed as a non-profit community group with a grand dream: To reconstruct a modern version of an Ancient Deep Water Voyaging Canoe. Today, with the help of many, that dream is a reality, Hokule'a has been born, dedicated, launched and sailed over 1500 miles. It has been a magnificent learning process for society members. Hokule'a has met her trials, been rescued, refined, rededicated and now stands poised to begin one of the greatest scientific adventures of modern times. Soon Hokule'a will begin the voyage that will take her from Hawaii to Tahiti and back without charts or instruments. In early spring the vessel, crew and supplies must be fully provisioned and ready to sail. Your Membership and/or Donation (tax deductible) will help offset the many expenses of this huge effort.....





~~Antares~~  
~~Phoebe~~  
~~Magez~~  
~~Acru~~  
~~Gacru~~  
 Recru

177  
 178  
 182  
 186  
 188  
 192

PVS  
 July

Star Name and Pronunciation	Constellation	Distance from	
		V.E. (°)	Equator (°)
Alioth, al' i-oth	UMa	193	+56
Cor Caroli, kor kar' ol-i	Com	194	+38
Mizar, mi' zer	UMa	210	+55
Spica, spi' ka	Vir	201	+11
Alkaid, al-kad	UMa	207	+49
Hadar, ha' der	Cen	211	-60
Arcturus, ark-tu' rus	Boo	214	+19
Rigel Kent, ri' jil kent	Cen	219	-61
Zubenelgenubi, zu-ben' el-ji- <sup>nu' be</sup>	Lib	222	-16
Antares, an-ta' rez	Sco	247	-26
Ras-Algethi, ras' al-je' the	Her	258	+14
Shaula, shaw' la	Sco	263	-37
Rasalhague, ras' al-ha' gwe	Oph	263	+13
Eltanin, el-ta' nin	Dra	269	+51
Kaus Australis, kos os-tra' lis	Sgr	276	-34
Vega, ve' ga	Lyr	279	+39
Nunki, nun' ke	Sgr	284	-26
Albireo, al-bir' e-o	Cyg	292	+28
Altair, al-tar'	Aql	297	+ 9
Deneb, den' eb	Cyg	310	+14
The Sun's path among the stars-- the ecliptic		160	+ 8
		187	- 3
		216	-14
		247	-22
		281	-23
		314	-17

The sun's annual path among the stars is the ecliptic.

Plot the data in the table onto the celestial sphere grid, connect the points, and the ecliptic appears.

The autumnal equinox is in the direction of Virgo.



SCORPIUS,  
The Scorpion



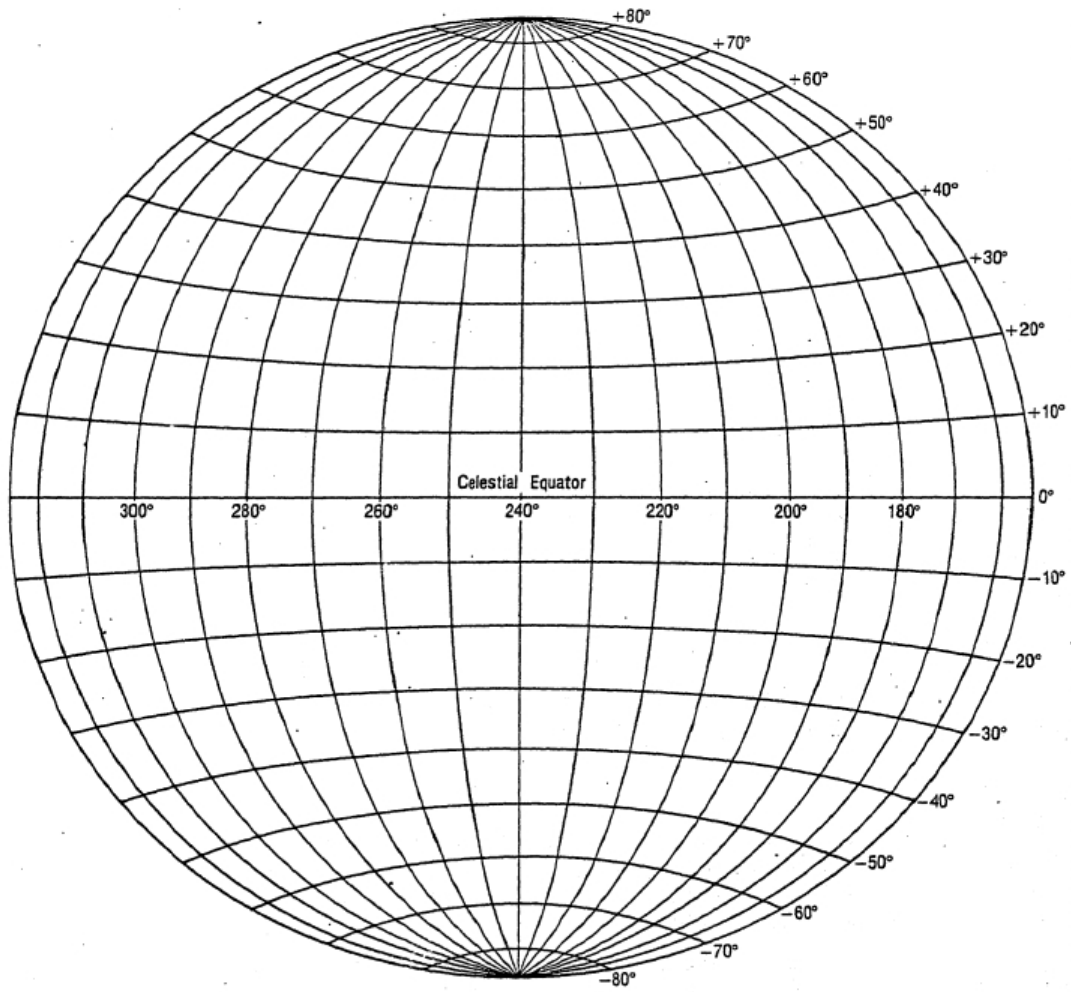
DRACO,  
The Dragon

HERCULES,  
The Kneeler



OPHIUCHUS,  
The Doctor

SERPENS,  
The Serpent

PVS  
July

Sept 1	160	+08
Oct 1	187	-03
Nov 1	216	-14
Dec 1	247	-22
Jan 1	281	-23
Feb 1	314	-17

## JULY

## Along the Sun's Path

Emerging in the evening twilight near the setting sun is bright Regulus. But this bright Heart of Leo does not linger long, for it is far to the west and goes to its setting soon after the sun. Regulus and the sun will be together in another month, about August 20th.

Virgo and Libra are high in the west. The heart of Scorpius is at the meridian. Sagittarius and Capricornus are rising, zodiacal constellations far to the south.

## About the Meridian

The red-giant-Antares, -Rival-of-Mars- dominates the summer season.

Scorpius is at his best at this time of year, his tail sweeping the southern horizon, and his heart, Antares, shining at the meridian a third of the way to the zenith.

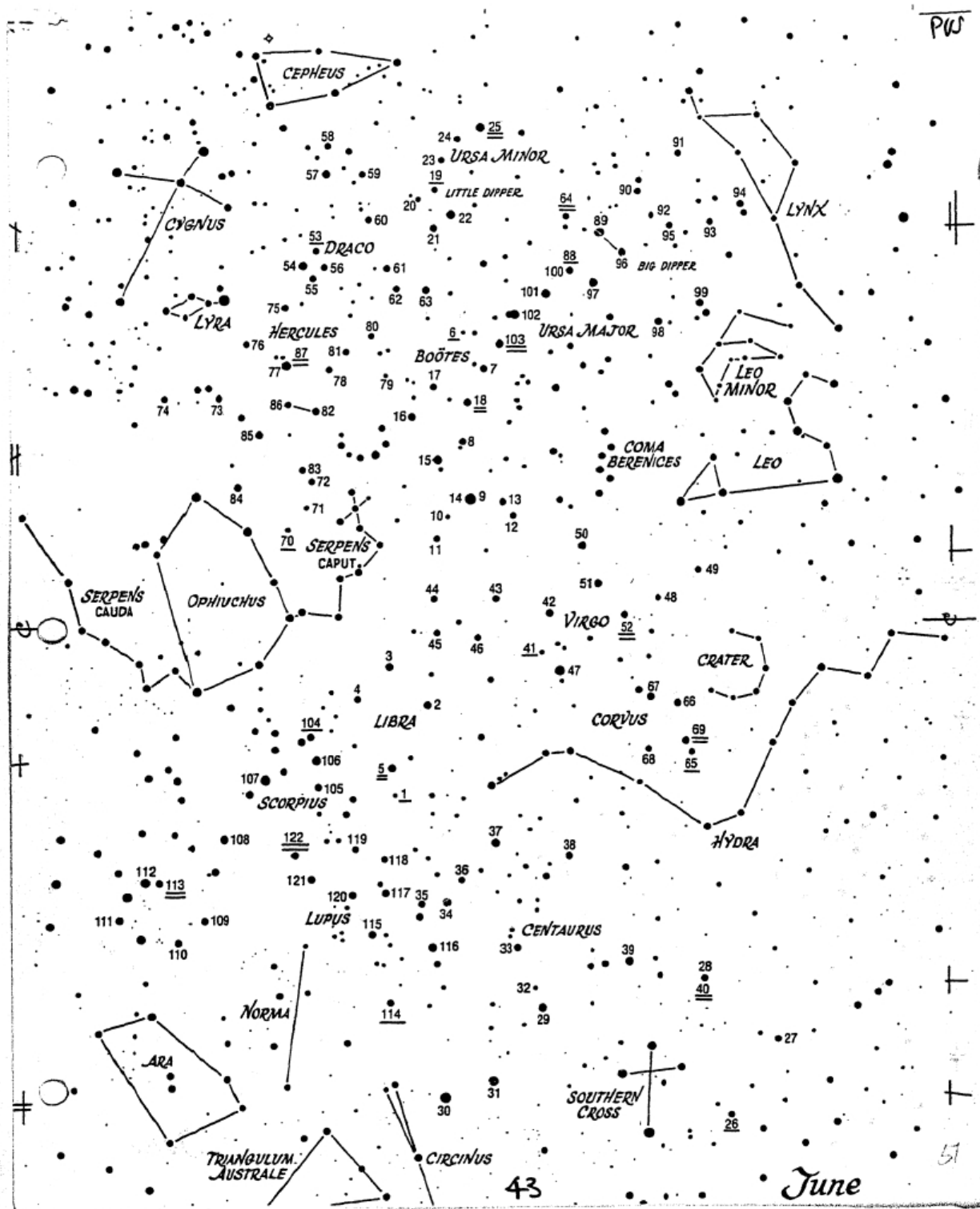
The heads of two giants, Ophiuchus and Hercules, are close to each other as if they're in a top-level conference. Corona Borealis is overhead, its crescent opening toward Hercules and the head of Draco.

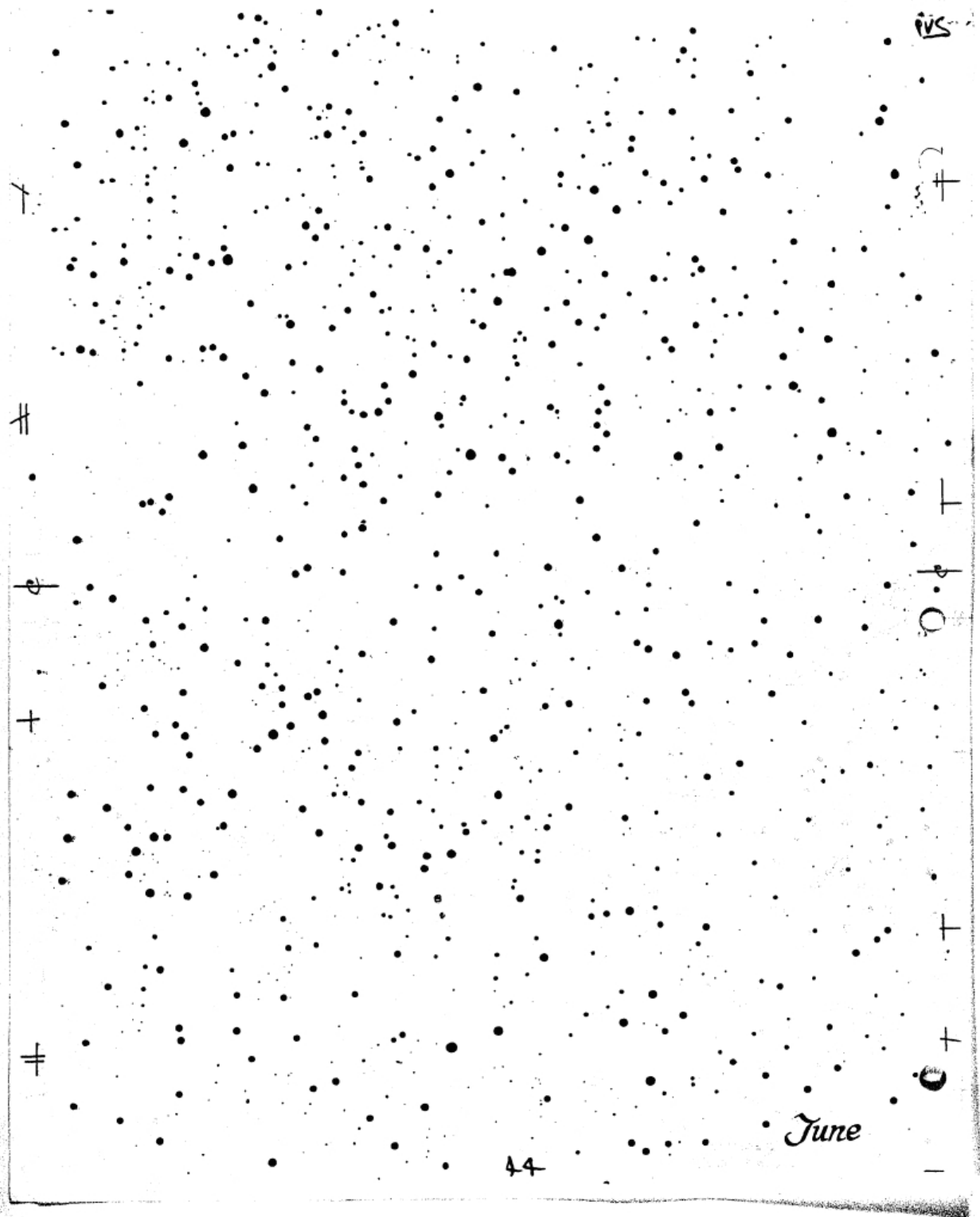
Bootes the Herdsman wanders toward the west marked by the brightest star in the northern hemisphere, Arcturus. The Arcturus-Spica-Antares triangle is prominent in the south. And the Little Dipper hangs downward as far to the south as it goes.

## Around the Sky

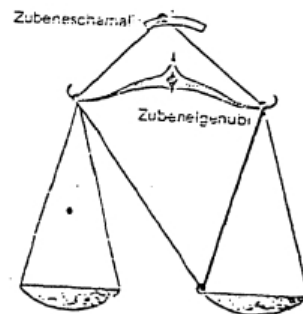
The Big Bear is about to make a four-footed landing on the northwestern horizon. On the opposite side of Polaris from the Big Dipper, Cassiopeia is beginning to rise as a large W-shaped group.

Leo is setting and the Winged Horse is rising. The Summer Triangle of Deneb-Vega-Altair is climbing higher in to the sky, soon to rule the late summer season. The triangle spans the Milky Way, and within that faint band of light flies Cygnus the Swan, southward toward the Scorpion.





LIBRA,  
The Scales



BOOTES,  
The Herdsman



URSA MINOR,  
The Little Bear

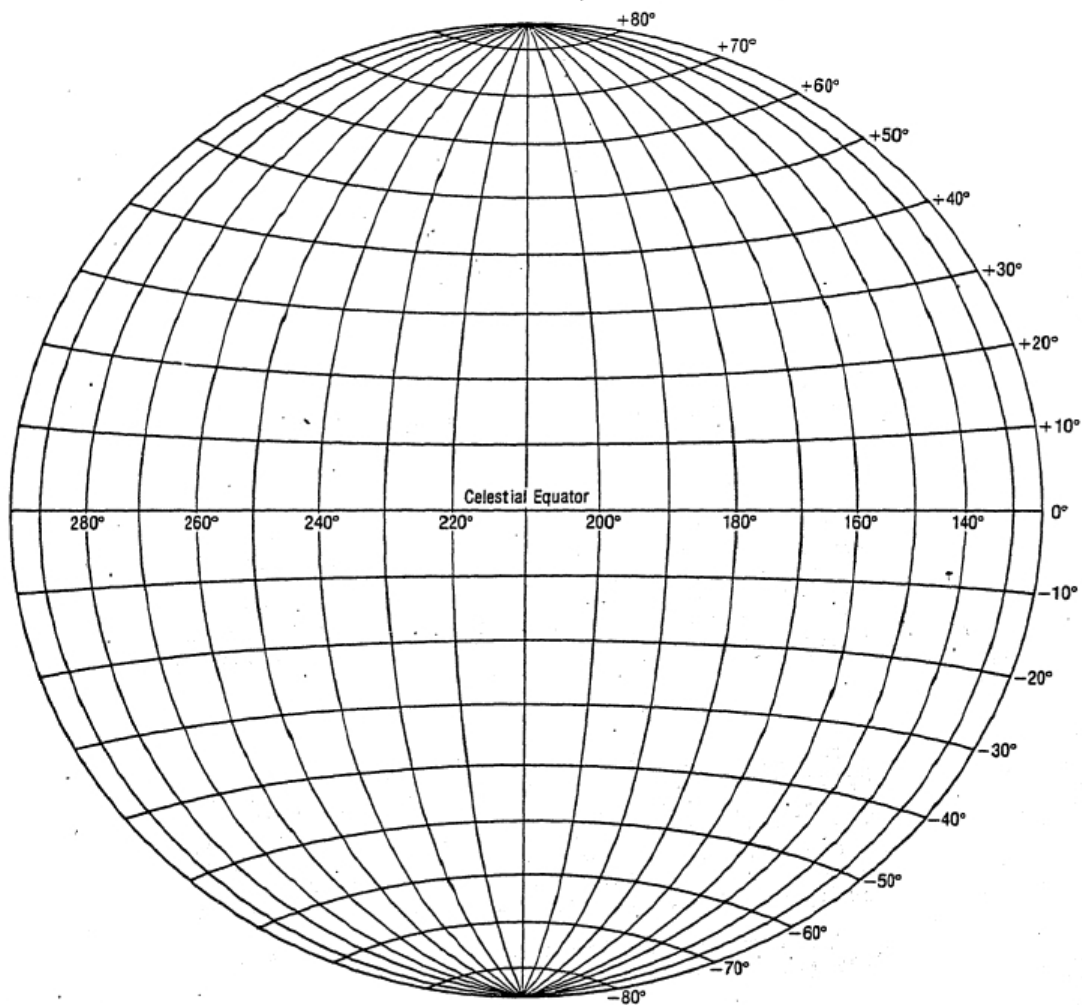


PVS

June

Star Name & Pronunciation	Constellation	Distance from	
		V.E.	Equator
		(°)	(°)
Alphard, al' fard	Hy	142	-09
Regulus, reg' u-lus	Leo	152	+12
Merak, me' rak	UMa	165	+56
Dubhe, dub' e	UMa	166	+62
Denebola, de-neb' o-la	Leo	177	+15
Phocda, fek' da	UMa	178	+54
Megrez, me' grez	UMa	183	+57
Acrux, a' kruks	Cru	186	-63
Gacrux, ga' kruks	Cru	188	-57
Becrux, be' kruks	Cru	192	-60
Alioth, al' i-oth	UMa	193	+56
Cor Caroli, kor kar' ol-i	Com	194	+38
Mizar, mi' ser	UMa	201	+55
Spica, spi' ka	Vir	201	-11
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PVS



JUNE

August 1	131	+18
Sept 1	160	+08
Oct 1	187	-03
Nov 1	216	-14
Dec 1	247	-22
Jan 1	281	-23

53



## JUNE

## Along the Sun's Path

The heads of the Twins are just above the place of the setting sun. On the 22nd of June, the sun will be at the feet of Castor at summer solstice.

Cancer is faint. But Regulus, marking Leo's heart, is a brilliant evening object. Huge Virgo follows, then the Scales. Red Antares glows in the southeast, the heart of the Scorpion.

Once the autumnal equinox occurred in Libra, the scales then marking the equality of day and night at that season.

## About the Meridian

A great curve unites the North Star to the Southern Cross. The curve sweeps through the handle of the Big Dipper, through Arcturus, then Spica, and down to Crux. But you have to be between the northern tropics and the equator to see both.

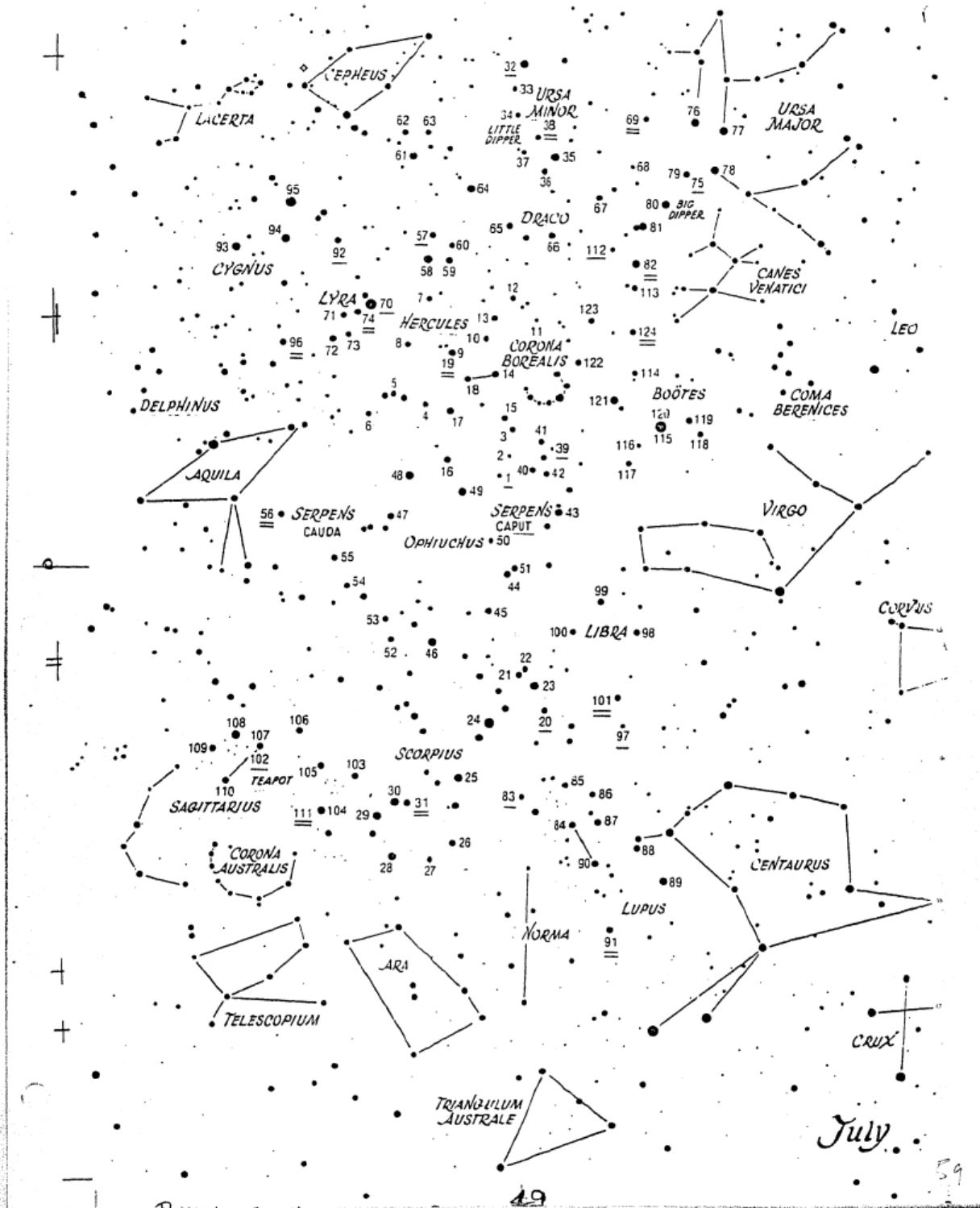
Arcturus crosses the meridian early in the evening. Above the head of Serpens is the Crown, opening toward Hercules and the Dragon's head. The Little Dipper stands on the end of its handle while the closest star to the sun, Rigil Kentaurus, reaches the meridian far to the south--61 degrees south of the celestial equator.

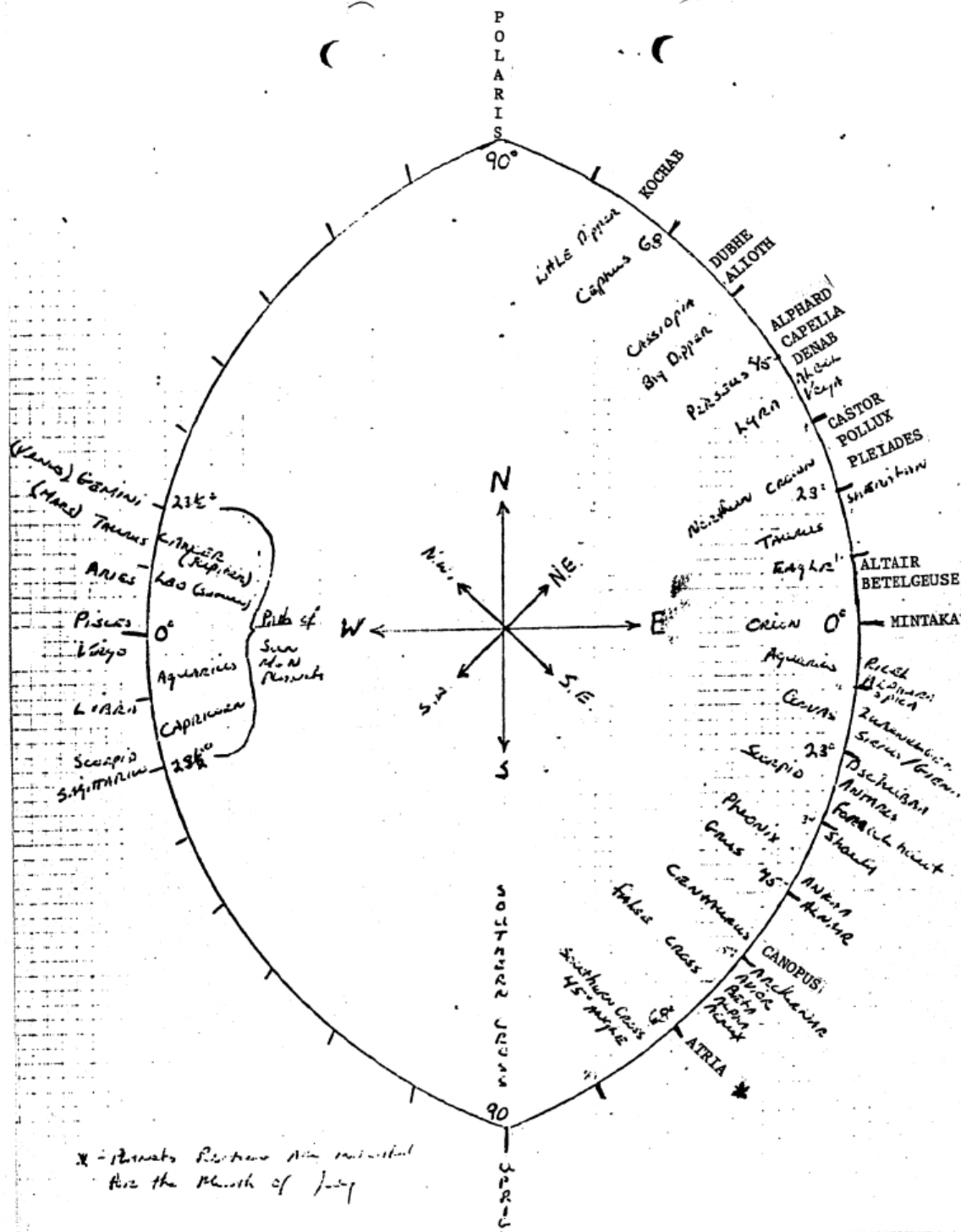
## Around the Sky

Two big triangles are in the sky. Arcturus and Spica form the base of each. One points toward the setting sun and has Regulus at its point. The other, toward the east, and it has Antares, the heart of Scorpius, at its apex. The heart of a Lion is at one point; the heart of a scorpion at the other, each dominating a season.

The Vega-Deneb-Altair triangle is well above the eastern horizon







NONINSTRUMENTAL NAVIGATION TRAINING PROGRAM

1980 Hawaii-Tahiti Hokule'a Voyage

Nainoa Thompson  
Will Kyselka

Polynesian Voyaging Society

February 7, 1979

## NONINSTRUMENTAL NAVIGATION TRAINING PROGRAM

Nainoa Thompson

Will Kyselka

February 7, 1979

The crew members of Hokule'a need to know the principles and specifics of holding a particular course set by the navigator. Such competency depends upon a knowledge of the stars as well as the ways of the sea.

### Noninstrumental Celestial Navigation

Crew members will become familiar with the terms and concepts relating to the stars.

1. Sidereal compass and the rising and setting places of principal stars.
2. The sun, and its eastward movement among the stars of about one degree a day. The sun's apparent path on the celestial sphere (ecliptic)
3. Relationship of the sun and full moon in the sky relative to the ecliptic.
4. The planets and their motions among the stars and relationship to the ecliptic.
5. Changes in the sky due to daily, annual, and precessional motions.

6. Changes in the azimuths of rising and setting stars with a change in latitude.
7. Steering stars for March through July as well as the stars for backsighting.
8. The solar and sidereal day as well as the synodic and sidereal month.
9. Major zenith stars of Polynesia.
10. Terms: celestial equator, declination, meridian,

#### Training

Training in the Planetarium and at sea as well as the knowledge to be gained through books will provide crew members the information they need to perform their steering tasks.

Five two-hour sessions in the Planetarium by Thompson/Kyselka will provide background information on the needed terms, concepts, and movements in the celestial sphere. Cost of training: \$50.00 per hour Planetarium fee. However, since the Bishop Museum views Polynesian voyaging with its domain of research, the fee is waived. Mention is to be made of the Museum's support of such research in pertinent publicity releases.

Crew members are expected to further their own knowledge through such sources as the following: STARS OVER HAWAII, Ed Bryan; STARS, H.L. Rey; NORTH STAR TO SOUTHERN CROSS, Kyselka/Lantermann; TWELVE SKY MAPS, Lantermann/Kyselka; POLYNESIAN STARS AND MEN, Kyselka/Bunton; and the articles BY STARS TO TAHITI, Kyselka/Thompson, and KEALAIKAHIKI, Kyselka/Thompson.

The work in the Planetarium will be followed by practical work on land and at sea in star identification and further knowledge of the celestial sphere.

#### Noninstrumental Navigation at Sea

Here we encounter the problems of holding a course when the steering stars are visible as well as maintaining direction when stars are obscured.

1. Sensing the weather. What signs to look for.  
Prediction for days in advance. Checking with weather satellite pictures.
2. A study of swells for direction-keeping.  
Indication of open sea swells and identification.  
Daytime clues for nighttime steering.
3. Steering--holding a desired course at any given wind direction or condition.
4. Extensive use of steering paddle, sweep, and center sweep.
5. Sail setting for self-steering and changes of sail setting for maximum efficiency.
6. The retaining of knowledge and experience will be done by chant, song, dance.
7. Overnight trips or weekends on Hokule'a will provide opportunity for experiencing the sea and learning the celestial sphere.

February 7, 1979.



Natural Navigation

~~Nat.~~ instrumental Navigation

Way Finding

Haw to Tahiti: 3000 nm (10,000 km) x 2

Metaphor

Namoa learns; here's Tahiti.

Process of Data / Chart / Overload of Info - stars:

Look for patterns / Random scattered <sup>groups</sup> ~~stars~~

"For 3 yrs Namoa & I sailed back and forth between Hawaii & Tahiti in The Museum Planetarium."

We explored the skies widely, searching for ways that the ancients might have used the stars in sailing to tiny islands over vast Pacific distances.

Namoa kept detailed records but how could he remember it all? Orion is rising as the tail of Canis Major <sup>reaches the meridian</sup>. Arcturus is almost at the meridian when Spica & Hoku-lea (Arcturus) are rising. With Arcturus at the meridian Kaph is setting & H is 4° above the horizon. When Navi sets, the back 2 stars of the False Cross are on the meridian. Gacrux is rising as Canopus & the Pleiades sets. When Regulus is at the meridian the False Cross & 80 Cross are tilted the same to the horizon.

There is data overload & deduction and reduction takes place - hard to remember all of the data. Thus, look for useful things: Patterns + relationships

(2)

A process of mind & soul.

Not only what is seen above horizon but also what is visualized below the horizon.

Info generated outdoors, in Planetarium

H had Transponder

Nav: Internal = D.R.; everything processed in head. Reference Cae used. Programmed into R.Cae are currents & winds above & below equator.

( '76 = 70° int wind objective. )

4° above QP have ITCZ + Eq. Counter Current why pushes vessels east.

Use of land life: Birds; 2 types; expanded land fall - watch for reefs.

Direction during day: Arc. Watch stars in a.m.

ANTARES in front of Scorpion. Ries. Use sun NE swells most of time, SE swell generated below QP. Swell compass. V. of stars & swell.

Point to SE swell - MANU/row.

Navigation at center of  $\odot$ . ETAK principle.

Direction: Hawaii, Mangrove, Tuamotu, Tahiti,  
Cook Island. Latitude.

Either Island move - vessel still. A way proceeding  
info. Metaphor. We know islands don't move.

122 stars memorized.

So Cross  $6^\circ$  above horizon from Hawaii

Earth - Twin - not evening  $\star$

$\rightarrow$  Alpha & Beta Centaurus. N we have Big Dipper  
& N $\star$  Corvus the crow Jupiter & Saturn  
& H off to left. Mark & Double point  
to N $\star$  ( $21^\circ$  above horizon in Hawaii)

(Jup brighter). (So Cross  $6^\circ$  bottom -  $12^\circ$  top  $\star$ )

Handle to H to Spica (over Sarnad to  
So Cross - Hawaii only place that N $\star$  & So Cross  
can be seen.

Sirius set w/ Pollux (& Castor) in Tahiti.  
What happens as we go north.

