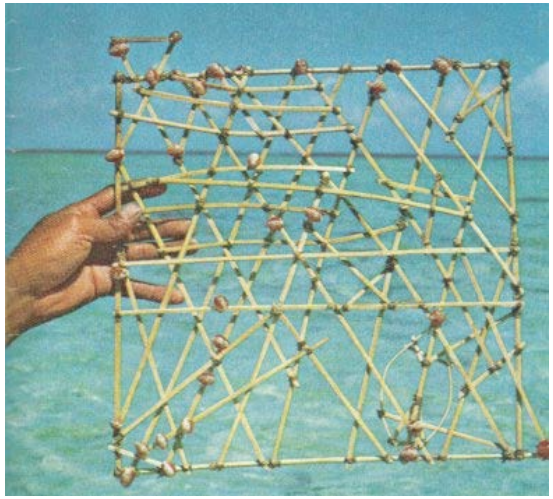
Geog 126: Maps in Science and Society

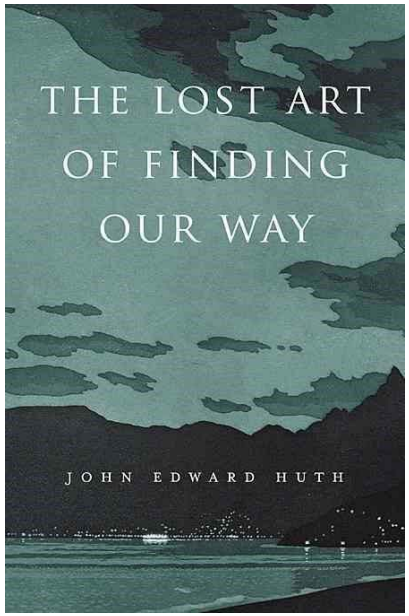
From Before the Compass to the Chronometer

https://www.youtube.com/watch?v=ymI5Uv5cGU4

- Homo sapiens leaves Africa 65,000BP
- Arrives at Tierra del Fuego 15,000BP
- Agriculture develops after 11,500BP
- First ships about 4,000BC in Turkey
- Ancient Egypt unified around 3100 B.C. conquered by Alexander the Great in 332 B.C.
- Pacific Islands 800BC-1200AD
- How did H. Sapiens use maps?

Before maps and compasses





Information from:

Sun
Moon
Stars
Wind
Currents
Clouds
Tides
Fish
Birds
Ocean color
Pacing
Smell/Sounds/Vision

Ancient Egypt: Saqqara سقارة

Imhotep
(c. 2650–2600 BC)

Egypt

Periodic Rediscovery

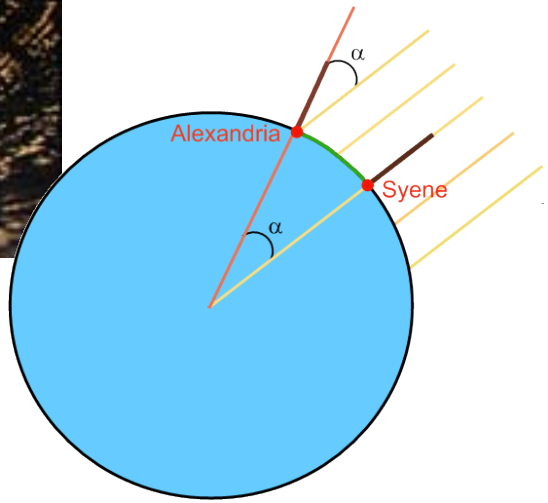
Herodotus
(Greek, Fifth Century BC)

the pharaoh Sesostris "distributed the land to all the Egyptians, giving an equal square portion to each man, and from this he made his revenue… and if the river should take away any man's portion… the king used to send men to examine and to find out by measurement how much less the piece of land had become, in order that for the future the man might pay less…"

Nilometer: Elephantine Island

Length using ropes. Crop survey 1400-1390 B.C.

The Well at Syene

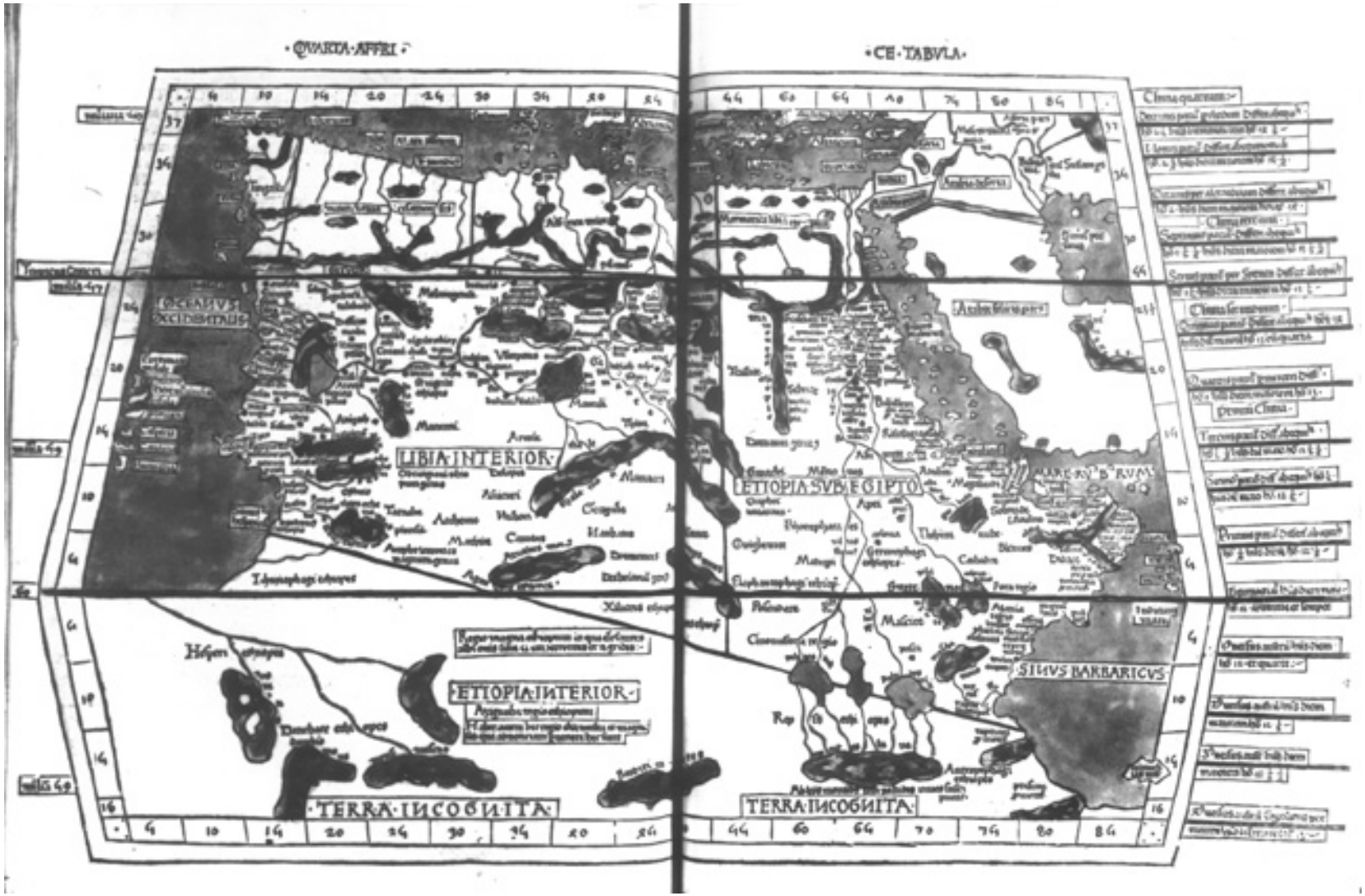


Eratosthenes (276-194 BC)

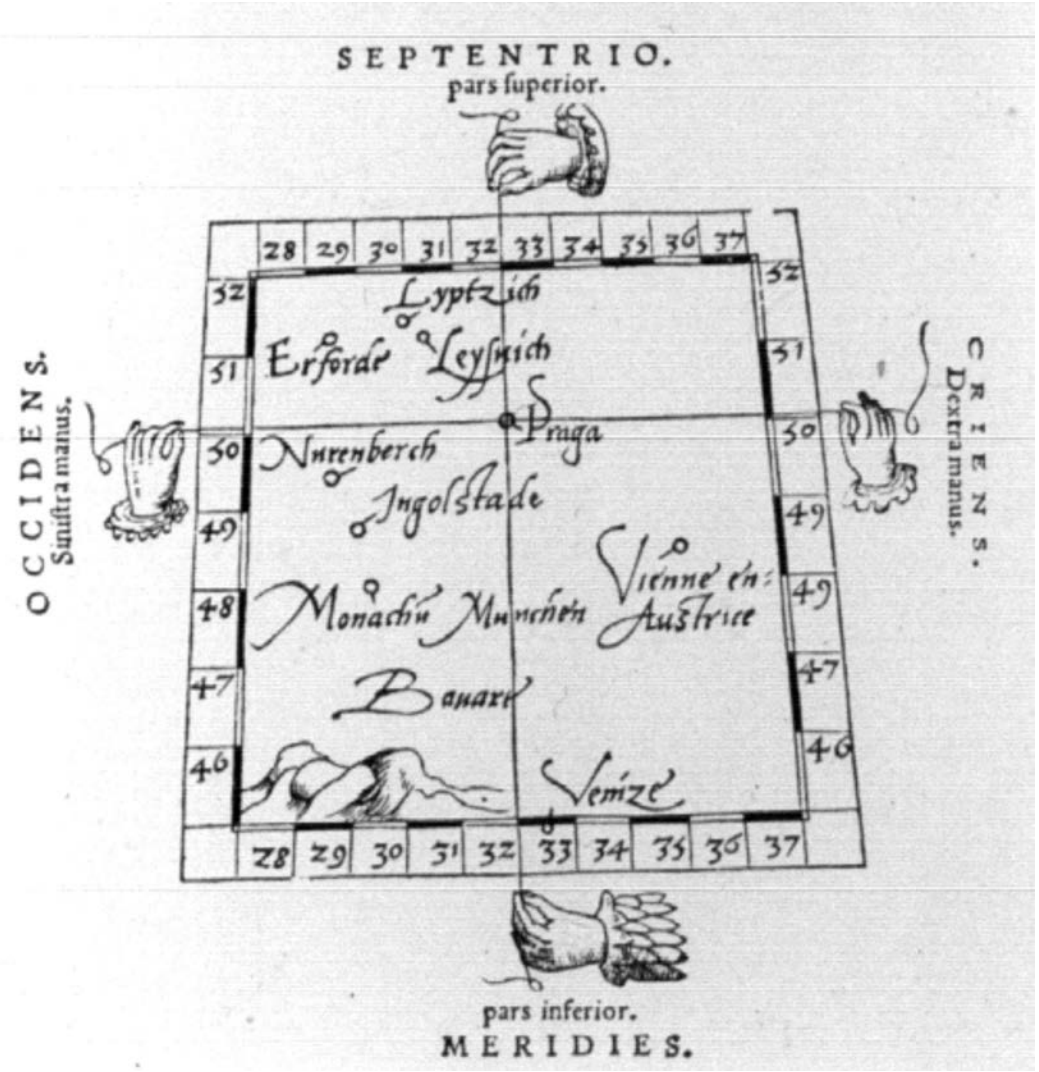
Claudius Ptolemy

- Lived in Egypt, held Roman citizenship, wrote in Greek c. AD 100 – c. 170
- astronomical treatise now known as the *Almagest*
- Geographical treatise: *The Geography*
- Contains 8 books or volumes
  - Description of the known world
  - Gazetteer: Place name list with lat/longs
  - Instructions on how to do map projections
  - Four of his own map projections
  - Maps at http://penelope.uchicago.edu/Thayer/E/Gazetteer/Periods/Roman/_Texts/Ptolemy/home.html

Ptolemy (90AD-168): (Ulm)



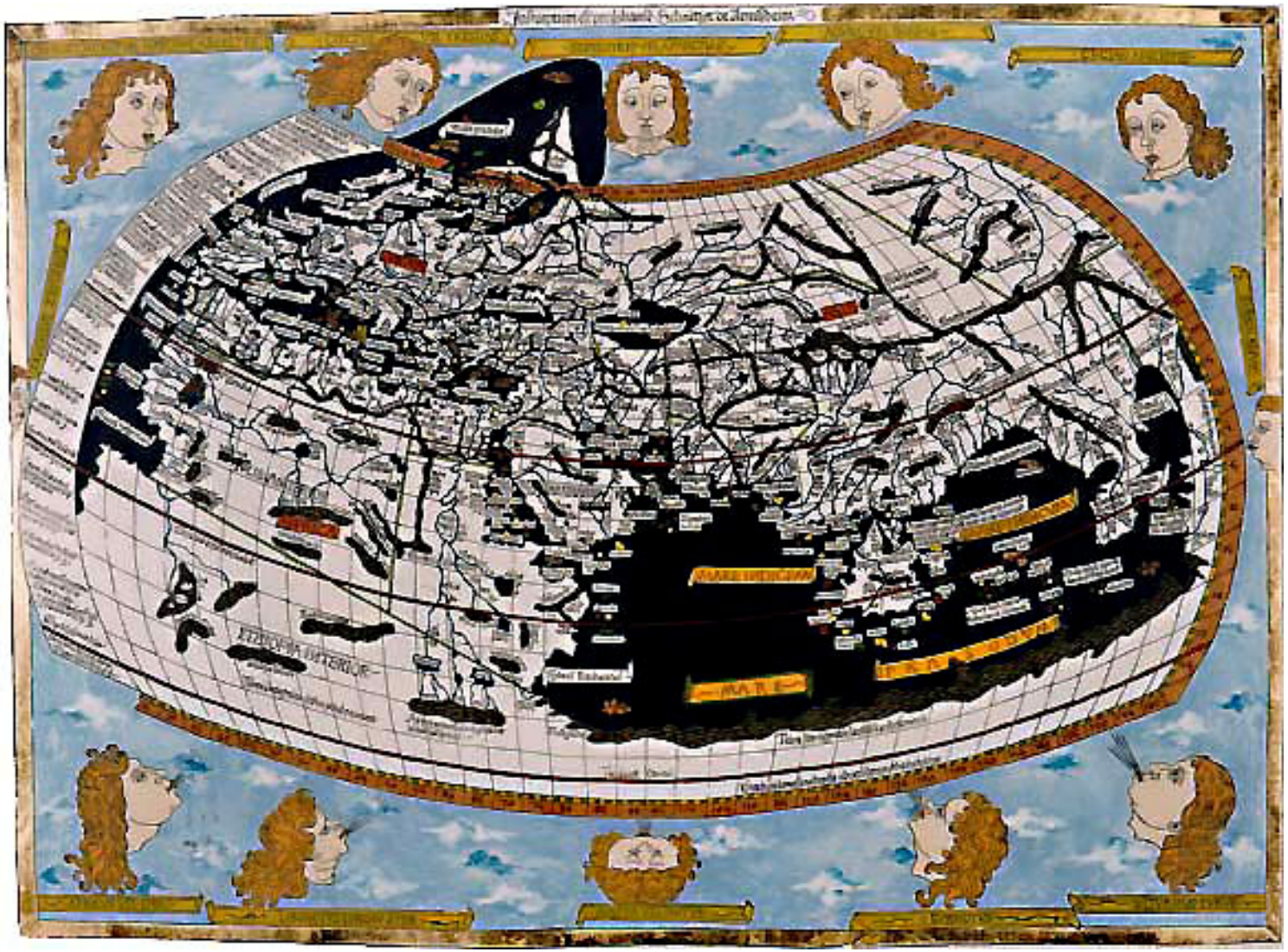
Ptolemy's Gazeteer



Lost: Maps and Text

- Marinus of Tyre plus Greek/Roman/Persian gazetteers
- 180 degrees of longitude from the Blessed Islands in the Atlantic Ocean to the middle of China
- 80 degrees of latitude from Shetland to anti-Meroe (east coast of Africa)
- Ptolemy was well aware that he knew about only a quarter of the globe
- Parts of the book date at different time periods
- After fall of Rome, book disappears
- Rediscovered by the Arabic revival about 800-1300AD
  - Ibn Khordadbeh (c. 820 – 912 CE) Persian *Kitāb al Masālik w'al Mamālik* (The Book of Roads and Kingdoms)
  - Ahmad al-Ya'qubi (Died AD 897-898) *Kitab al-Buldan* (Book of the Countries) Mahgreb
  - Muḥammad Abū'l-Qāsim Ibn Ḥawqal Ṣūrat al-'Arḍ (" ;صورة الارضThe face of the Earth"

More Ptolemy 1482



The Geography Rerediscovered

- Latin translation of the *Geography* was made in 1406 or 1407 by Jacobus Angelus in Florence, Italy, under the name *Geographia Claudii Ptolemaei*
- Probably did not include the maps
- Recorded that Manuel Chrysoloras gave Palla Strozzi a Greek copy of Planudes's maps in Florence in 1397
- Many versions by the time of the Ulm edition

Regional and Global maps

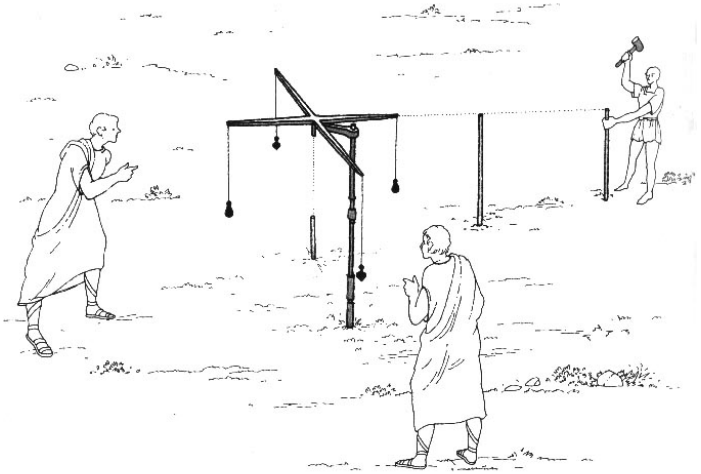
India

INDIA·INTRA·GANGEM·
SINVS·GANGETICVS
MARE·
INDICVM
Sacharum pars.
Scithie extra imaum pars.
Indie extra gangem pars.
Arachosia

Legs: Navigation and surveying

- Needed way to fix direction
- Also to standardize lengths
- Trip = multiple legs
- Problem: Errors compound and multiply
- Especially a problem at sea!
- Needed means to find latitude

Roman Surveying: The groma



China 4th Century BC Lodestone

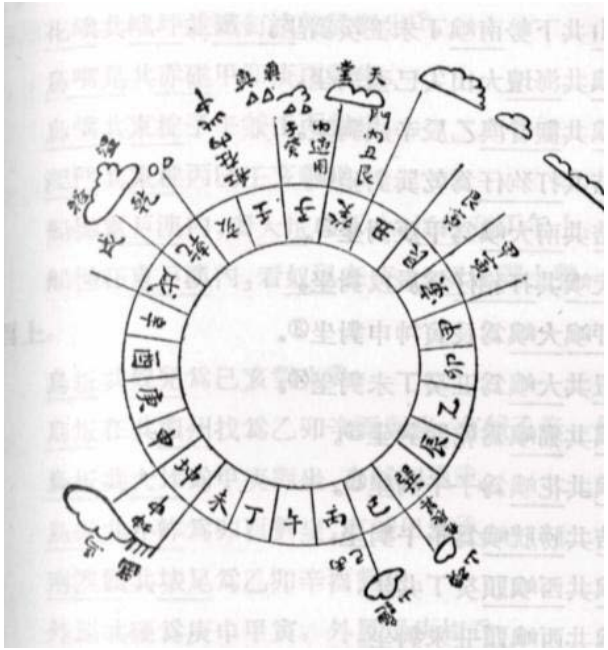
Book of the Devil Valley Master (鬼谷子):
"The lodestone makes iron come or it attracts it."

Magnetized needles or “fish”

- The earliest recorded actual use of a **magnetized needle for navigational purposes** is Zhu Yu's book *Pingzhou Table Talks* (萍洲可談; Pingzhou Ketan) of AD 1119 (written from 1111 to 1117 AD):
- *“The navigator knows the geography, he watches the stars at night, watches the sun at day; when it is dark and cloudy, he watches the compass.*”
- This would have been aided by Shen Kuo's discovery of the concept of true north: magnetic declination towards the magnetic north pole away from the polestar

First recorded use of a compass at sea

- “The Customs of Cambodia” by Yuan dynasty diplomat Zhou Daguan, who described his 1296 voyage from Wenzhou to Angkor Thom
- 48 point compass



Ankor Thom

Distance measures

- 1 ordinary Mesopotamian cubit = 5 hands = 30 fingers = 25 thumbs = 500 mm.
- 1 great Mesopotamian cubit = 6 hands = 36 fingers = 30 thumbs = 600 mm.
- 1 ordinary Egyptian cubit = 6 palms = 24 fingers = 450 mm.
- 1 royal Egyptian cubit = 7 palms = 28 fingers = 525 mm.

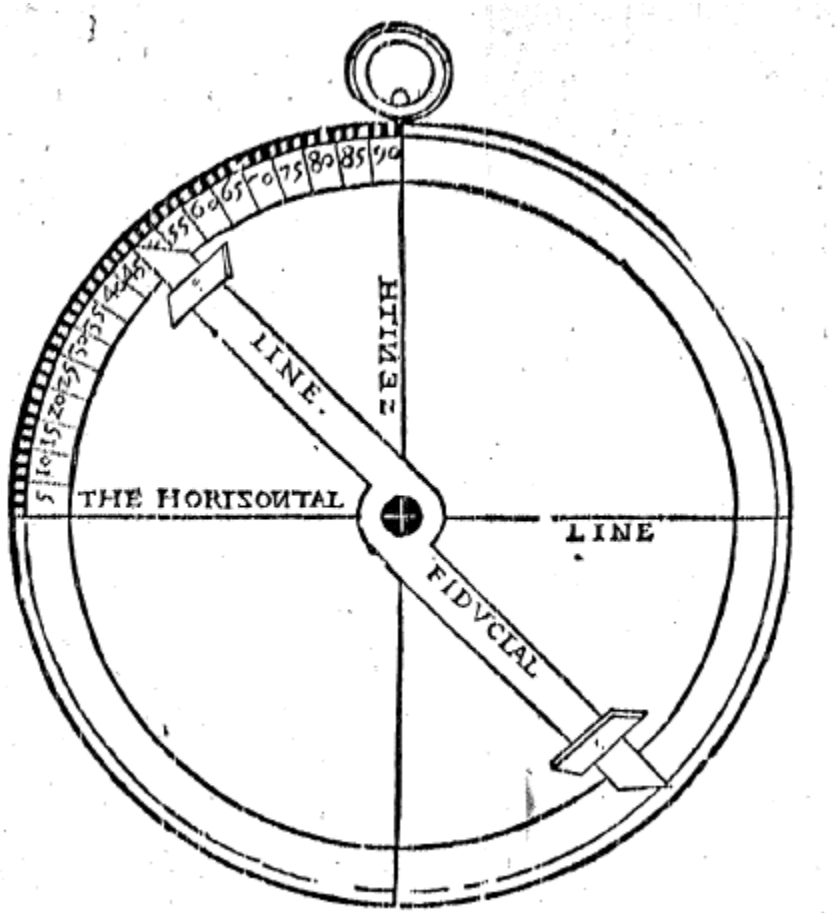
- The Greeks used cubits based on hands while the Romans used cubits based on palms

Roman Distance Measurements			
Unit	**Roman Equivalent**	**Description**	**Modern**
Mille (mille passus)	1000 passus	Roman mile. Roughly how far a legionary could march in a day. Slightly shorter than a modern mile.	1,618 yds or 1,480 meters.
Stadium (stadia)	125 passus	Used as a measurement by sea.	615 ft. or 187.5 meters
Actus	120 pedes	Used for land surveying and roughly translated as how far oxen would drive a plough before being turned.	116 ft. or 35.5 meters
Passus	1/1000 mille or 2 gradus	Roughly the 'pace' step of a single legionary.	1.62 yards or 1.48 meters
Gradus (gradii)	2 1/2 pedes	1/2 passus	.81 yards or .74 meters
Pes (pedes)	12 unciae	Roman foot.	11.6 inches or 29.5 cm
Uncia (unciae)	Base Unit	Roman inch.	0.97 inches or 24.6 mm

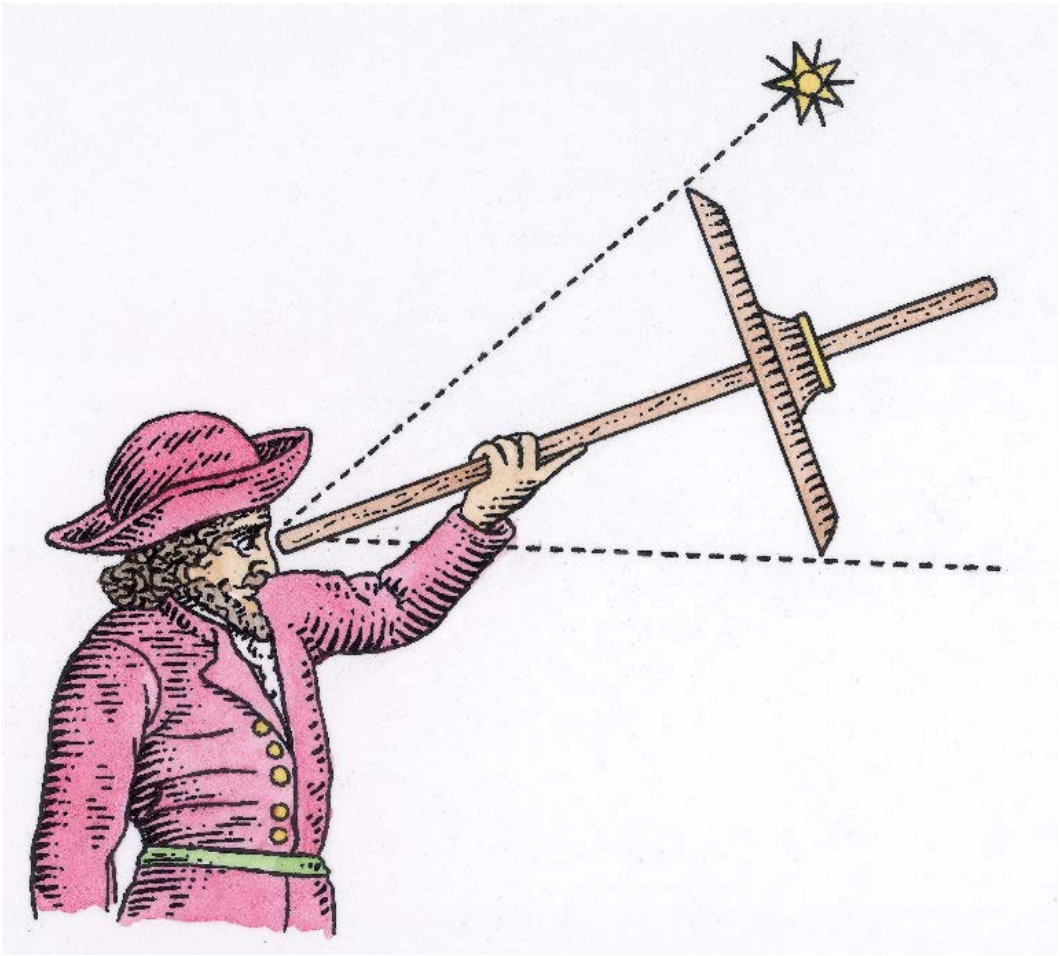
Place descriptions

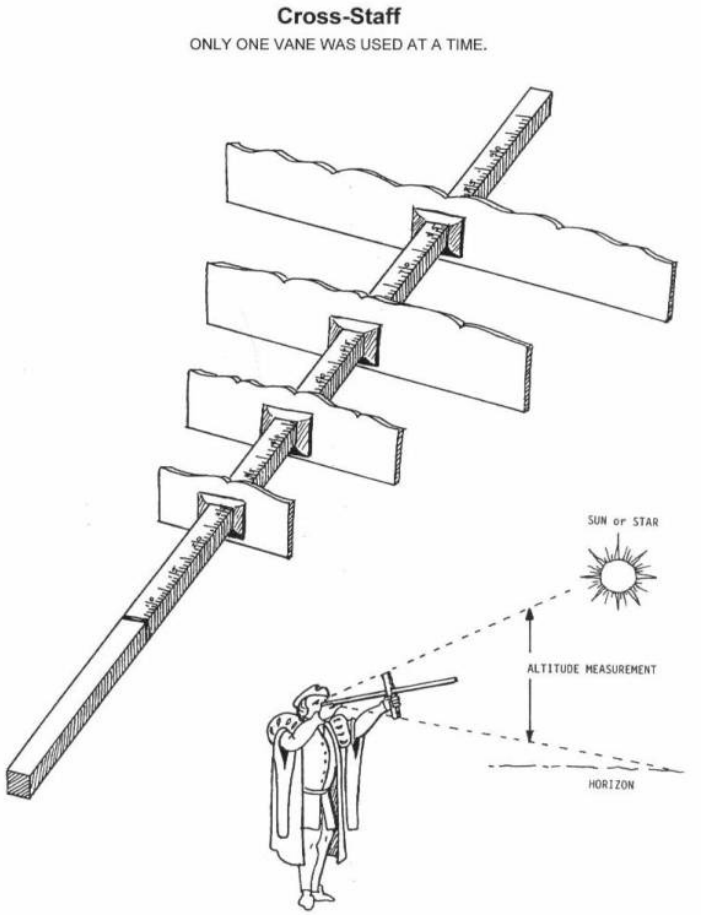
- Geography had a long tradition of listing places and everything found there
- The Travels of Marco Polo written by Rustichello da Pisa from stories told by Marco Polo, describing travels through Asia between 1271 and 1295
- https://en.wikisource.org/wiki/The_Travels_of_Marco_Polo
- Example: From Juju you set out again and travel four days towards the south, finding many towns and villages. The people are great traders and craftsmen, are all Idolaters, and use the paper-money of the Great Kaan their Sovereign. At the end of those four days you come to the city of Cacanfu belonging to the province of Cathay, and of it I shall now speak.

The astrolabe: Latitude

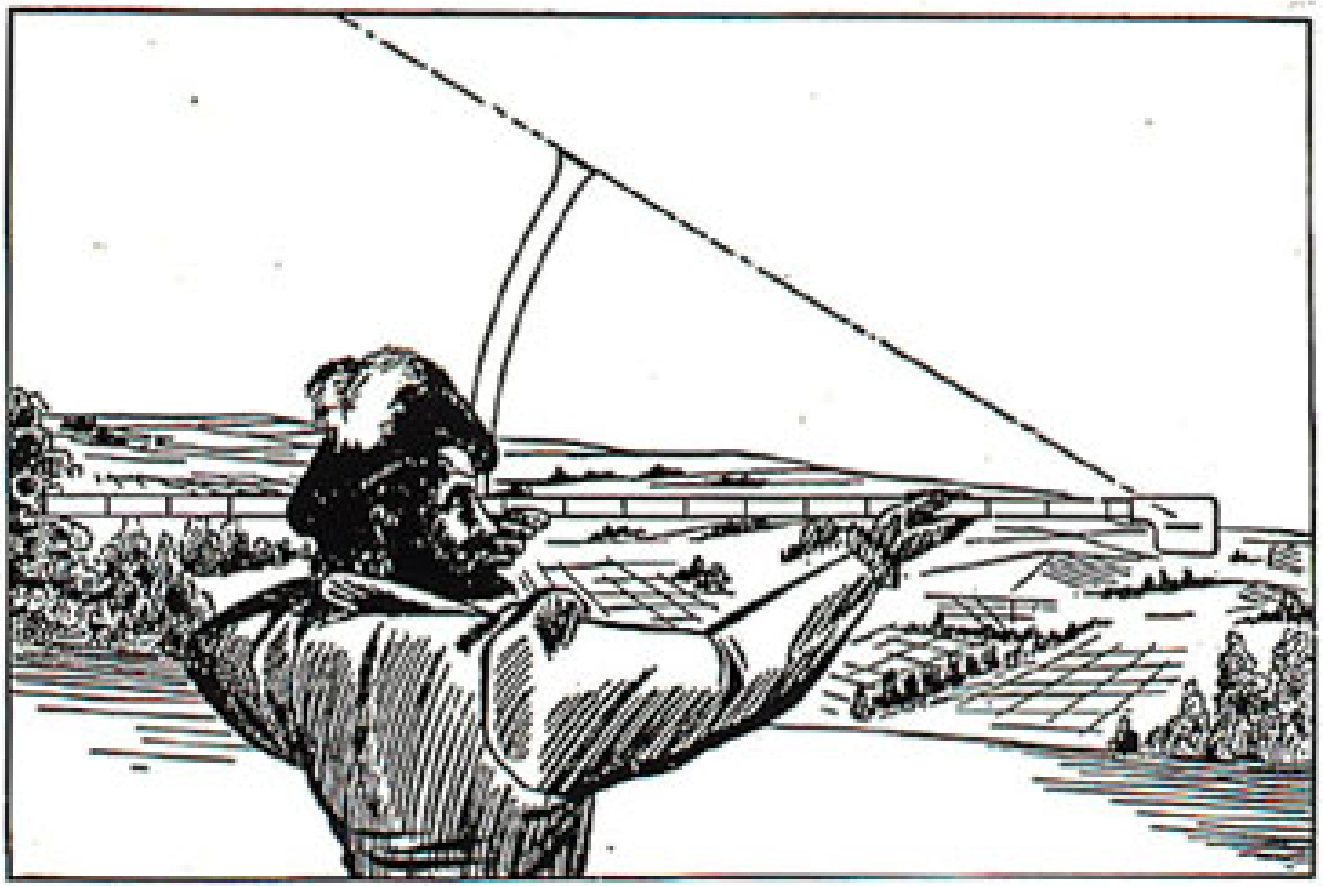


Cross staff



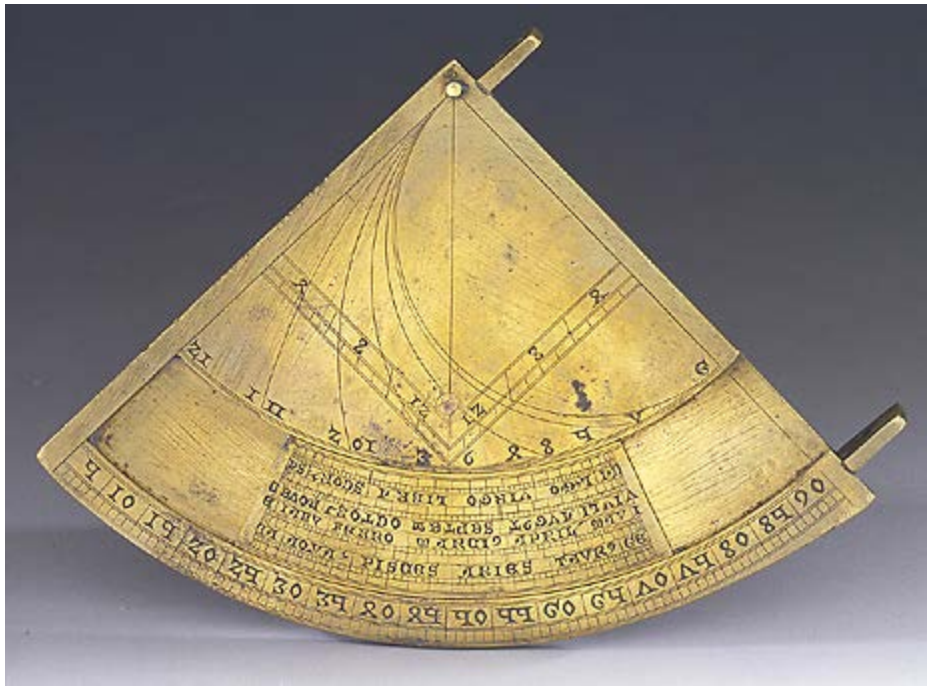

Cross-Staff
ONLY ONE VANE WAS USED AT A TIME.
SUN or STAR
ALTITUDE MEASUREMENT
HORIZON

Back-staff

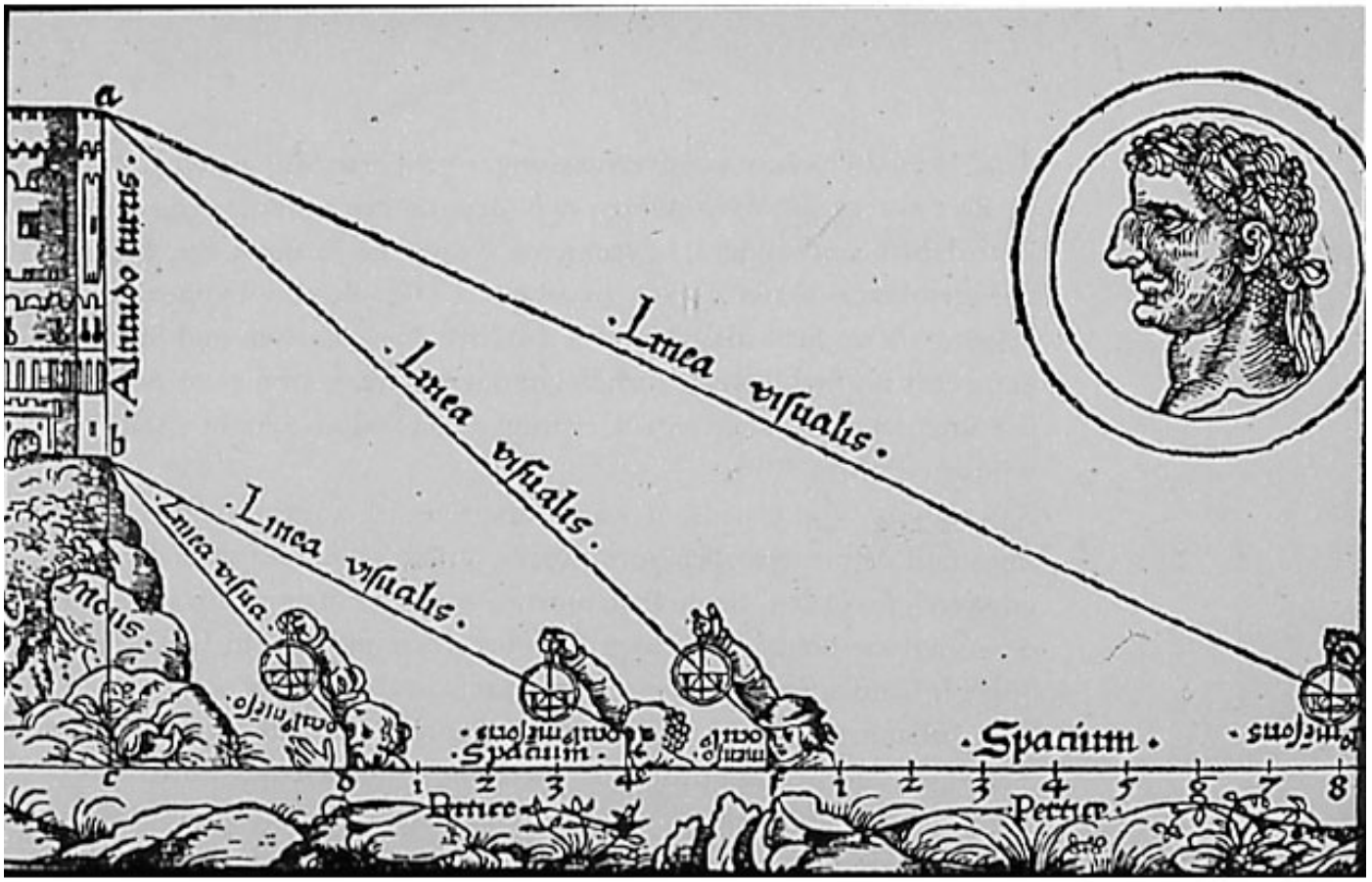


The back-staff was an invention of John Davis of Sandridge, who described it in a book entitled *The Seamans Secrets* published in 1607.

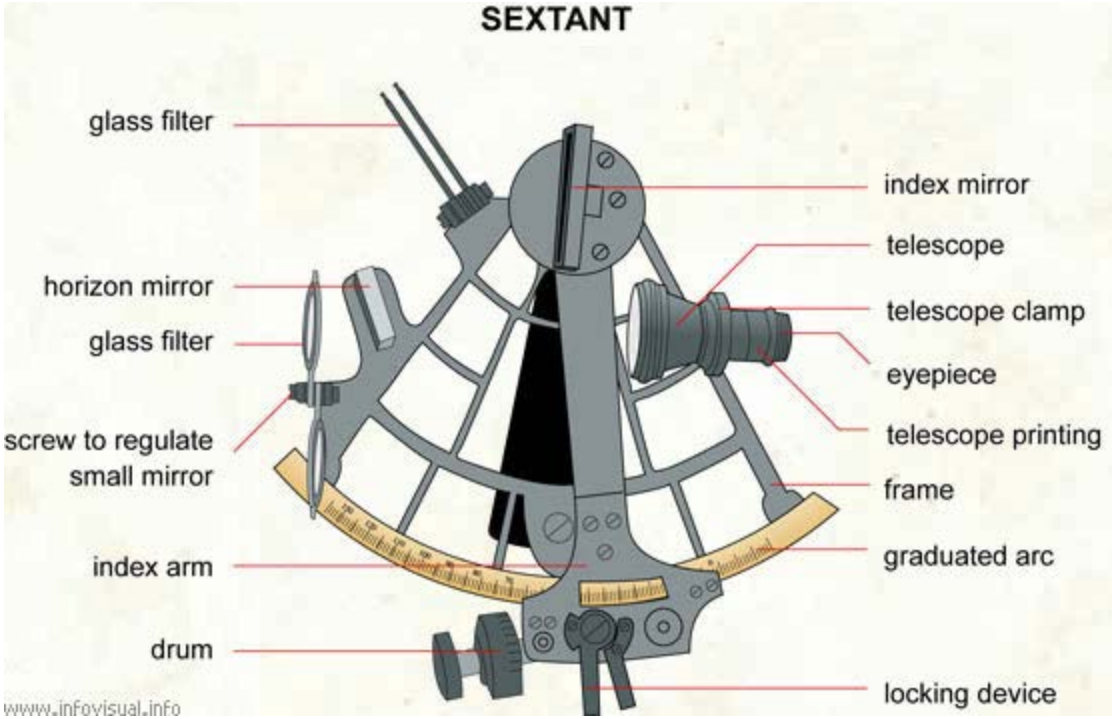
Quadrant/Octant



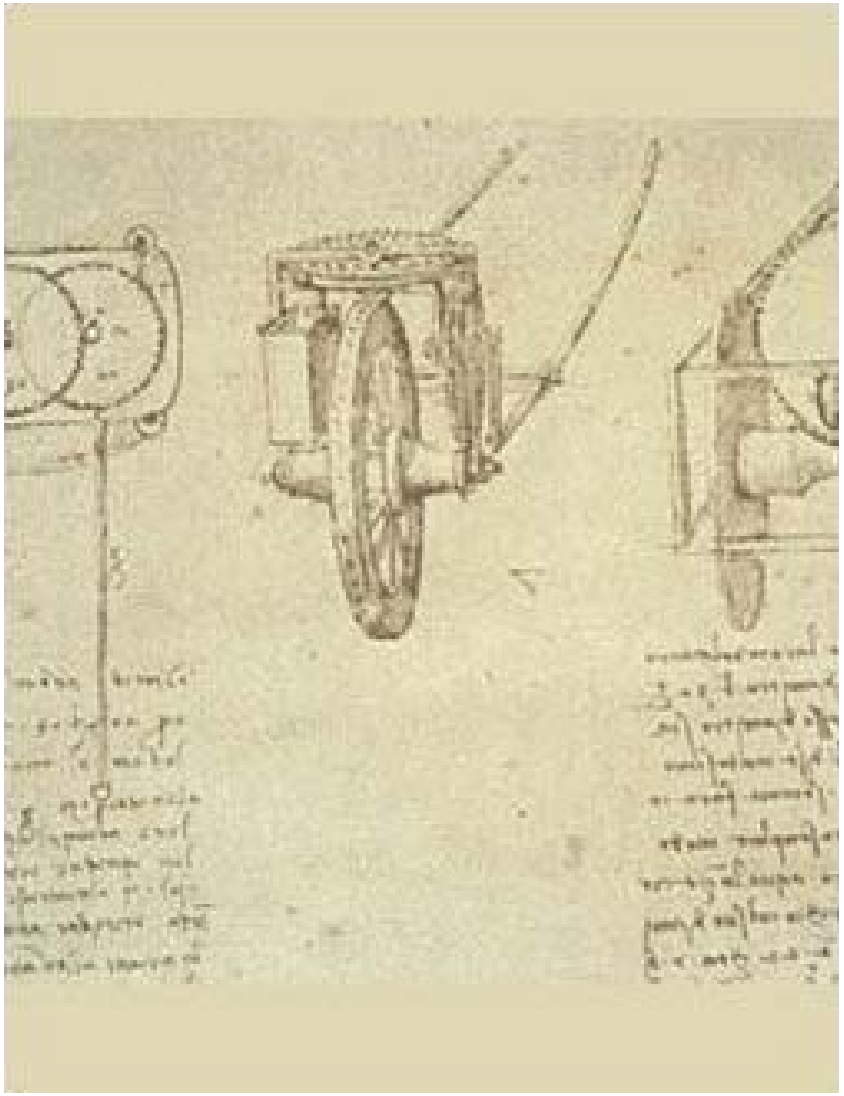
Height by quadrant



Sextant


SEXTANT
glass filter
horizon mirror
glass filter
screw to regulate small mirror
index arm
drum
index mirror
telescope
telescope clamp
eyepiece
telescope printing
frame
graduated arc
locking device
www.infovisual.info

Leonardo Da Vinci



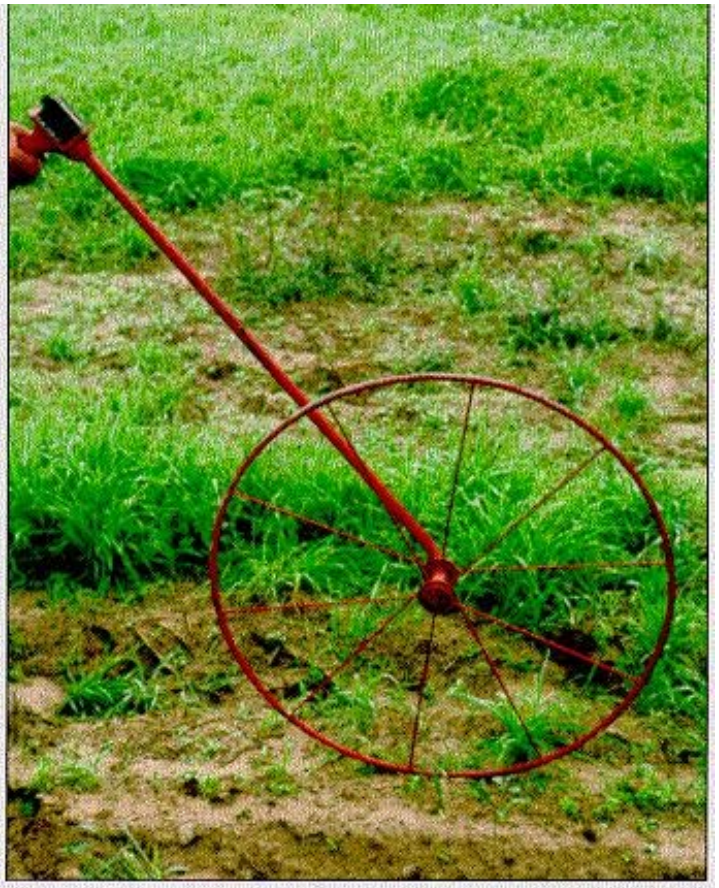
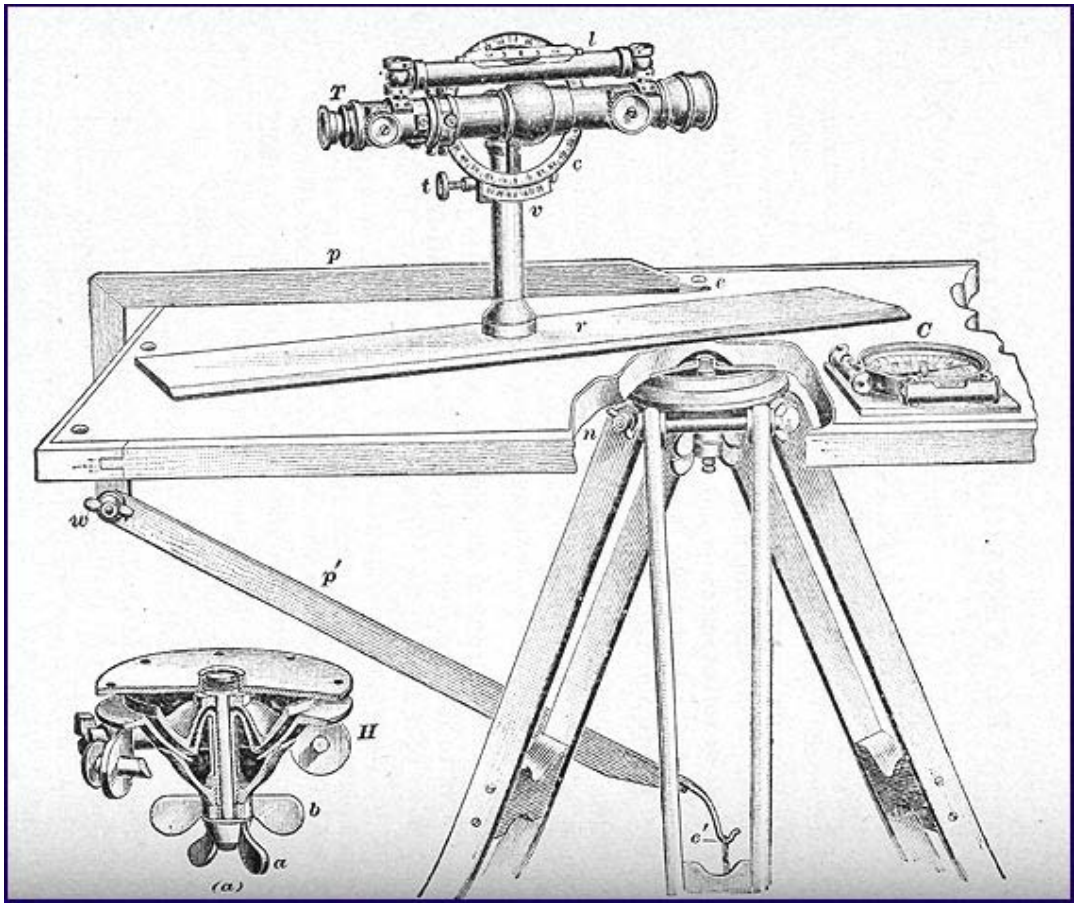
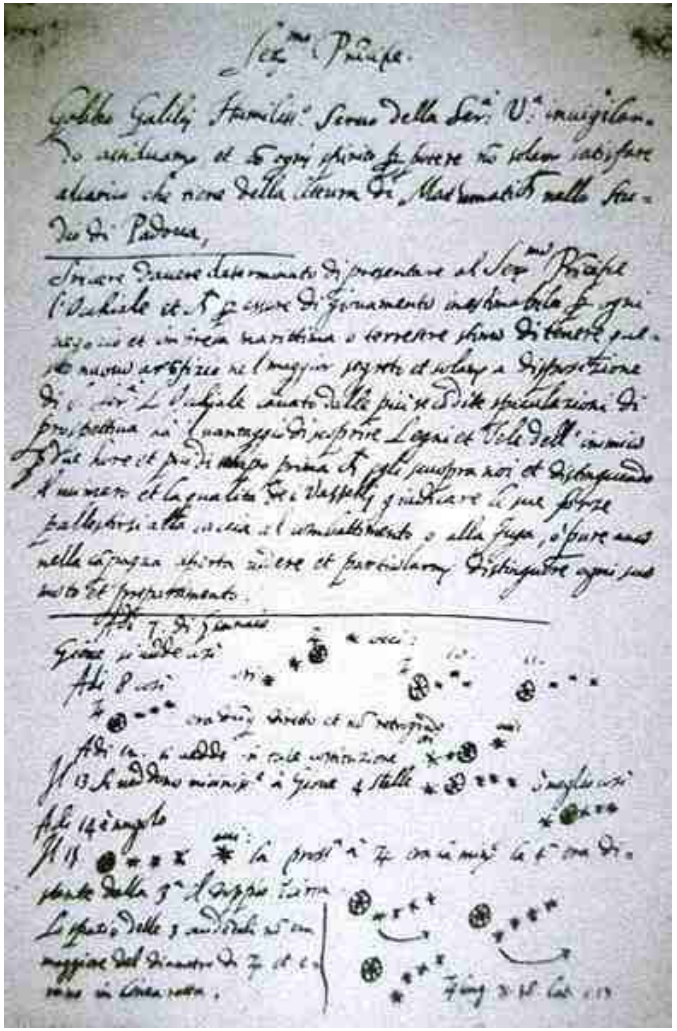


Fig. 7. This measuring wheel is used to easily measure distances for making a vineyard sketch. It records on a counter in the handle the number of rotations of the wheel as it is rolled along the ground. Each rotation is 6.6 feet.

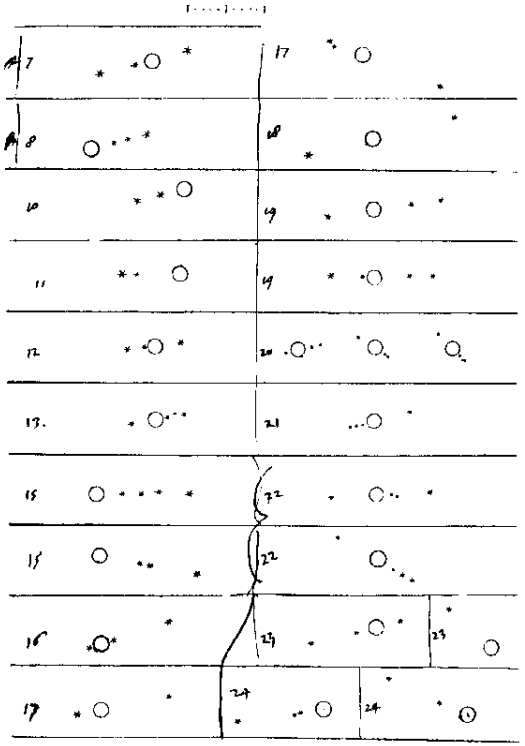
Plane table



The Moons of Jupiter



Galileo Galilei (February 15, 1564 – January 8, 1642) Italian physicist, astronomer, astrologer, and philosopher. Discovered in 1610, measured 1620.



First Atlas
Ortellius: *Theatrum Orbis Terrarum* 1572:
1400 years after Ptolemy

Harvard Map Library

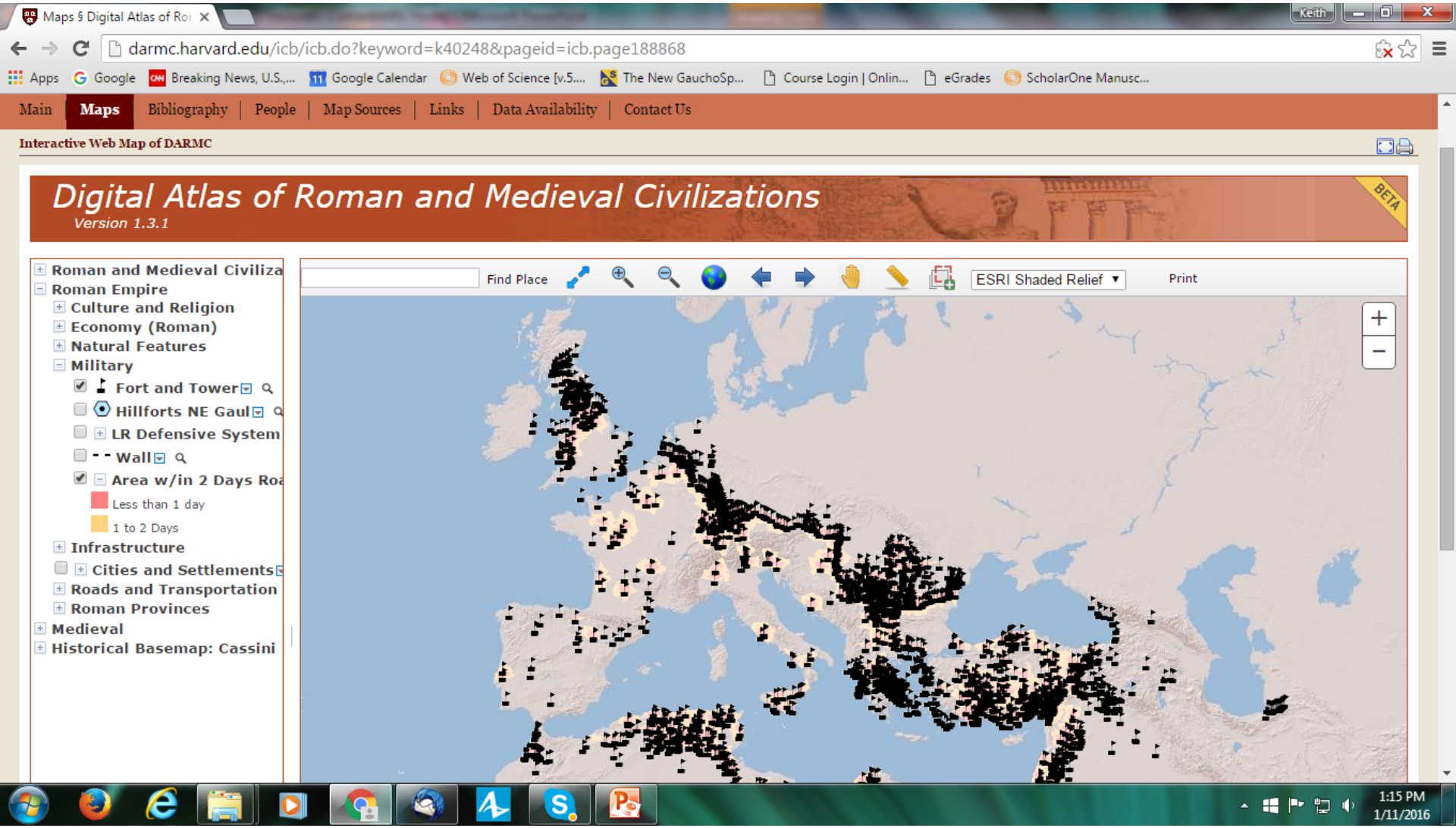
THE LIFE OF ABRAHAM ORTELL,

COSMOGRAPHER TO PHILIP THE SECOND, LATE KING OF SPAINE,

written first in Latine by *Francis Sweert* of Antwerpe, his familiar and louing friend, and now translated into English by W. B. as great a louer of his learning and vertues.

THe stocke of the ORTELS flourished not long since, and liued in good state and credit at Ausburg in Bayern, (*Augustam Vindelicorum*, the Latines called it.) From that family came WILLIAM ORTELL, who about the yere of our Lord 1460 left his natiue country, and seated himselfe in Antwerpe, (at that time one of the famousest Mart-townes of the world) where he did many notable things worthily deseruing great commendation: among which that is most memorable, that of his owne proper cost and charges he caused a goodly crosse of free stone to be set vp without the Emperours gate, in that place where the malefactours are vsually woont to be executed and put to death. Beneath this crosse, at the base or foot of the same, stood Mary and Iohn, and beside them, a little farther off, hung the two theeues, the one vpon the right hand and the other vpon the left, vpon their seuerall gibbets. This *William* died vpon the seuenth day of Ianuary in the yeere of our Lord God 1511, and was buried in the cloisters of the Franciscane Friers in Antwerpe, leauing his sonne LEONARD ORTELL sole Executor, and heire, not only of his goods and substance, but also of his vertues and good qualities: For they report that he was a man so deuout and religious, that it was an hard matter to finde him from his booke, serious meditation on heauenly matters. This *Leonard* maried ANNA HERWAYERS, and by her had issue two daughters, and one sonne named ABRAHAM, (whose life we heere purpose to describe) borne vpon the second day of Aprill, in the yeere of our Lord God 1527. Hee was euen in his child-hood of singular towardnesse, great capacity and passing quicke conceit, and, that which is very strange in

Atlases today



Summary

- Very early origins of mapping and navigation
- Published maps used to guide place descriptions
- Need for maps in land navigation, sailing, land partitioning (and war)
- Distance and direction measurement and description critical
- Place names to places link
- Many different measurement technologies
- Information lost and re-found several times