Kotebe University of Education

Course Title: Cartography and Map Reading

Course Code: SSEd3332

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UNIT ONE

Introduction

Definition and concepts of Cartography

- Cartography has always been closely associated with Geography and Surveying.
- Its recognition as a distinct discipline is relatively recent. Scientific journals dealing with Cartography began to appear in the middle of the twentieth century.
- Numerous definitions of Cartography have appeared in the literature.

Definition and concepts of Cartography

- "Science that studies geographical maps and the methods and processes of their compilation and reproduction“ M. Shokalsky, V.A. Kamenetsky, 1930

- **"The science of making any map, embracing all phases of work from surveying to map printing“**
  Cartographic Office of the United Nations Organization, 1949

- **"Cartography ranged from the study of information, collected by "surveyors" - using that word in its widest observational sense - to the final reproduction of maps and charts at any scale, on any subject and by any means"**
  Cartography Subcommittee of the British National Committee for Geography of the Royal Society, 1965

Cont…

- "The conception, the designing and the execution of the map" *Robinson*
- "Cartography is the totality of investigation and operations - scientific, artistic and technical - which have as their aim the making of maps and as well as the use of maps" *Commission on Cartographic Education of the International Cartographic Association*
- "Cartography is the art, science and technology of making maps together with their study as scientific documents and works of art" *British Cartographic Society*
- "Cartography is the theory, technique and practice of map making and map use“ *Kolacny*

Cont…

- ✓ Earlier definitions of cartography tend to emphasize **map making**
- ✓ More recent definitions include **map use** within the scope of Cartography
- ✓ This means, if you knew how to make a map, then you also knew how to use them

- *The **Cartographer** is the map maker*
- *The **Map** is the communications medium*
- *The **Data** may be about anything*
- *The **Map** represents the spatial relationships among the individual pieces of data*

Cont…

Cartography is the art, science and technology of

- **Map making and Map use (**as research tools and as sources of information**),**
- the study of **maps in all its aspects** (For Eg. the study of **maps as histoical documents and works of art)**

Maps

"Neatly drawn, bird's eye views of the earth's surface" (Campbell, 2001)

"Any geographic image of the environment" (Phillip Muehrcke, 1978)

Cartography *or* ***mapmaking*** *(in Greek* ***chartis*** *= map and* ***graphein*** *= write)*

☞ *is the* ***study and practice*** *of making maps or globes*

Scope of Cartography

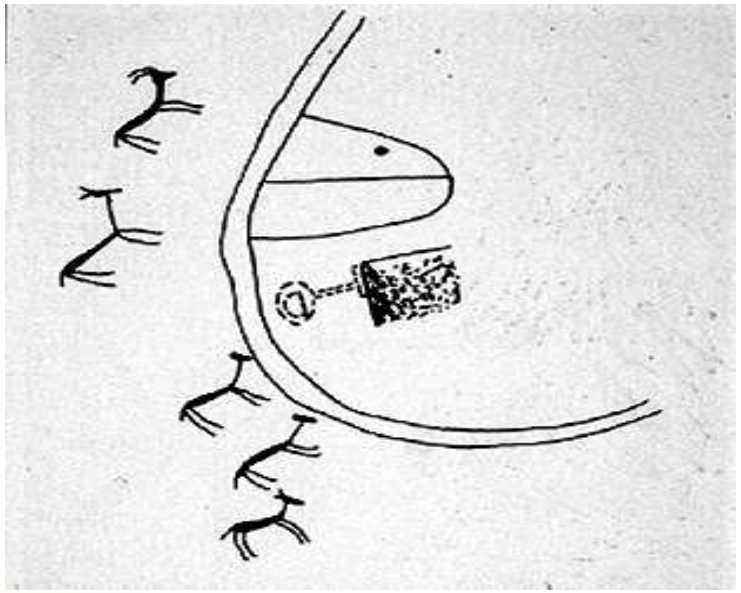
- Cartography covers the
  - art,
  - science and
  - technology of map making and map use, and the study of maps in all its aspects.

History of Cartography

- **Selected Highlights of "Chapters" or "Episodes" in Cartographic Development:**
  - **Prehistoric- Prior to ~3000 BC**
  - **Ancient- ~3000 BC to 400 AD**
  - **"Church maps" 400AD to 1450 AD**
  - **Age of Discovery- 1450 AD to ~1800's**
  - **Information Age- ~1900's to Present**

Prehistoric- Prior to 3000 BC

- Nobody knows when the first map was made.
- Figurative maps- carvings on rock, skin, bone & cave painting. Humans lived close to nature.
- Maps used to show location of resources, hunting game, or paths.



Ancient- 3000 BC to 400 AD

- Babylonians
  - Principles of cartography were understood as early as 2300 BC when drew maps on clay tablets as well as Egyptian drawings.
  - Use- immediate are not whole earth - engineering & cadastral.
- Greeks
  - Pursued development of geographical knowledge ~600 BC
  - Early view of earth as round disk surrounded by ocean
  - By 4th Century BC scholars accepted the earth was a **sphere**- proven by Aristotle's six arguments
  - Excelled in mathematical calculations & theoretical earth issues
  - Developed reference line system or orientation lines for maps
  - Ptolemy- 8 volume book on Guide to Geography
    - Map projections, 8000 place names with lat/long values, map making directions, map of whole known world (did under estimate earth size)

Cont…

- Romans
  - Focused on military & administrative needs
  - Disk shape of world was simple & easy to use
- Chinese (develop independently)
  - Astronomical knowledge
  - Topographic maps for military
  - First compass (453-221 BC)
  - First Paper making (105 AD)

Ancient-Early Mesopotamian Map of the World

The first known map was created in 2300 B.C.E. by the Babylonians, living in what is now modern day Iraq, and was scratched on a clay tablet. This map shows a representation of the world.

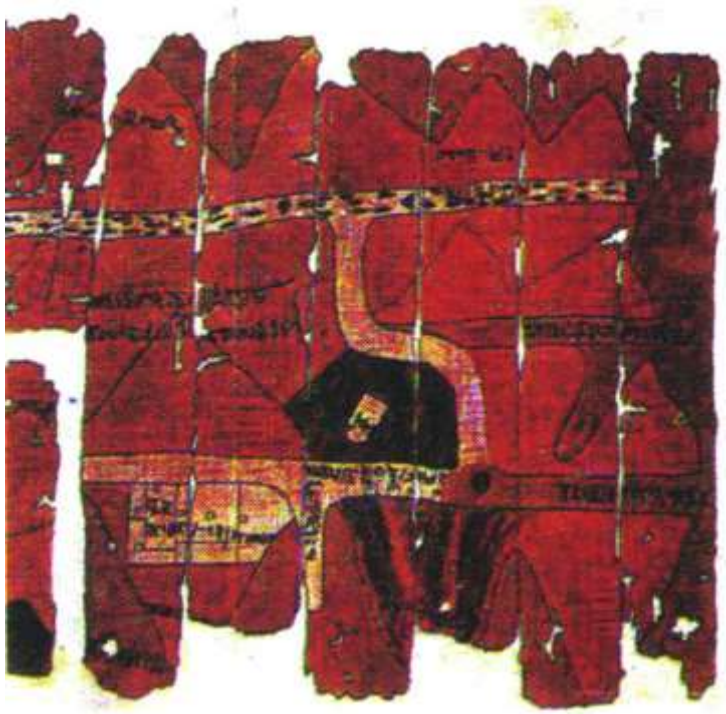
Earth is shown as a flat circular disc surrounded by ocean and several mythical islands.

(From Wilford, 2000)

A Map From Ancient Egypt

A map made in Ancient Egypt showing the trace of gold workings in Egypt. The map, now in Turin, depicts gold workings around the time of King Seti I (1350-1205 B.C.).

(From *GEOEurope*, January 2000)



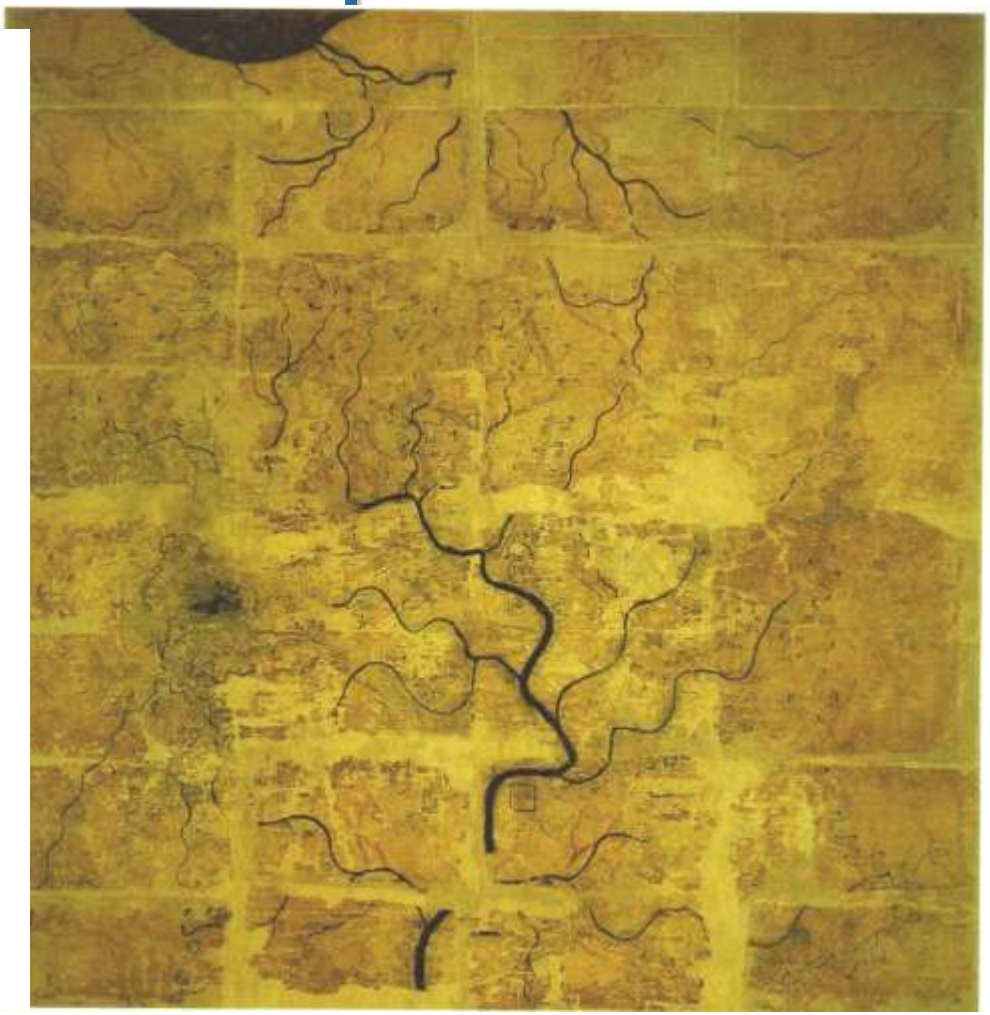
Ancient-
Cartography in China

- Astronomical knowledge existed in Shang Dynasty, 11th century B.C.
- Three maps made in Han Dynasty (2nd century B.C.) were discovered.
  - In a tomb
  - made in silk.
  - one topographic map focused on military matters: streams, roads, mountain ranges, names, scale and orthogonal view point.

Ancient-
Over 2000 Year Old Map

- Ancient Chinese topographical map (200 B.C.): A silk map in the ancient tombs.
- "Their great significance lies in the fact that they are in part surprisingly accurate and detailed and show that the art of cartography was well advanced at this time".

— Bulling, 1978 (cited in Wilford, 2000)



Ancient-
Cartography in China

- The first compass was invented in China.
  - 453-221 B.C.).
  - was not widely used until North Song Dynasty (960-1126 A.D.) when the artificial magnetisation was invented.
  - introduced to Europe in 12th century.
- Paper-making was invented in 105 A.D., East Han Dynasty (25-220 A.D.).

Ancient-
The Ancient Compass

Up: The earliest magnetic compass *Si-nan*) made in West Han Dynasty (206 B.C. – 8 A.D.). Right: the clay figure made in South Song Dynasty (1127-1279 A.D.) showing the rather modern look compass held in the man's hand.

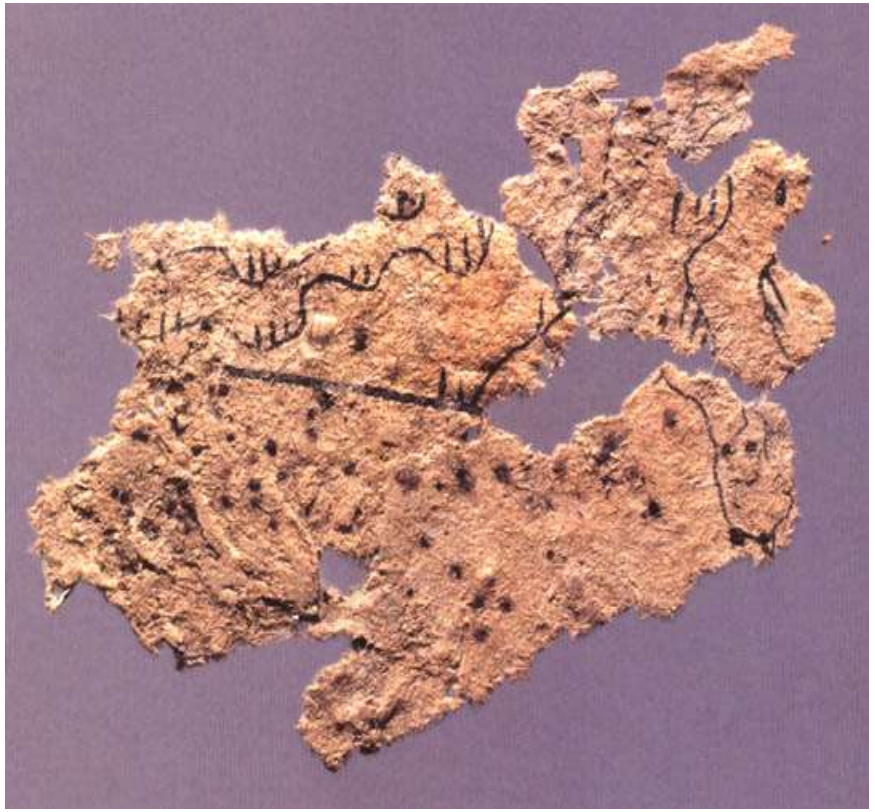
(The National Museum of Chinese History)

Ancient-
Earliest Paper Map ~105 AD

The earliest paper map made in the West Han Dynasty, almost at the same time when the paper itself was invented by Chinese.

The paper map was discovered in an ancient tomb in Gansu Province, western China.

(The Provincial Museum of Gansu)



Ancient-
Cartography in Europe

- Aristotle (384-322 B.C.): Earth is a sphere.
- Ptolemy (90-160 A.D.): *Geographia*.

8 volume set: (highlights)

- Instructions of how to construct maps
- Advocated map making using geographic coordinate systems
- 27 maps of places in Europe, Asia, & Africa
- Created "portolan charts"

Why important:

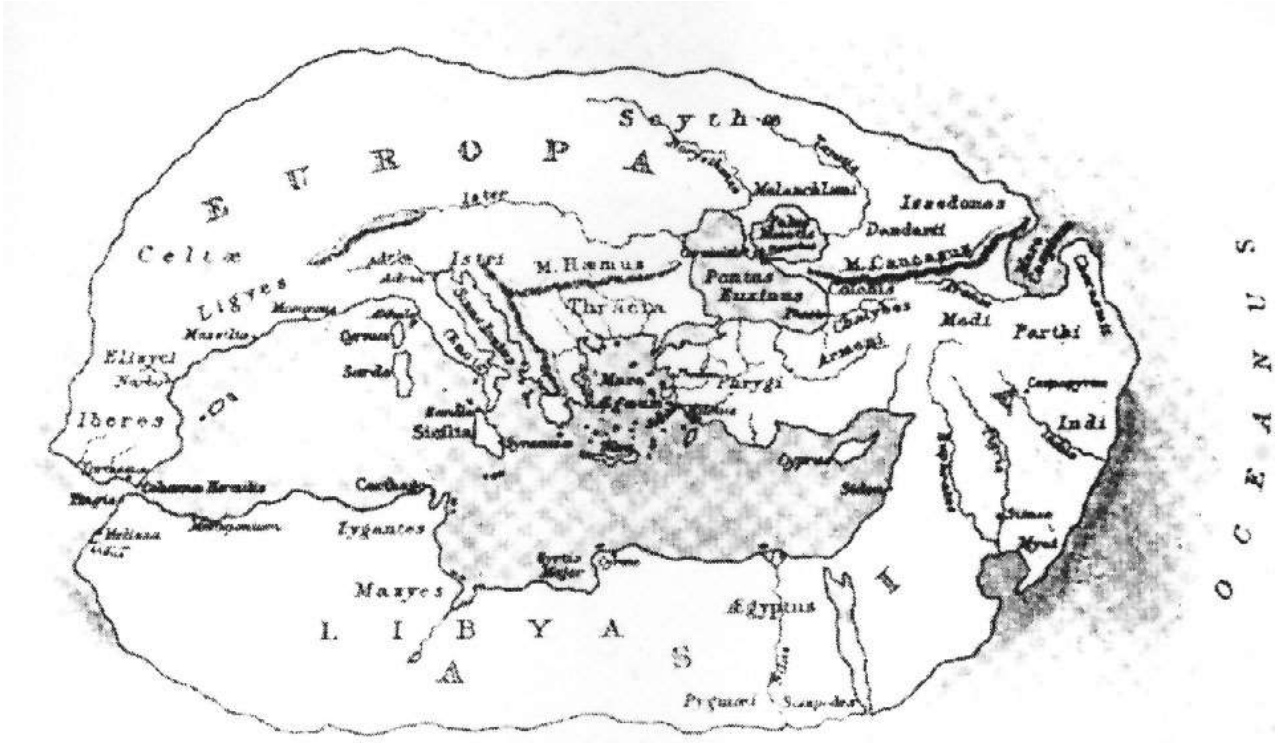
Huge influence on many- ie.

- cartographers – Ptolemy had written well for cartographic basics

- exploration- Columbus used his maps to strengthen his view that Asia could be reached travelling westward. Also, Ptolemy calculated the earth about ¾ of its actual size and his equator was too far north!

- navigators- used his portolan charts

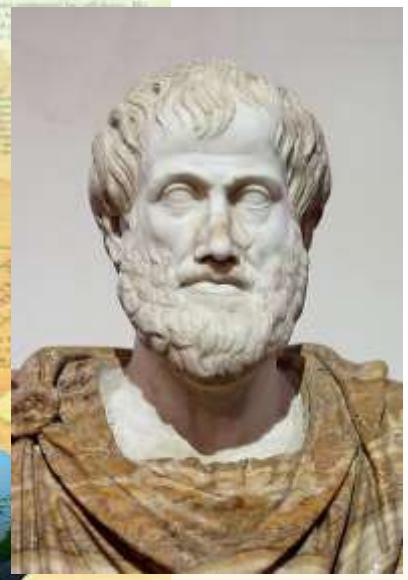
Ancient Greece



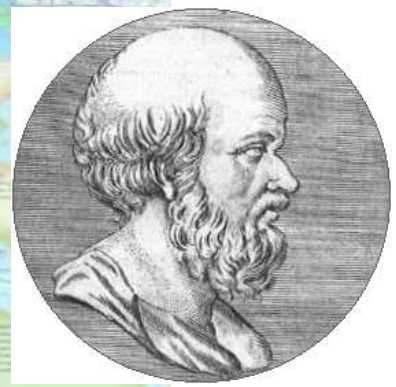
Map of Hecataeus (about 500 B.C.): by an empirical approach, relying on exploration and travel instead of pure geometry alone.

(From Dorling and Fairbairn, 1997)

Aristotle



- While the idea of a spherical earth was postulated by previous Greek philosophers, including **Pythagoras**:
- **Aristotle** (384–322 BCE)– proves that the earth is spherical with the following evidence.
- Lunar eclipse makes a circular shadow on the moon
- Ships "sink" on the horizon
- Some stars can be seen from some locations of the earth but not from others



Eratosthenes 276 BCE-194 BCE

- The first contributions to the science of cartography were the Ancient Greeks.
- Used logic and trigonometry to solve many
- early questions such as, the shape of the earth.
- Circumference of the earth was calculated by Eratosthenes.

Ptolemy's map

Church Maps:400 AD to 1450

- Encompassed ‘Dark Ages’ and ‘Medieval Times’ of Europe
  - World maps represented as a circular disks (at best)
  - Religious beliefs dominated
  - Religion & maps were melded as one
  - World maps became figurative as in prehistoric times
  - Development in medieval period (the “dark age”) was limited,

    except the sudden appearance in 13th century of “portolan charts”.

- Chinese (develop independently)
  - First printed map 1155 AD
    - 300 years before Europe

Church Maps:
The Roman Empire

The world-view of the Roman Empire (400 A.D.): A circular earth disc, set in a surrounding ocean, became the dominant interpretation of the Middle Ages cartographer.

(From Dorling and Fairbairn, 1997)

Church maps

- During the Middle Ages, scientific learning became less important than religion.
- The center of Christian faith was Jerusalem, so that city often occupied the center of a world map.
- Maps were wonderfully colored and decorated with fanciful animals and people.
- Two very useful maps were invented and produced during this time.
- Road maps-showing the route to holy places.
- Portolan maps-maps for navigators.

Age of Discovery 1450 AD to ~1800's

Early Navigation

- As the Middle ages came to a close, Ptolemy's maps drew a sense of curiosity to the people of Europe, and prompted new exploration.
- As a result, the explorations of two navigators changed the world forever.

Christopher Columbus

- Historic voyage in 1492 to chart a western trade route to Asia from Spain.
- Columbus used Ptolemy's inaccurate maps to cross what was then thought to be a small ocean.
- As we know he never found Asia.
- Instead he ran into what is now known as the America's
- The maps that were created from his voyages, changed the world forever.

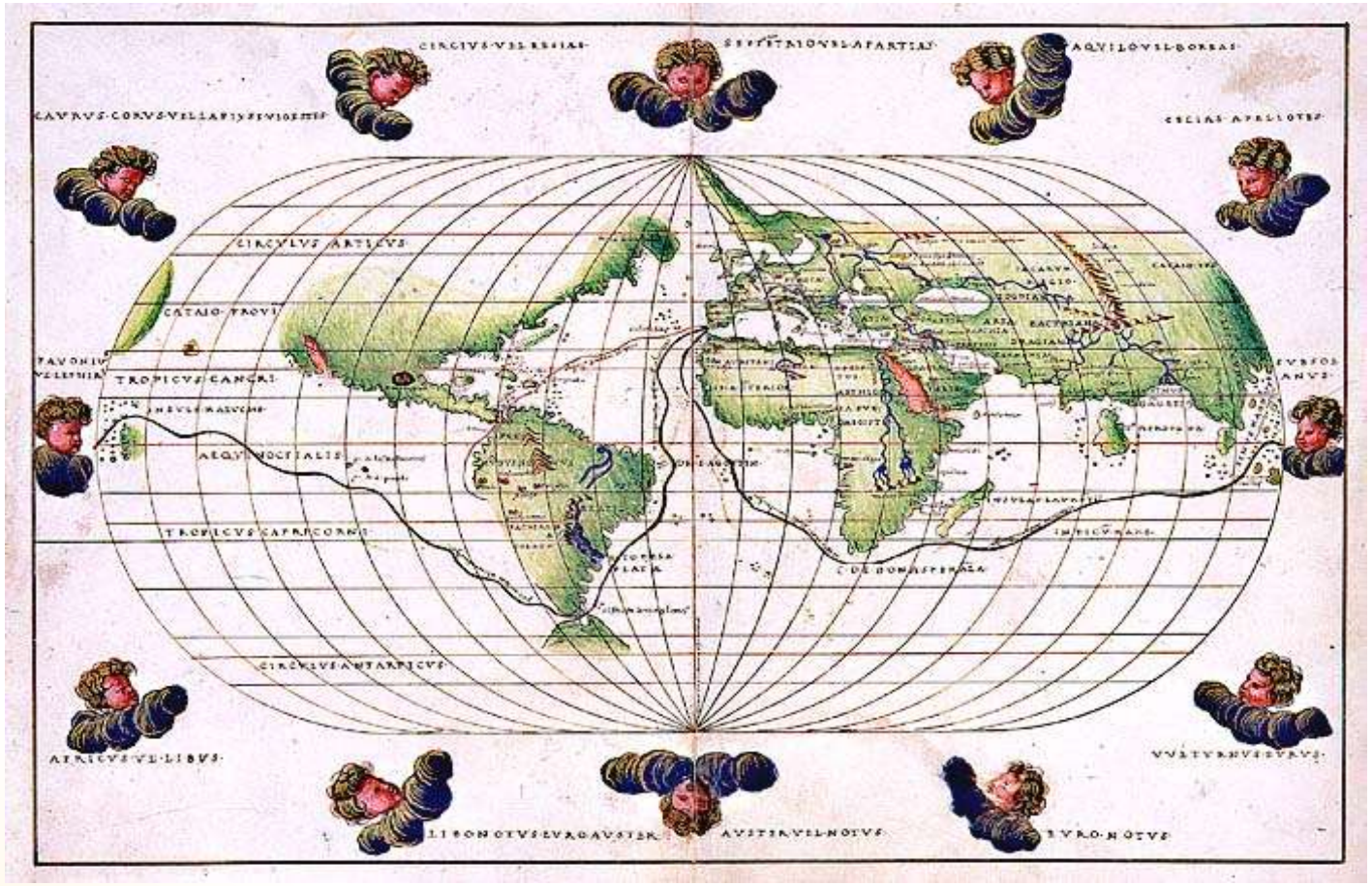
- ✓ The invention of printing made maps much more widely available beginning in the 15th century.
- ✓ Maps were at first printed using carved wooden blocks. Among the most important map makers of this period was **Sebastian Münster** in Basel (now Switzerland).
- ✓ His *Geographia*, published in 1540, became the new global standard for maps of the world.

Post Columbus world view

Ferdinand Magellan

- In 1519, Magellan was sent by Spain to once again find a trade route to Asia.
- This time they were searching for a way through the America's.
- As he found out, there is no way through the continents of North and South America.
- Magellan sailed to and around the tip of modern day South America to reach Asia.
- After finally reaching the modern day Philippines, he was killed by natives.
- Magellan's work will forever be remembered, because he was the first man to circumnavigate the planet.

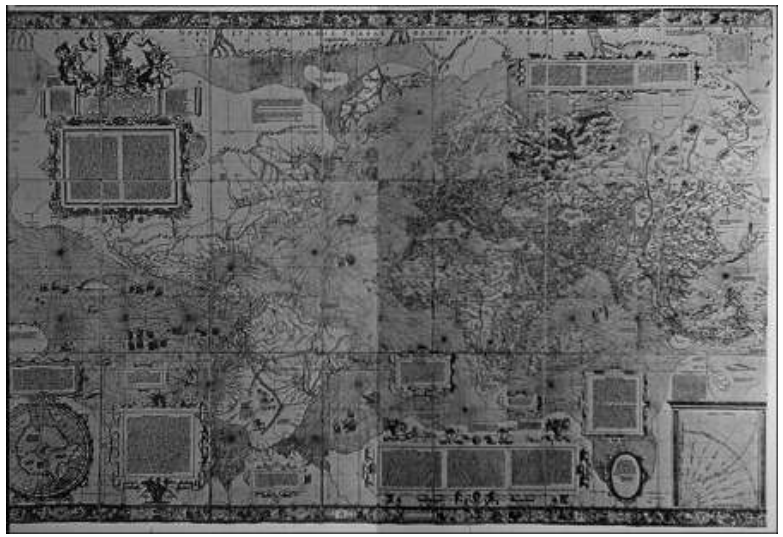
Magellan's Route



1500's

Gerardus Mercator of Flanders (now Belgium) was the leading cartographer of the mid-16th century. He developed a cylindrical projection that is still widely used for navigation charts and global maps. He published a map of the world in 1569 based on this projection. Many other map projections were soon developed.

Polar View



1694 Map


NOVA ORBIS TABULA, AD USUM SERENISSIMI BURGUNDIÆ DUCIS. Authore H. JAILLOT. Parisiis 1694
MAPPE MONDE
ou Description
DU GLOBE
H. JAILLOT
MER DU NORD
MER DU SUD
OCEAN MERIDIONAL
OCEAN ORIENTAL
OCEAN OCCIDENTAL

Thematic Maps (1800's) Example:

Poverty in London, 1898- 1999

Classification of poverty

The seven classes are described on the legend to the maps as follows:

- **BLACK**: Lowest class. Vicious, semi-criminal.
- **DARK BLUE**: Very poor, casual. Chronic want.
- **LIGHT BLUE**: Poor. 18s. to 21s. a week for a moderate family
- **PURPLE**: Mixed. Some comfortable others poor
- **PINK**: Fairly comfortable. Good ordinary earnings.
- **RED**: Middle class. Well-to-do.
- **YELLOW**: Upper-middle and Upper classes. Wealthy.

A combination of colours - as dark blue or black, or pink and red - indicates that the street contains a fair proportion of each of the classes represented by the respective colours.

Map created by Charles Booth

http://booth.lse.ac.uk

Technology/ Information Age- 1900's to the Present

- Changing Ideas
  - Scientific understanding of the earth
    - Geometry
    - Measurements
- Technology
  - Technology Mapping Techniques
    - Manual
    - Magnetic
    - Mechanical
    - Optical
    - Photo-chemical
    - Electronic
- Information Age
  - Developing methods to collect and use data
  - Access through computers
  - Geographic Information Systems (GIS)

Technology/ Information Age-
Impact of Changing Ideas

In the 1900's to present, we understand:

- Concept of representation
  - Early maps: more figurative than literal
- Geometry
  - Shape and size of the earth
  - Locational reference system
- Reconciling conflicting information
  - Church maps

Technology/ Information Age-
Impact of Changing Ideas (Cont.)

- Science and measurement
  - the concept of order: cause-effect relations
  - chance (or probability) as basic investigation tool
  - Enlightenment - positional accuracy
- Concept of distribution
  - place - general reference maps
  - space - the spatial extent and variation of features - the idea of distribution
  - thematic maps

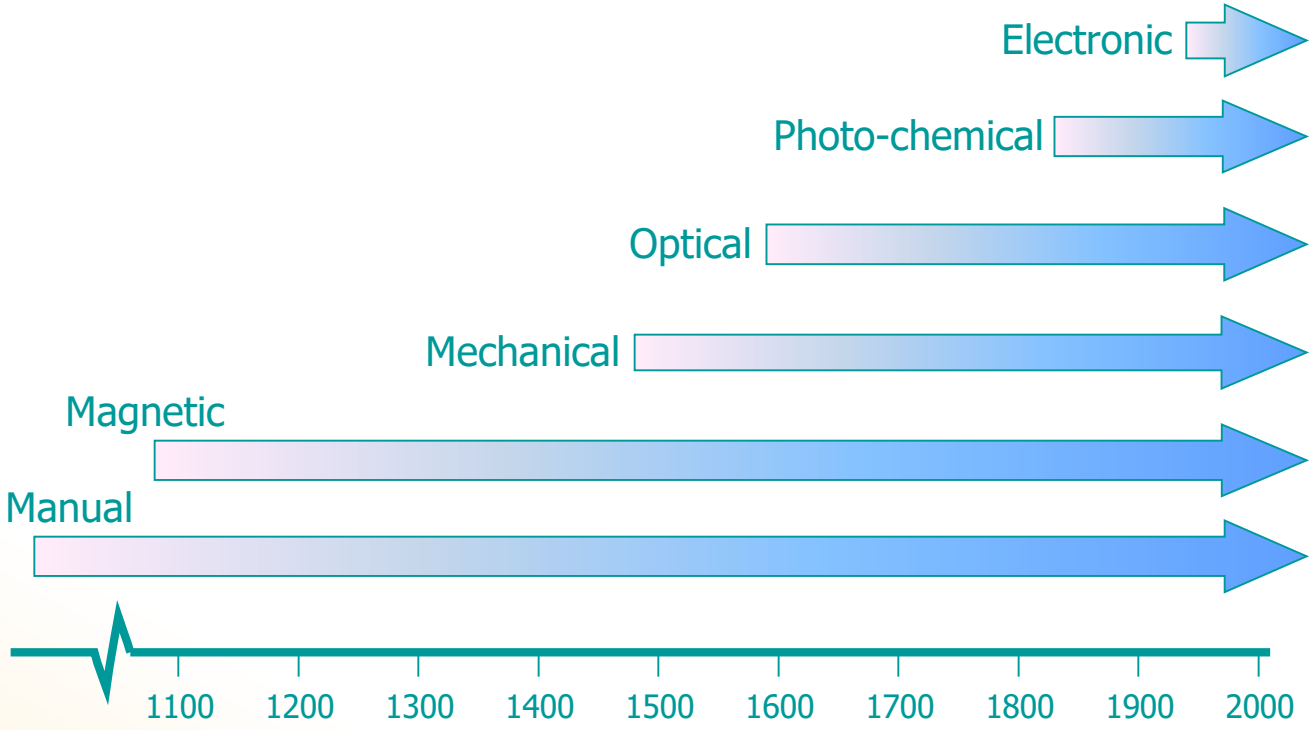
Technology/ Information Age- Impact of Changing Ideas (Cont.)

- Systems/ecological thinking
  - ecological model: view the environment as a system of interrelated processes (ie. species survival or environmental contamination)
  - systems approach: reintegrate what had been separated
  - cartographic modelling: environmental phenomena are selected, weighted by importance, and linked together to form a numerical index

Technology/ Information Age-
Impact of Changing Technology

- Manual: *mappae mundi* and portolan charts - hand drawing
- Magnetic: compass and magnetic media
- Mechanical: machine process and printing
- Optical: telescopic sighting instruments and projection, optical media
- Photo-chemical: photogrammetry
- Electronic: computer process

Technology/ Information Age-
Impact of Changing Technology



Technology/ Information Age-
Manual Technology

A *formschneider* (one who carves woodcuts) at work in front of a window. In those days there was no satisfactory substitute for daylight.

"Manual mapping procedures were dominant during the longest period in the recorded history of cartography".

— Robinson, *et al*., 1995

Technology/ Information Age-
Magnetic Technology

- The magnetic compass was brought from China in the 12th century.
- The devise contains a free floating magnetized needle that aligns with the earth's magnetic field.
- This provides a baseline that angles can be measured.
- The compass is the perfect tool for navigators as well as surveyors to determine accurate bearings (directions).
- Cartographers could produce more accurate positional maps.

— Robinson, *et al.*, 1995

Technology/ Information Age- Mechanical Technology

Printing from a copperplate engraving with the rolling press was a hard work.

The engraving machines could produce closely spaced parallel lines. No longer did every map- original and copies- need to be drawn by hand.

"Machine power augmented and magnified human muscle power. The result was a major increase in the speed and efficiency of the mapping process, with a commensurate reduction in mapping cost".

— Robinson, *et al*., 1995

Technology/ Information Age- Optical Technology

Telescoping sighting instruments instruments have extended human sight. (eg. Telescopes & magnifying glasses)

"Laser technology such as laser optical surveying & CD-ROMs are examples of recent breakthroughs in the technology. Massive data storage & retrieval possible in the form of CD- ROMs."

Recent advances in light projection improved accuracy of image transfer with photo-chemical processes.

— Robinson, *et al*., 1995

Laser optical surveying tools

Technology/ Information Age-
Photo-Chemical Technology

Photography enabled cartographers to acquire an image base map form.

Image reduction or enlargement could be completed with photographic technology.

Photographs from the air were taken. Photo images could be transformed to **orthophotos**– from which planimetric data can be derived.

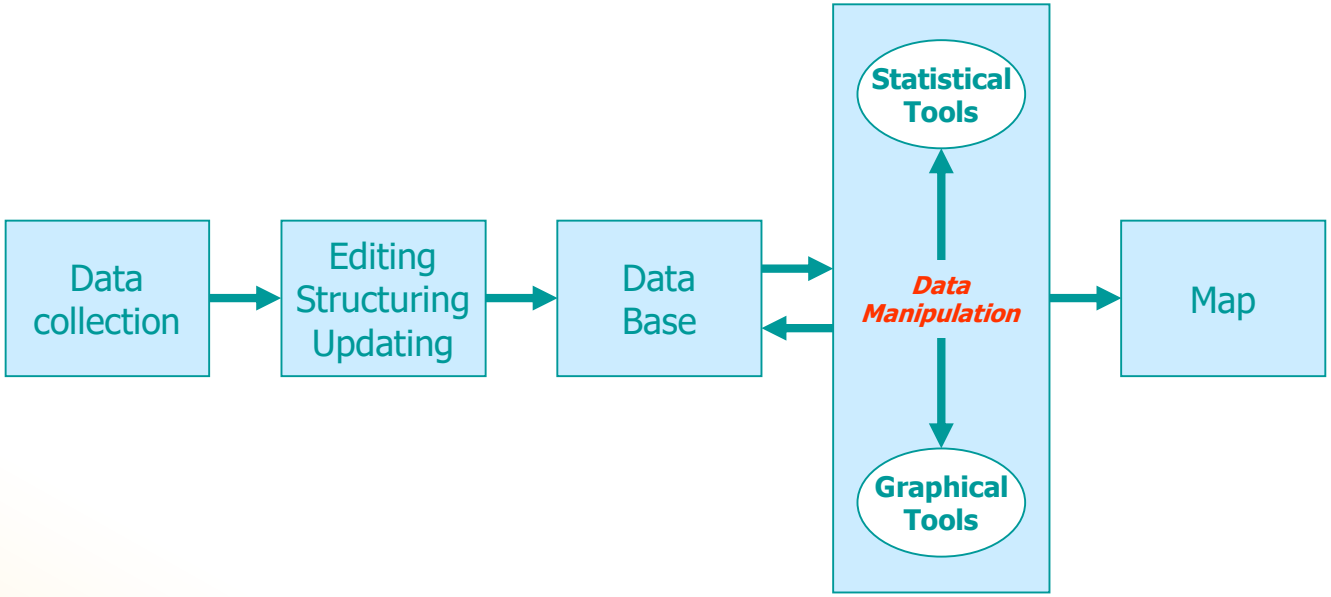
Technology/ Information Age-
Electronic Technology

- ✓ Computers & software
- ✓ Digital files- binary code to store spatial attributes & data tables.
- ✓ Digitizers
- ✓ Ink jet printers
- ✓ Laser printers
- ✓ What next???

Technology/ Information Age-
Information Age Mapping

- Information- to inventory & manage the earth.
- Information systems- Database & DBMS.
- Geographical information systems (GIS).
- Maps play a key role in GIS.
- GIS is crucial in modern mapping.

Technology/ Information Age-
Mapping With GIS



Cartography as a means of Communication

Cartography is closely related to graphical communication

- *Cartography is related to, but different from other forms of **visual communication***
- *Cartographers must pay special attention to **coordinate systems, map projections, and issues of scale and direction** that are in most cases of relatively little concern to other graphic designers or artists*
- *But, because cartography is a type of graphical communication, some insights to the demands of cartography can be gleaned from the literature of graphical communication and statistical graphics*
- *As you begin to study cartographic design, you may find it useful to consult some of the standard works on graphical communication*

Cartography as a means of Communication

Maps are symbolic abstractions--"generalizations" or "representations"--of reality

- *By stressing cartography as a form of communication, it is easier to make the point that maps are really **symbolic abstractions**--or **representations**--of **real world phenomena** (**Natural** and **Man-made** phenomena)*
- *In most cases, this means that the world represented on a map has been greatly **simplified, or generalized,** with symbols being used like words to stand for real things*
- *Some of the most important decisions cartographers make in the process of cartographic design revolve around:*
  1) *How much to **simplify** the situation being depicted; and*
  2) *How to **symbolize** the relationships being represented*

Cartography as a means of Communication

- ***Communication*** *is the process of generation, transmission, or reception of messages to oneself or another entity, usually via a* ***mutually understood set of language and signs***
- *Cartographers seek to make use of* ***visual resources*** *(such as color, shape and pattern…) to communicate information about* ***spatial relationships***
- *If cartography is a form of communication, the measure of a good map is* ***how well it conveys information to its readers***
- *To ask "what is a good map?" is to ask* ***how well it communicates*** *with its audience*

Cartographic Communication Process