A Computational Perspective on Navigation

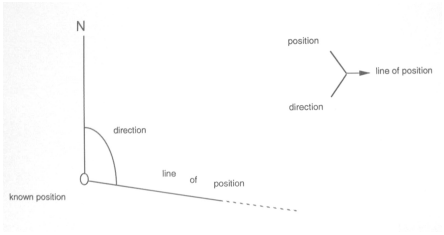
Marr's three descriptions for every intelligent system

- Computational
- Representational/algorithmic
- Implementational

Constraints

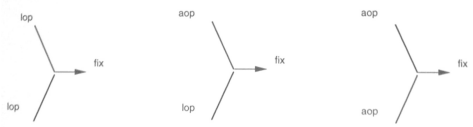
- A constraint excludes some possibilities in a range of possibilities.
- A particular constraint may leave many possibilities in play.
- Constraints can be combined to restrict the range of possibilities in play.
- Sometimes it is possible to combine constraints in a way that leaves only a single possibility.

Line of Position

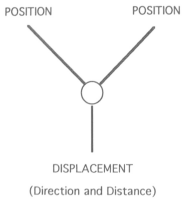


Arc of Position

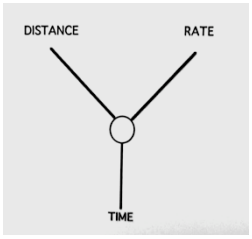
Combining one-dimensional Constraints



Position/Displacement Constraint

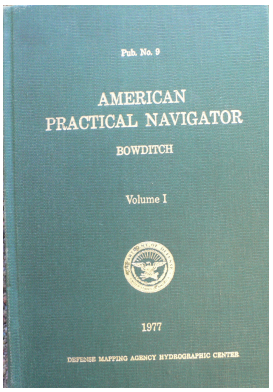


Distance, Rate, and Time Constraint



Where are we?

- On earth
- In California
- La Jolla
- Pepper Canyon Hall 109 at UCSD
- Between the parking office and Vis Arts



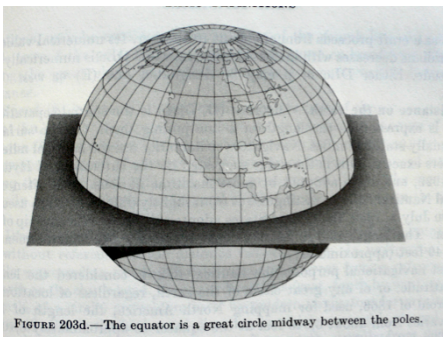


FIGURE 203d.—The equator is a great circle midway between the poles.

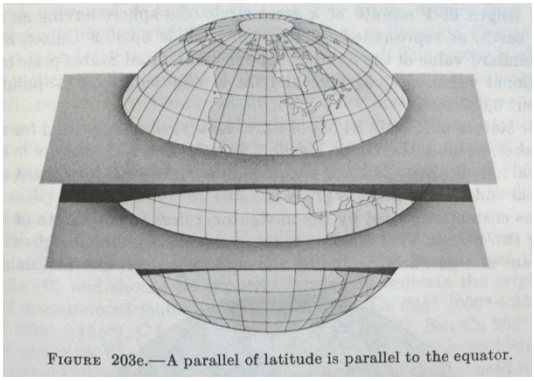


FIGURE 203e.—A parallel of latitude is parallel to the equator.

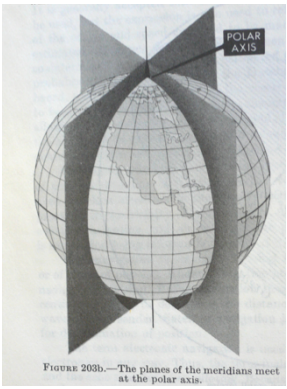


FIGURE 203b.—The planes of the meridians meet at the polar axis.

Where are we?

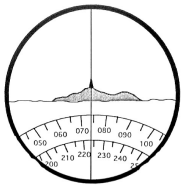
- Pepper Canyon Hall 109 at UCSD.
  - Latitude 32° 52’ 39.56” N
  - Longitude 117° 14’ 13.79” W

Computation via the propagation of representational state.

- Ship position plotting
- What information…
  - Goes where?
  - When?
  - In what form?

Navigation team on the bridge of the Palau

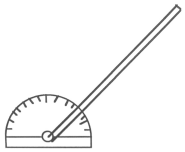
View through the Alidade

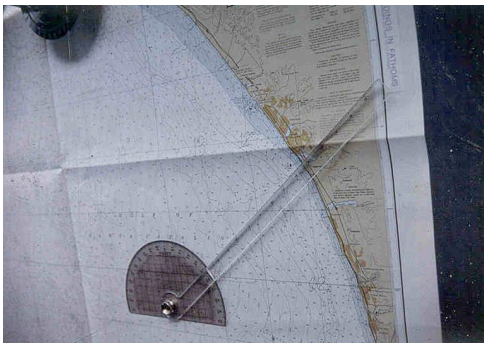


The Bearing Record Book

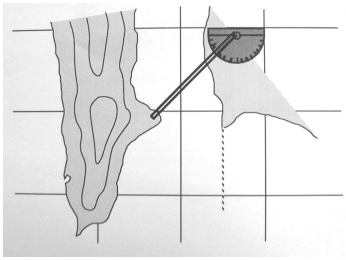
	Tower	Hotel	Pier	Depth
13:25		008		23
13:28		006	148	27
13:31		006	146	32
13:34		005	143	29
13:37	205	004	139	30
13:40	211	004	135	35
13:43	218	003	130	24
13:46	**224**	003	122	26

The Hoey

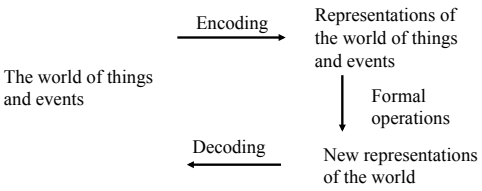




Hoey in Coordination with the Chart



The Secret of Our Success



Units in the Western System

- Geographical position: latitude, longitude
- Nautical Mile
- Time
- Charts, properties of projections

Navigation Chart

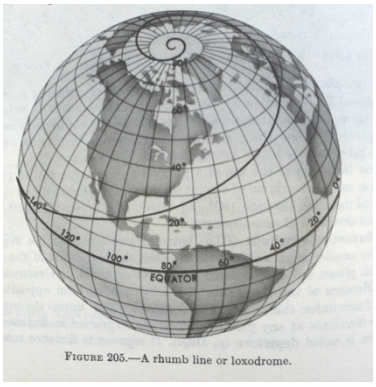
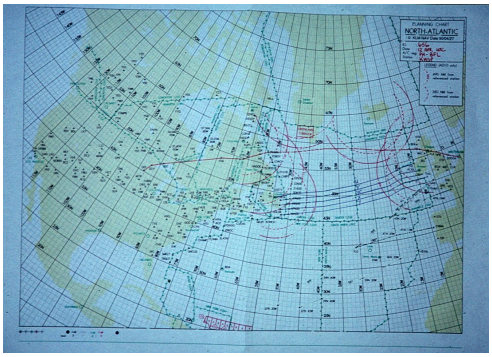


FIGURE 205.—A rhumb line or loxodrome.

N. Atlantic Air Routes



Pre-modern Western Navigation

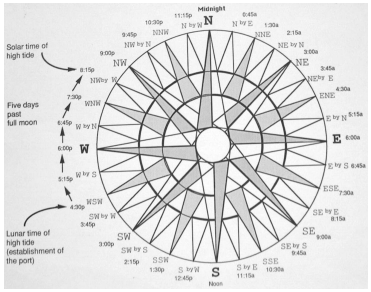
- Sidereal Compass
- Linear constellations
- Units
  - Day's Sail
  - Kenning (= etak of sighting)
- Birds
- Latitude Sailing

The divergence of traditions

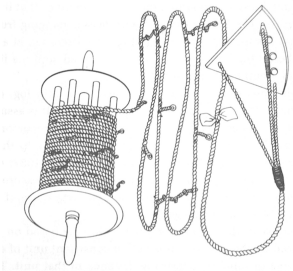
- Crystallization of knowledge and practice in physical artifacts
- Measurement and analog/digital conversions
- Digital computation
- Chart as the model of the world

Astrolabe

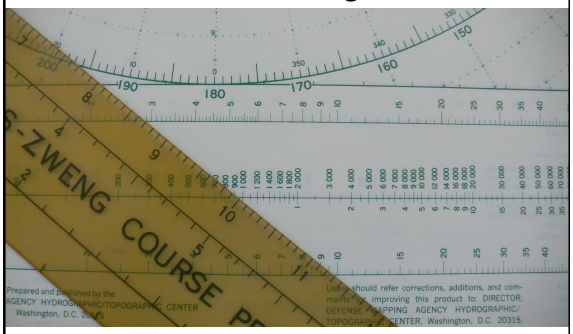
Medieval Tide Computer



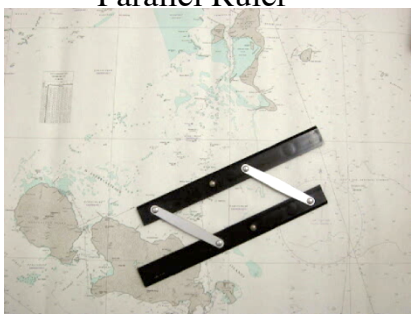
Chip Log

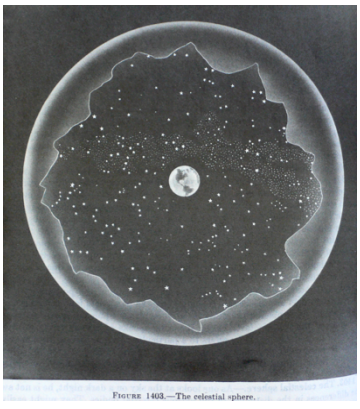


3-scale nomogram



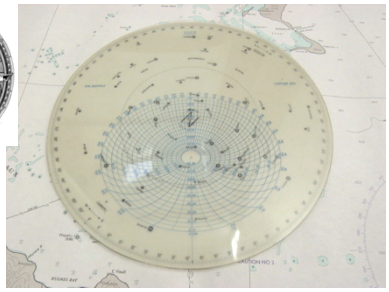
Parallel Ruler





Sextant

Star Finder (descendant of Astrolabe)

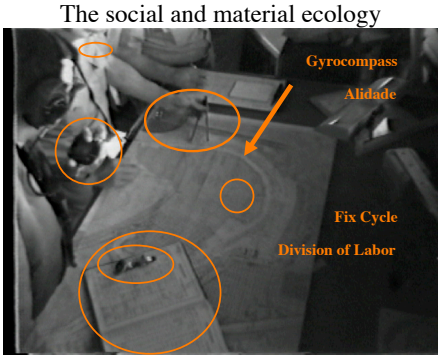


Harrison's Marine Chronometer

The Discovery of Longitude
An Historical Account of
Maritime Navigational Practice
and the subsequent Invention of the Chronometer
by Jonathan Medwin

http://rubens.anu.edu.au/student.projects97/naval/

The social and material ecology



Concepts

- Every cognitive ecosystem has a history
- Every history is contingent
- Change – adaptation through constraint satisfaction
- Relations are not found in the properties of the elements, but in the roles the elements play in an activity.

Ecosystem Relations

- Dependence
- Synergy – symbiosis
- Competition – arms race
- Predator – prey