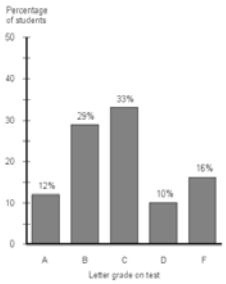
Geog 126: Maps in Science and Society

The History of
Quantitative Graphics to 1850

How old are graphs and charts?



The Birth of Quantitative Graphics

- Tied to the emergence of statistical thinking and data collection
- Tied to media
  - Printers, paper, computer screens etc.
- This lecture source entirely from:
- http://www.math.yorku.ca/SCS/Gallery/milestone/

Precise Scientific Observation

- Data graphics are bound to data collection
- Census in Egypt 3340 BC and in 3050 BC
  - Well-developed and precise data collection techniques: Late 1500's

Statistical Thinking and Visual Thinking

- Diagrams began to accompany mathematical proofs
- Various graphic forms were invented to help communicate numerical / statistical findings

Manuscript written in 1269 for the Order of Cistercians.

Media for Statistical Graphics

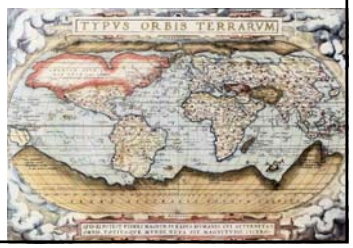
- Early graphics were hard to produce and distribute
  - Hand and paper
  - Copper plate etching
  - Lithography
  - Photo etching
  - Computers
- Ease of creation improves

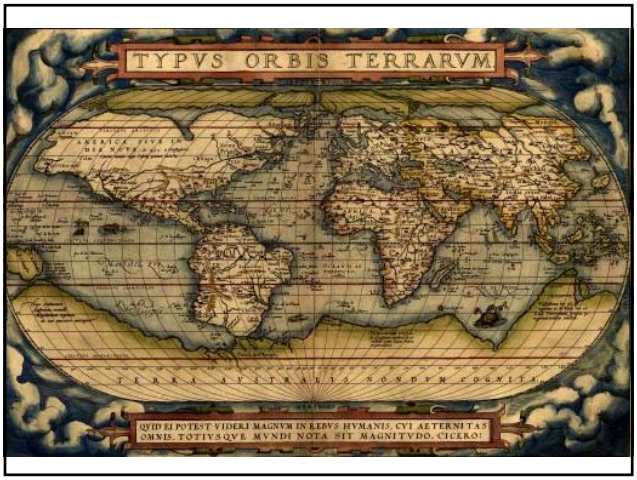
1350: Proto-bar graph

- Nicole Oresme
  - Bishop of Lisieux (1323-1382)
  - French
  - Proposed the use of a graph for plotting a variable magnitude whose value depends on another
  - Implies a coordinate system!
- Before Descartes

1570: First Modern Atlas

- Theatrum Orbis Terrarum
- Abraham Ortelius, 1527-1598
- Belgian





1584 edition

1572: Instruments for astronomy

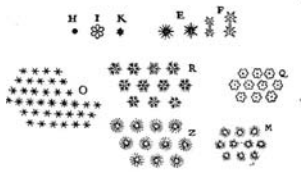
- Tycho Brahe 1546-1601, Danish
- Improved instruments for accurate measurement of stars and planets
- Kept and supported record keeping

Disputed quote

- I've studied all available charts of the planets and stars and none of them match the others. There are just as many measurements and methods as there are astronomers and all of them disagree. What's needed is a long term project with the aim of mapping the heavens conducted from a single location over a period of several years.

17th Century

- The rise of analytic geometry
- Beginnings of demographic statistics
- Descartes: Variables, exponents
- 1637. *La Géométrie* (*Geometry*)

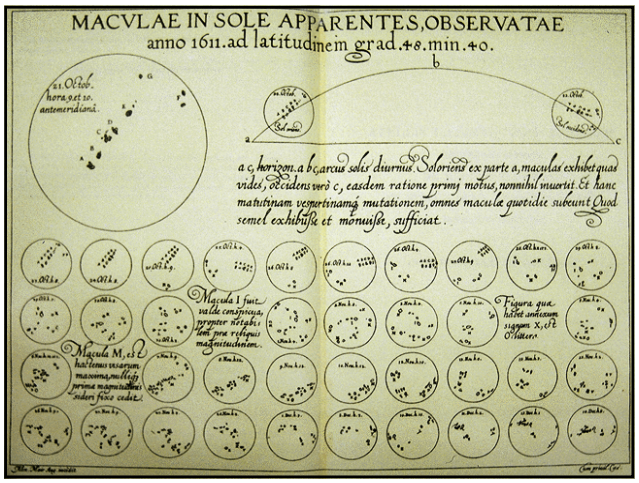


1637: Coordinates reintroduced

- Cartesian Coordinates
- Relationship established between graphed lines and equations
- Rene Descartes 1596-1650
  - French

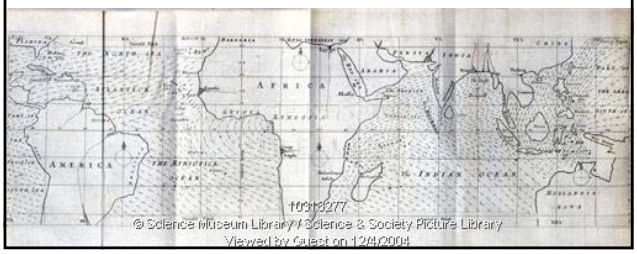
1626: First “Small Multiples”

- Shows a series of images
  - Arranged in a logical sequence
  - Depicts changes over time graphically
- Christopher Scheiner (1575-1650)
  - Italian
  - Changes in sunspots over time
  - Same idea used by Galileo in 1610



1686: First Weather Map

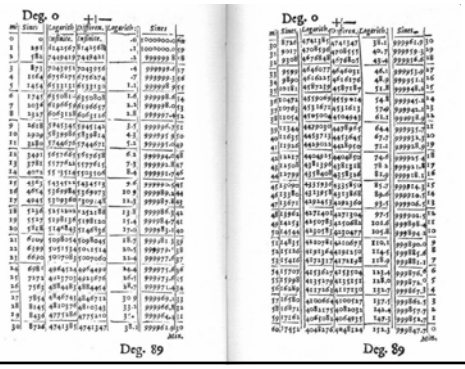
- Edmond Halley, 1656-1742
  - English
- Prevailing winds atop a geographic map



18th and 19th centuries: Statistical Thinking

- Numbers, calculations and tables **John Napier** (1550 -1617) Leonhard Euler connects to the exponential function in the 18th century.
- Data collection surges
  - People/social stats
  - Medical stats
  - Economic stats
- Quantitative graphics arose out of need for reporting/summarizing techniques

Napier's Tables



1701: First isolines

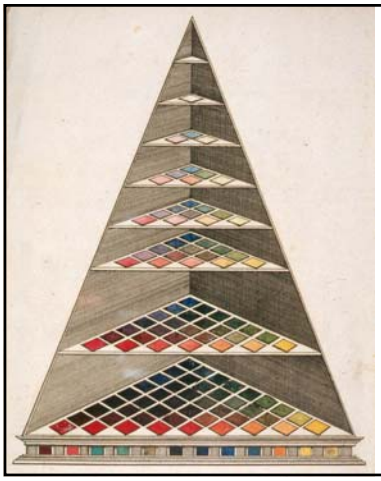
- Edmond Halley
- Isogonic map: lines connect points of equal magnetic declination
- Attribute only possible by measurement

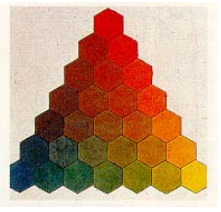
1700's

- 1710: Three-color printing invented
- 1748: First use of the word "statistik"
- 1752: Three-dimensional coordinates (x,y,z)

1758-1772: Color Diagrams

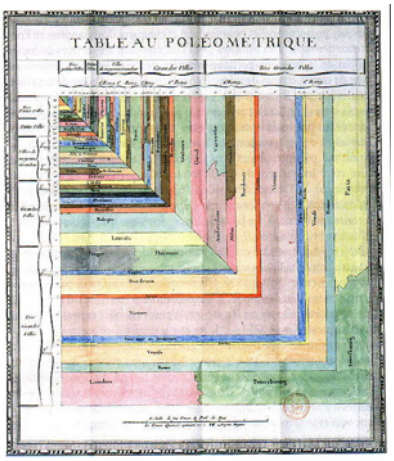
- Diagrams to represent color spaces
- 3D pyramid
- Johann Heinrich
  - German
- Tobias Mayer
  - German





1782: Proportional Symbols

- First use of geometric figures to compare attributes
- Charles de Fourcroy
  - French
  - Tableau Poléometrique 1782
- Used area of squares to depict urban statistics



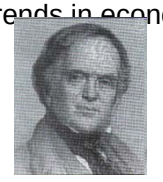
1782

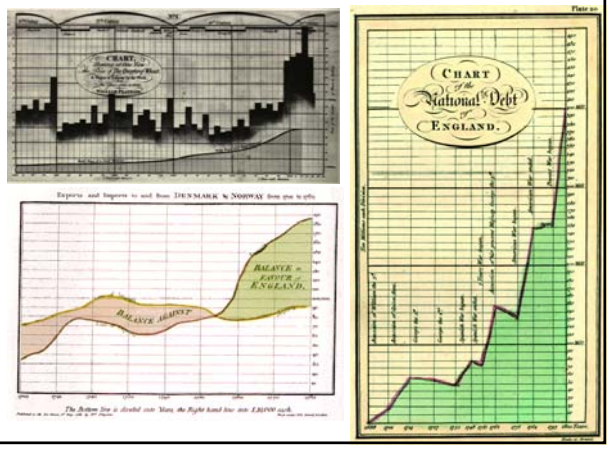
- First topographical map
- Marcellin du Carla-Boniface
  - France

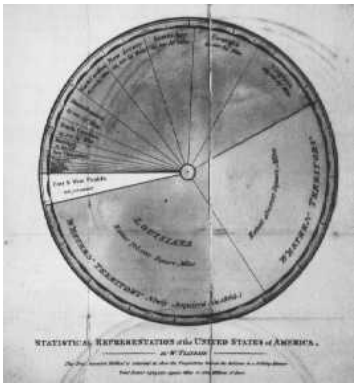
Expression des nivellements; ou, Méthode nouvelle pour marquer sur les cartes terrestres et marines les hauteurs et les configurations du terrain.

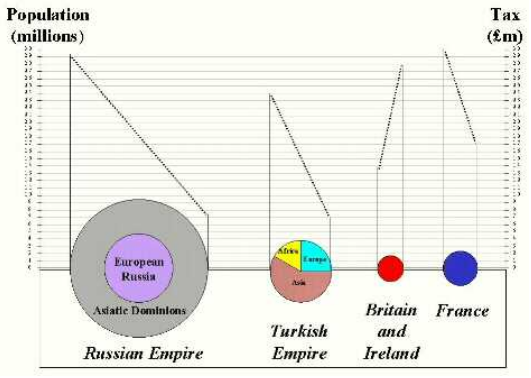
1786: Bar Charts, Line Graphs

- William Playfair (1759 –1823)
  - Huge figure in the world of figures
- First bar charts, line graphs, pie charts (1801)
- Trends in economic dat



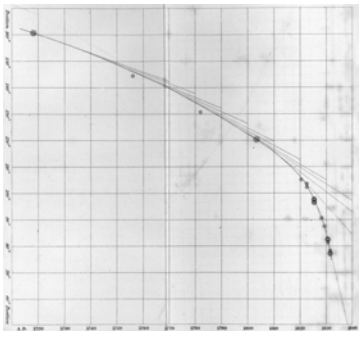




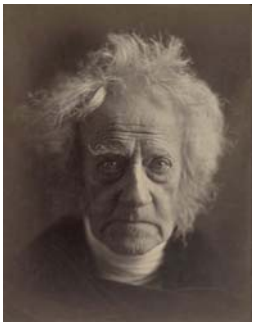


1832: Fitting a curve to a scatterplot

`The process by which I propose to accomplish this is one essentially graphical; by which term I understand not a mere substitution of geometrical construction and measurement for numerical calculation, but one which has for its object to perform that which no system of calculation can possibly do, by bringing in the aid of the eye and hand to guide the judgment, in a case where judgment only, and not calculation, can be of any avail." (p. 178)] - **John Frederick W. Herschel**



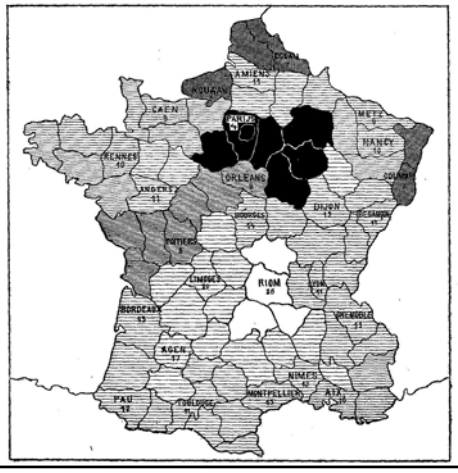
John Frederick W. Herschel (1792-1871)



- Originated the use of the Julian day system
- Names the moons of Saturn and Uranus
- Made contributions to the science of photography
- Investigated color blindness
- Explored impact of ultraviolet

1819: First Choropleth Map

- Baron Pierre Charles Dupin 1784-1873
  - French
- Unclassed choropleth map of illiteracy
- First “modern statistical map”

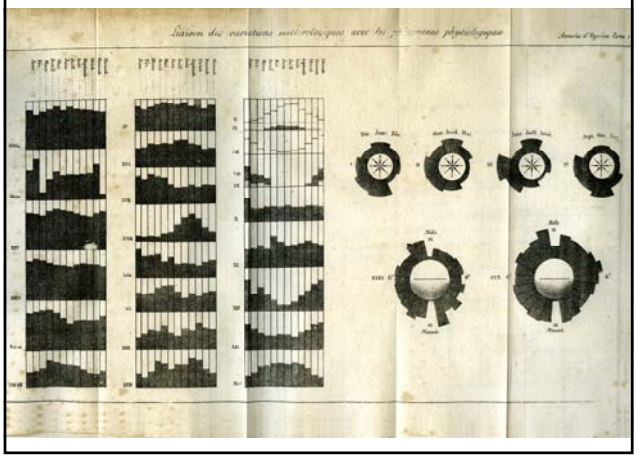


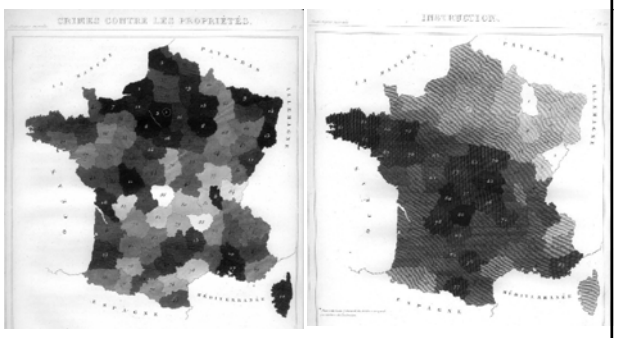
1827: First Successful Photograph

- 8-hour exposure
- Joseph Nicephore Niepce
  - French
  - Point de vue du Gras

1829: Polar-(Radar) charts

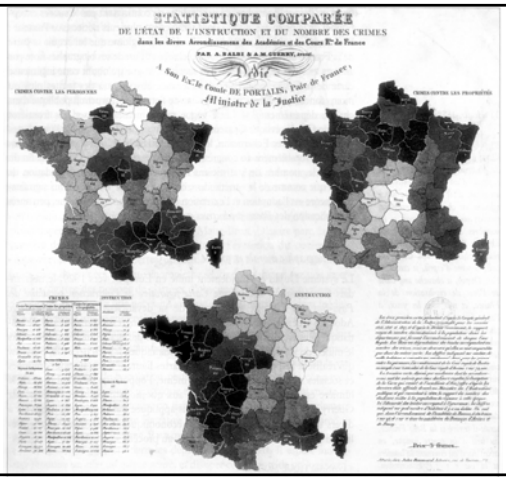
- Show frequency of cyclic phenomena
- Andre Michel Guerry 1802-1866
  - French
  - Lawyer and amateur statistician.
  - Together with Adolphe Quetelet founded moral statistics
  - Led to criminology, sociology and ultimately, modern social science.





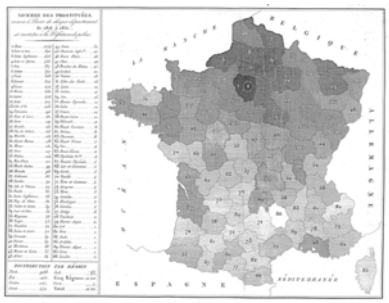
1829: First Cartographic Small Multiples

- Andre Michel Guerry
- Crimes against persons compared to poverty
- Balbi, Adriano, and André-Michel Guerry. 1829. *Statistique comparée de l'état de l'instruction et du nombre des crimes dans les divers arrondissements des Académies et des Cours Royales de France.* Paris
- Also studied suicide, analyzed text reports



1836: Origins of Parisian Prostitutes

Alexandre Jean Baptiste Parent-Duchatelet (1790-1836), France



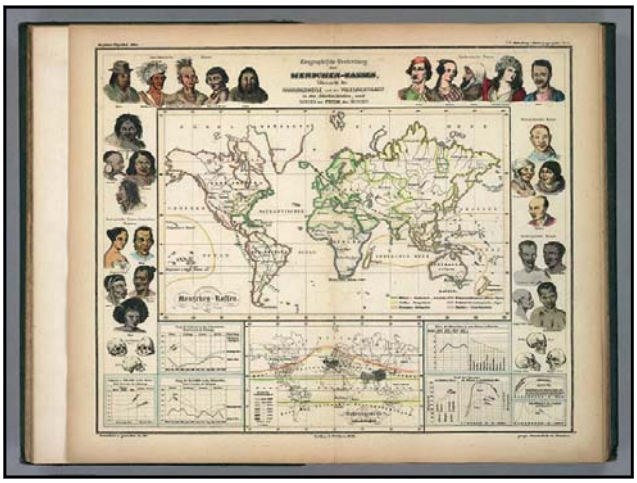
1836: Distribution of Parisian Prostitutes

1837: First Flow Map

- Henry Drury Harness 1804-1883
  - Irish
  - Commander Royal Engineers at the siege and capture of Lucknow during the Indian Mutiny

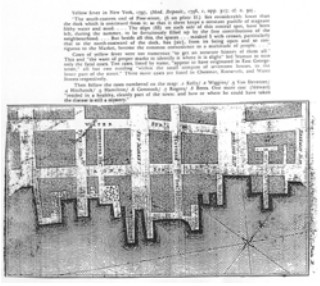
Thematic Atlas

- Heinrich Berghaus (1797-1884), Germany
- Worked on Prussian trigonometrical survey in 1816, pioneer at Potsdam
- Physical atlas of the distribution of plants, animals, climate, etc
- Contained tables, graphs, pictorial profiles of distributions over altitude
- Cultural and human themes
- *Physikalischer Atlas* (Gotha, 1838–1848)



Physikalischer Atlas

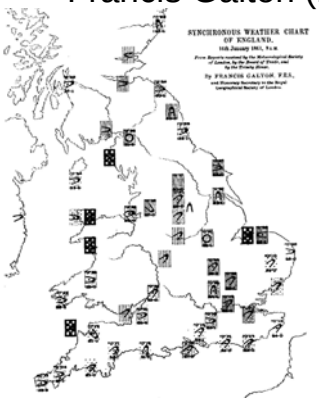
1798 First maps of the incidence of disease (yellow fever)



Using dots and circles to show individual occurrences in waterfront areas of New York

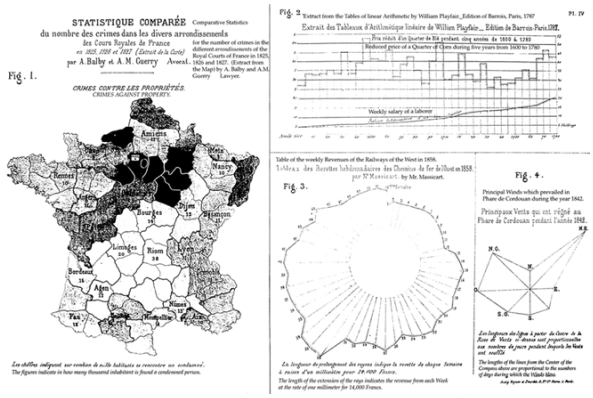
Valentine Seaman (1770-1817), USA

Francis Galton (1822-1911),



1861

The modern weather map, a chart showing area of similar air pressure and barometric changes by means of glyphs displayed on a map.



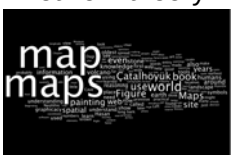
Émile Levasseur (1828-1911), France

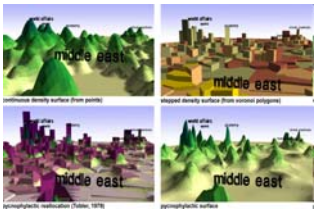
Since the mid-19th Century

- Rise of professional societies
- Attempts at symbol standardization
- Widespread use in science
- Increased use in government, especially for social issues e.g. public health
- Origins of computing in Hollerith cards
- Ideas appear in textbooks, comparisons made

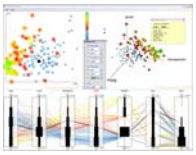
Rediscovery in cartography

- Scientific visualization
- GeoViz
- InfoViz
- Spatialization
- Data mining
- Network theory

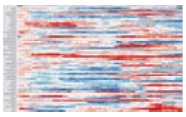




Visual analytics:
the science of analytic reasoning, facilitated by interactive visual interfaces.







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- http://kottkegae.appspot.com/images/taxi-flow-nyc.jpg
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