Statistics 120
A Graphical Tour

The Earliest Known Map.

Early Uses of Graphical Representation

- The oldest known uses of graphical representation are probably cave paintings found in a variety of caves in Southern Europe (E.g. Lascaux, Altamira, Chauvet).
- Some of the paintings found in these caves date back over 30,000 years.
- Many of the paintings show stylised pictures of animals and may have been associated with hunting rituals.

Maps

- Map making was common across a variety of cultures; Chinese, Greek, Egyptian …
- For the most part, maps were strictly representational; showing the shape and location of landmasses.
- The best "world map" was created by Claudius Ptolemy in Alexandria in about 100 AD.
- Ptolemy's work was unsurpassed until the 16th century.

The Great Hall of the Bulls, Lascaux Cave.

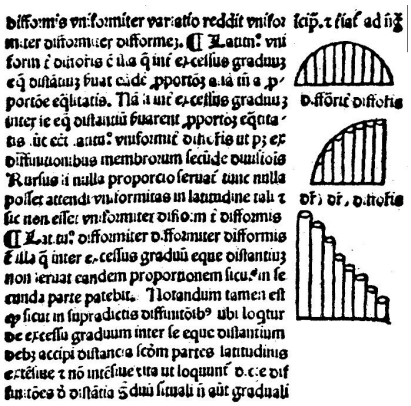
A 15th Century Copy of the Ptolemy World Map.

The Path to Abstraction

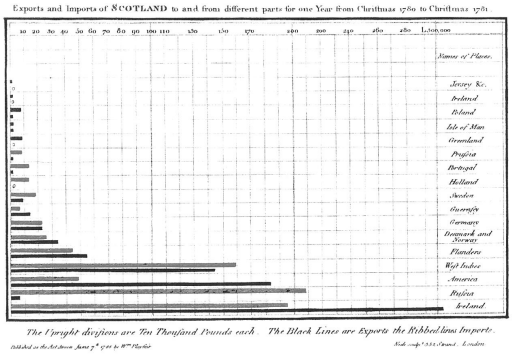
- Cave paintings are largely representational, and show limited abstraction.
- The first step toward modern graphical displays came with the use of graphic images as maps.
- The earliest known map is Babylonian and was found at Nuzi near Kirkuk in Iraq.
- It dates from the dynasty of Sargon of Akkad, about 2400 – 2200 BC.

Diagrams

- Early scholars made use of diagrams but there was no systematic body of knowlege about visual representations.
- Amazingly modern looking diagrams can be found in the manuscripts of Nicholas Oresme (1323–1381, France).
- Oresme discovered the idea of plotting a variable magnitude which depends on another variable.



Exports and Imports of SCOTLAND to and from different parts for one Year from Christmas 1760 to Christmas 1761.



The Upright divisions are Ten Thousand Pounds each. The Black Lines are Exports the Ribbed lines Imports.

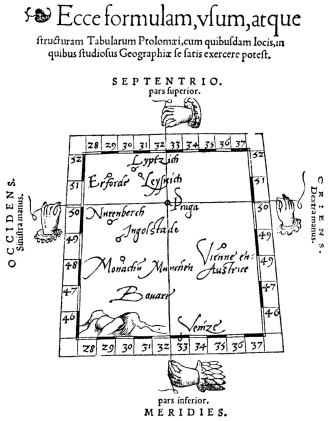
A Playfair Barchart.

Coordinates

- By the 16th century the idea of coordinate pairs was becoming commonplace.
- The 1546 edition of *Cosmographia* by Petrus Apianus contained a diagram which showed how city locations correspond to latitude and longitude values.
- René Descartes (1596–1650, France) formalised the use of coordinate pairs in analytic geometry.
- We now refer to (x, y) coordinate pairs as *Cartesian coordinates*.

Some Types of Graph

- Illustrative diagrams
- Organisational diagrams
- Maps and plans
- Statistical graphs
  - Bar charts, dot charts, pie charts
  - Histograms, density plots, boxplots
  - Function plots, Scatter plots



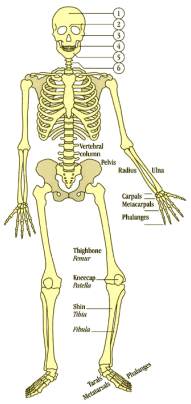
Location described by latitude and longitude.

Illustrative Diagrams

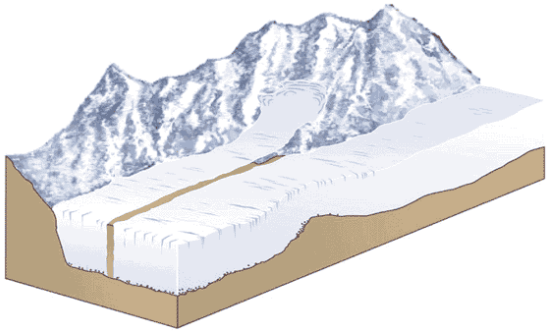
- These graphically portray an object, usually in a simplified or schematic form.
- A common use is to show a complex object broken down into its component parts.
- The images presented trade off *realism* and *abstraction*.

Data Graphics

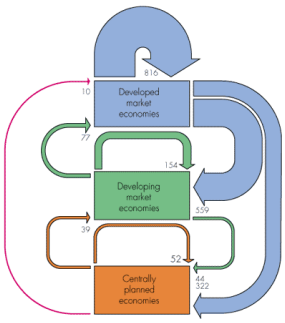
- Although Descartes had provided the machinery required to produce statistical graphs it took nearly a century for such graphs to become commonplace.
- The German mathematician Johann Heinrich Lambert (1728–1777) and the English political economist William Playfair (1759–1823) created many modern graphical designs.
- The invention of lithography in 1798 made it possible for these designs to reach a large number of people.



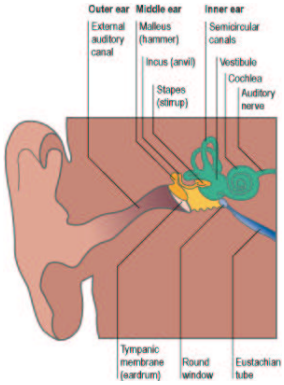
The Human Skeleton



Illustrative Cross-section of a Glacier.



Volumes of Trade
From an FAO Document



The Human Ear

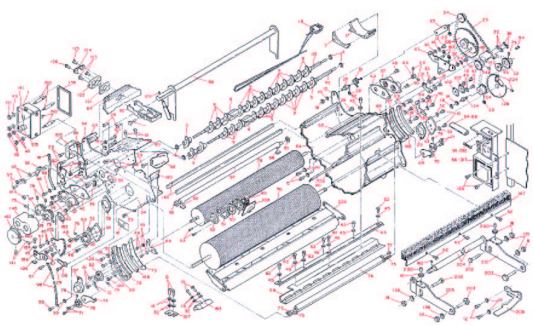
Maps and Plans

- Some maps are simple representations of spatial locations.
- Other maps include additional numeric information encoded in some graphical fashion.

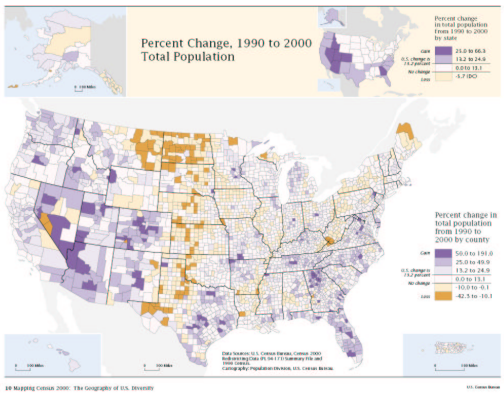
Organisational Diagrams

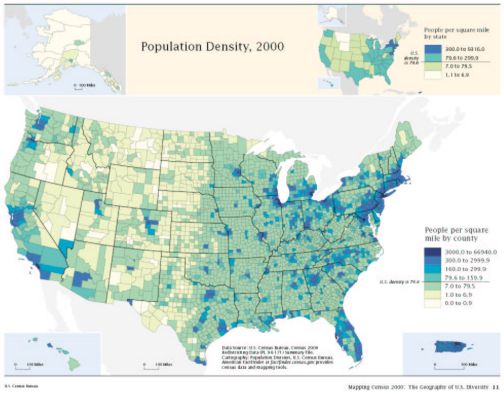
- These diagrams emphasise the relationships between objects, or the parts of a single object.
- The objects represented can be concrete or may be quite abstract.
- The boundary between illustrative and organisational diagrams is not always clear.

A map of a golf course.



IBM Series III Copier/Duplicator (1976)





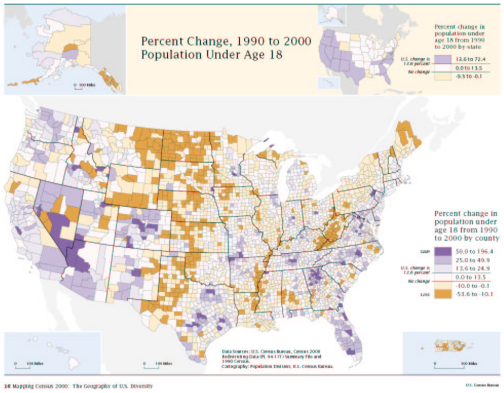
Data to Theory

This graph says

$$\log(\text{Size}) = a + b \times \log(\text{Generation Time}),$$

or

$$\text{Size} = A\exp(\text{Generation Time}).$$



The Importance of Data Graphs

- Seeing that a set of observations follows a particular pattern will often allow us to move from the specific to the general.
- It is ability of graphs to suggest theories or to provoke questions which makes them so important.

Statistical Graphs

- Statistical graphs represent a quantum jump in abstraction over the other plots we have seen.
- Even the choropleth population maps we have seen retain a representational component (the map).
- William Playfair's great achievement was to introduce entirely abstract forms of graphical data display.
- The use of abstract graphs is now so ingrained in our culture that we hardly notice them.