Geog 126: Maps in Science and Society

From Before the Compass to the Chronometer
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

Imhotep
(c. 2650–2600 BC)
Egypt Periodic Rediscovery
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'I-Qāsim Ibn Ḥawqal Shūrat al-'Arḍ ("The face of the Earth")
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
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
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.
<table>
<thead>
<tr>
<th>Unit</th>
<th>Roman Equivalent</th>
<th>Description</th>
<th>Modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mille (mille passus)</td>
<td>1000 passus</td>
<td>Roman mile. Roughly how far a legionary could march in a day. Slightly shorter than a modern mile.</td>
<td>1,618 yds or 1,480 meters.</td>
</tr>
<tr>
<td>Stadium (stadia)</td>
<td>125 passus</td>
<td>Used as a measurement by sea.</td>
<td>615 ft. or 187.5 meters</td>
</tr>
<tr>
<td>Actus</td>
<td>120 pedes</td>
<td>Used for land surveying and roughly translated as how far oxen would drive a plough before being turned.</td>
<td>116 ft. or 35.5 meters</td>
</tr>
<tr>
<td>Passus</td>
<td>1/1000 mille or 2 gradus</td>
<td>Roughly the 'pace' step of a single legionary.</td>
<td>1.62 yards or 1.48 meters</td>
</tr>
<tr>
<td>Gradus (gradii)</td>
<td>2 1/2 pedes</td>
<td>1/2 passus</td>
<td>.81 yards or .74 meters</td>
</tr>
<tr>
<td>Pes (pedes)</td>
<td>12 unciae</td>
<td>Roman foot.</td>
<td>11.6 inches or 29.5 cm</td>
</tr>
<tr>
<td>Uncia (unciae)</td>
<td>Base Unit</td>
<td>Roman inch.</td>
<td>0.97 inches or 24.6 mm</td>
</tr>
</tbody>
</table>
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
- 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
The back-staff was an invention of John Davis of Sandridge, who described it in a book entitled *The Seaman's Secrets* published in 1607.
Quadrant/Octant
Height by quadrant
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
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
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