History of Data Visualization

John Keyser

Why Look at History?

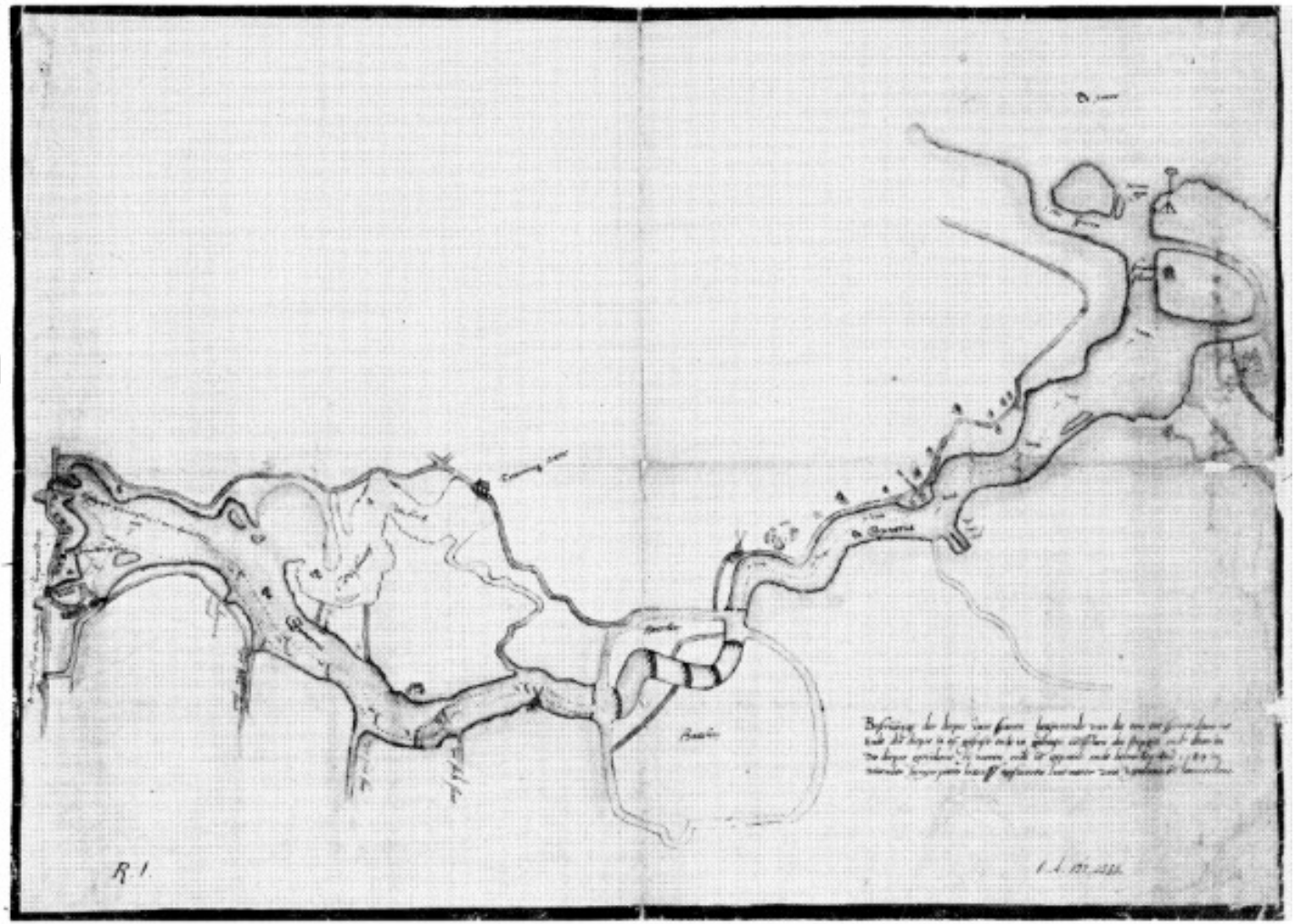
- See some of the major conceptual innovations that occurred along the way
- We still use these, today; helps to know how they arose
- The people here are seen as key figures, but almost certainly aren't the only ones, and there are others we could probably include

Maps and Cartography

- Maps and atlases have been some of the oldest data representations
  - Labeling key features on a 2D diagram
- Longitude and latitude were used to identify locations
  - Even in ancient times
  - Improved over time
- But, these concepts were not generalized to more general data

Pieter Bruinsz: 1584

- First use of contour lines on map (to show depth)



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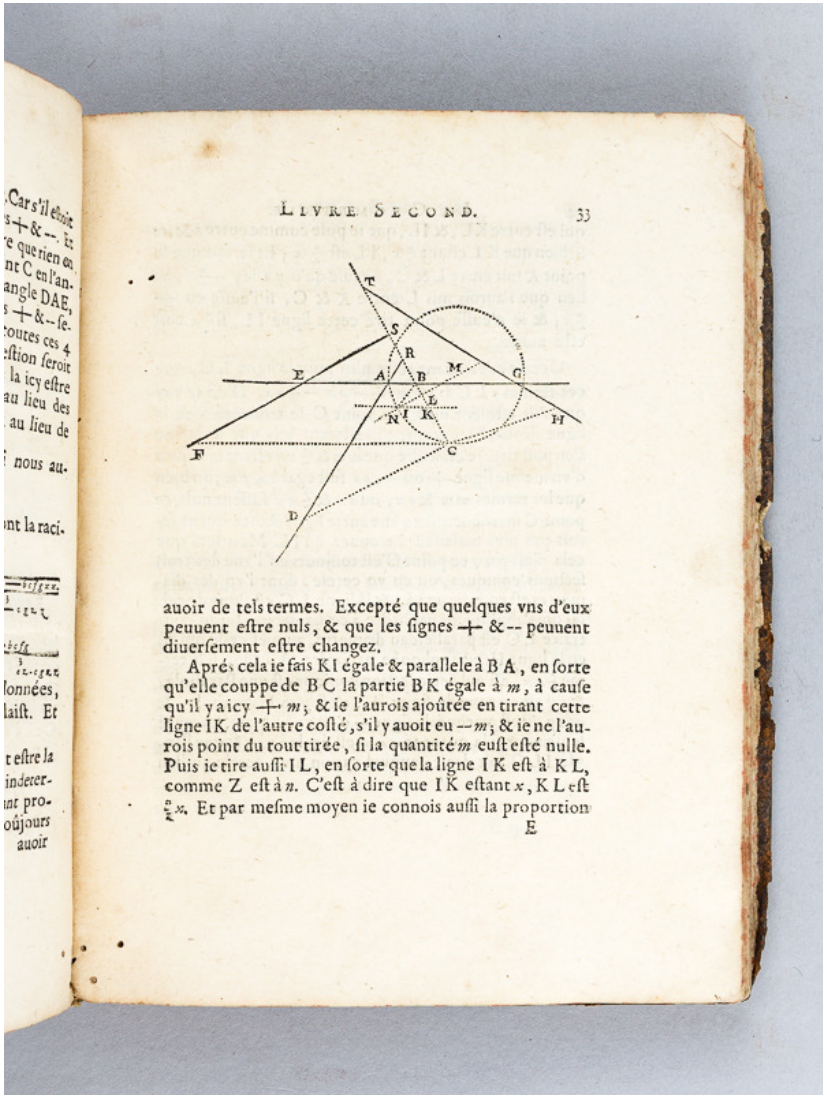
Rene Descartes: 1637

- Cartesian (named for him) geometry: coordinate points
- Allowed the visual representation of two variables, plotting of relationships, etc.
- Key idea is that more abstract data could be handled



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auoir de tels termes. Excepté que quelques vns d'eux peuuent eſtre nuls, & que les ſignes + & − peuuent diuerſement eſtre changez.

Aprés cela ie fais KI égale & parallele à BA, en ſorte qu'elle coupe de BC la partie BK égale à *m*, à cauſe qu'il y a icy + *m*; & ie l'aurois ajoûtée en tirant cette ligne IK de l'autre coſté, s'il y auoit eu − *m*; & ie ne l'aurois point du tout tirée, ſi la quantité *m* euſt eſté nulle. Puis ie tire auſſi IL, en ſorte que la ligne IK eſt à KL, comme Z eſt à *n*. C'eſt à dire que IK eſtant *x*, KL eſt $\frac{nx}{z}$. Et par meſme moyen ie connois auſſi la proportion

E

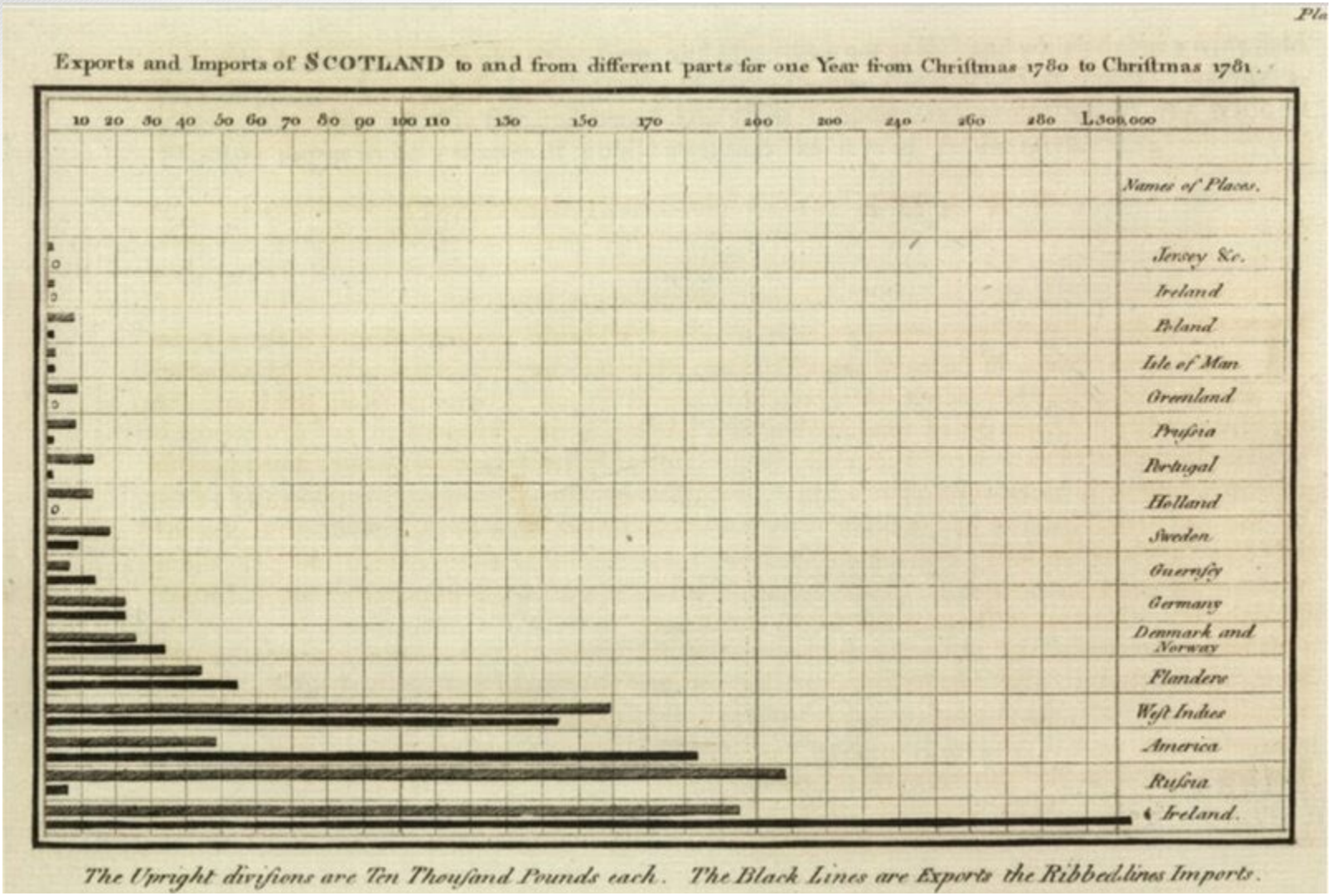
Edmond Halley: 1701

- Plotted additional data on map, to show magnetic isolines
- Early use of contour lines for info other than height

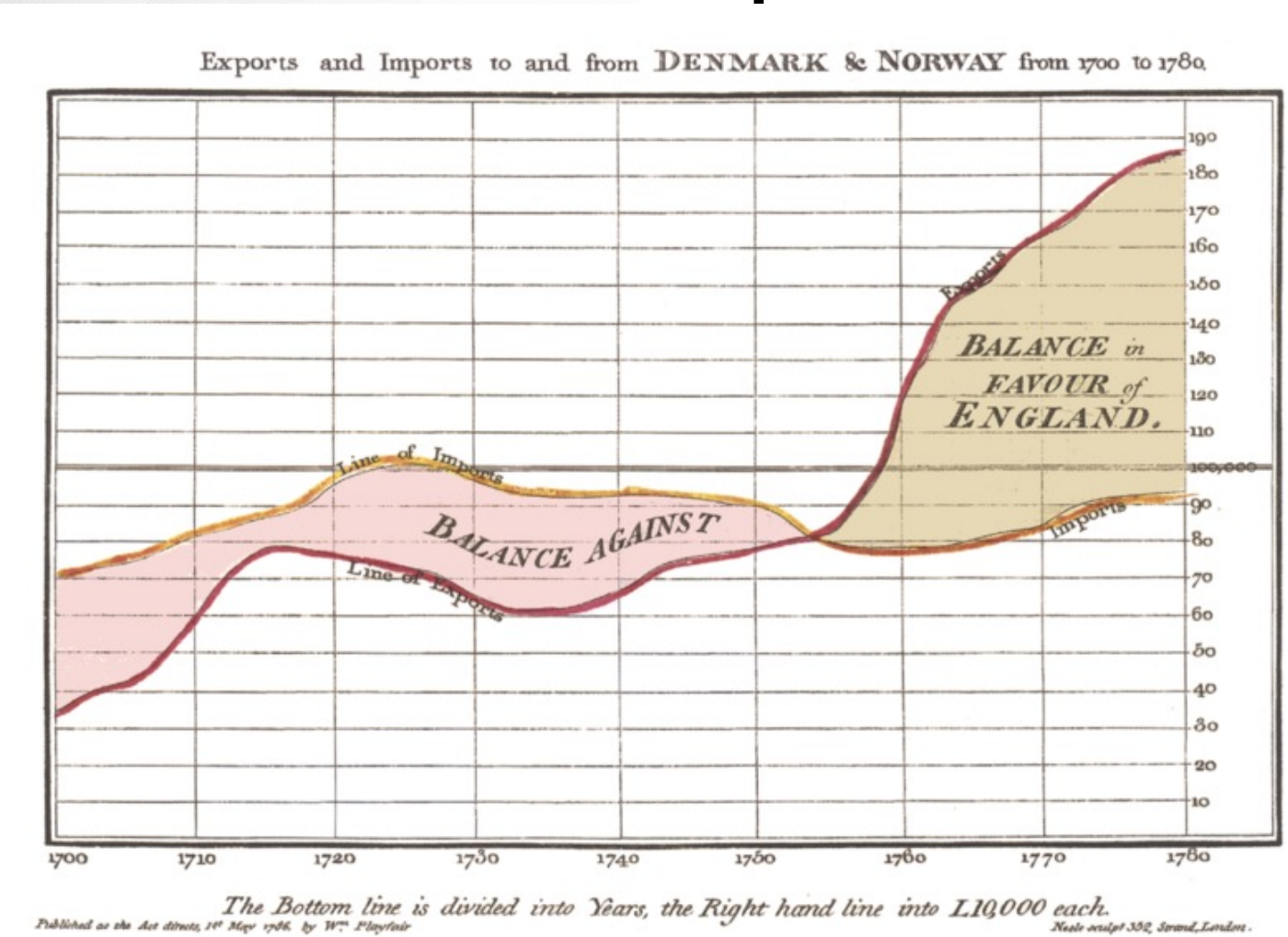
William Playfair

- The “father” of data visualization
- Created the bar chart, line chart, pie chart!
  - Was a little surprised, himself, that he was the first to come up with some of these.
- Started the use of statistical graphics in the late 1700s, which continued to grow into the late 1800s

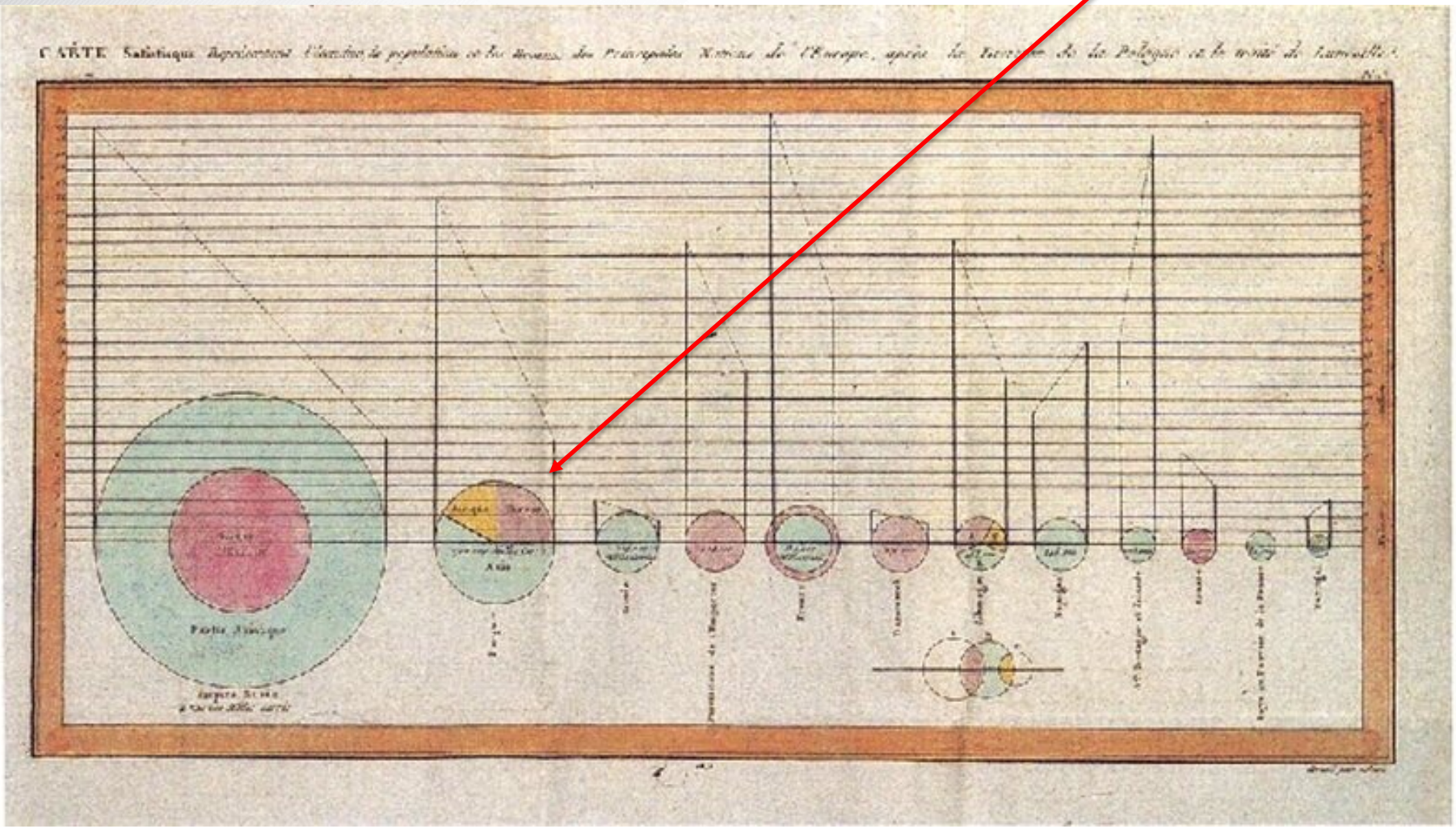
William Playfair
First Bar Chart: 1786



William Playfair
First Line Graph: 1786

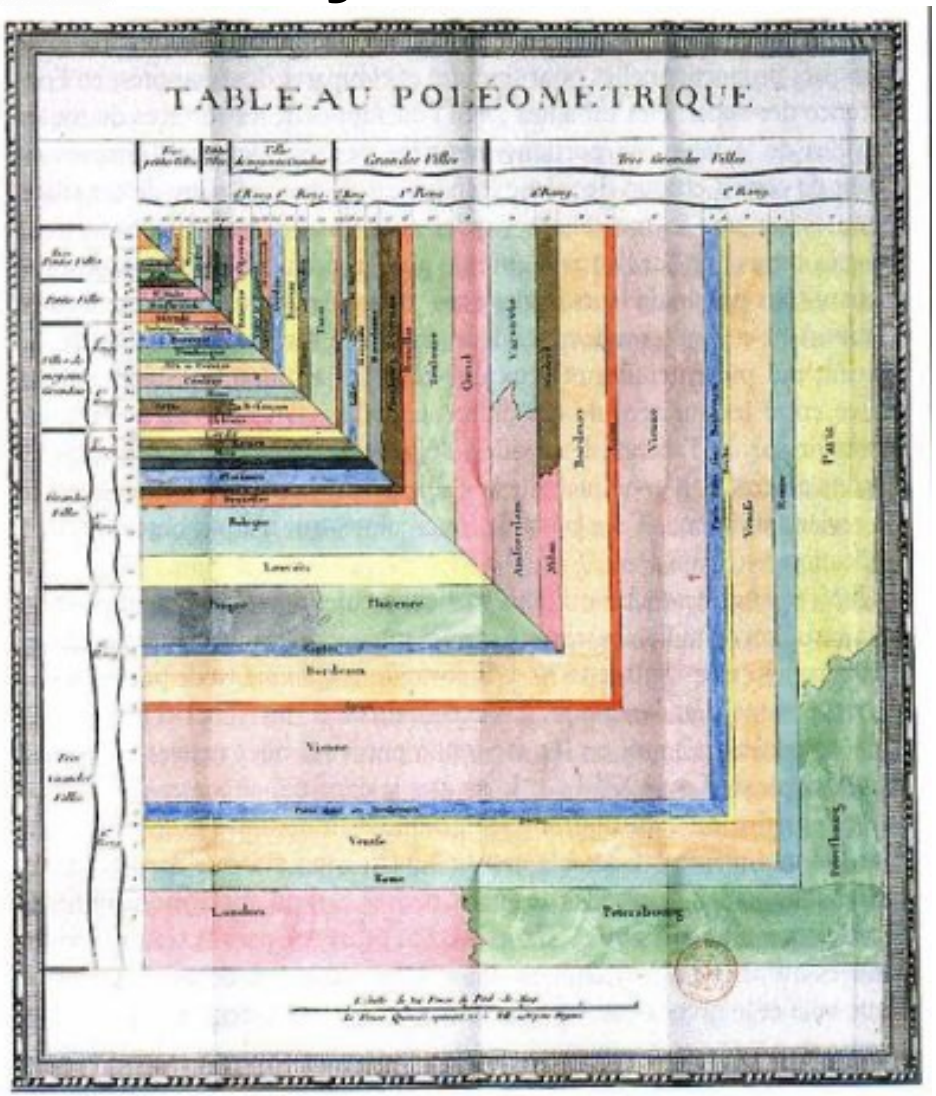


William Playfair
First Pie Chart: 1801



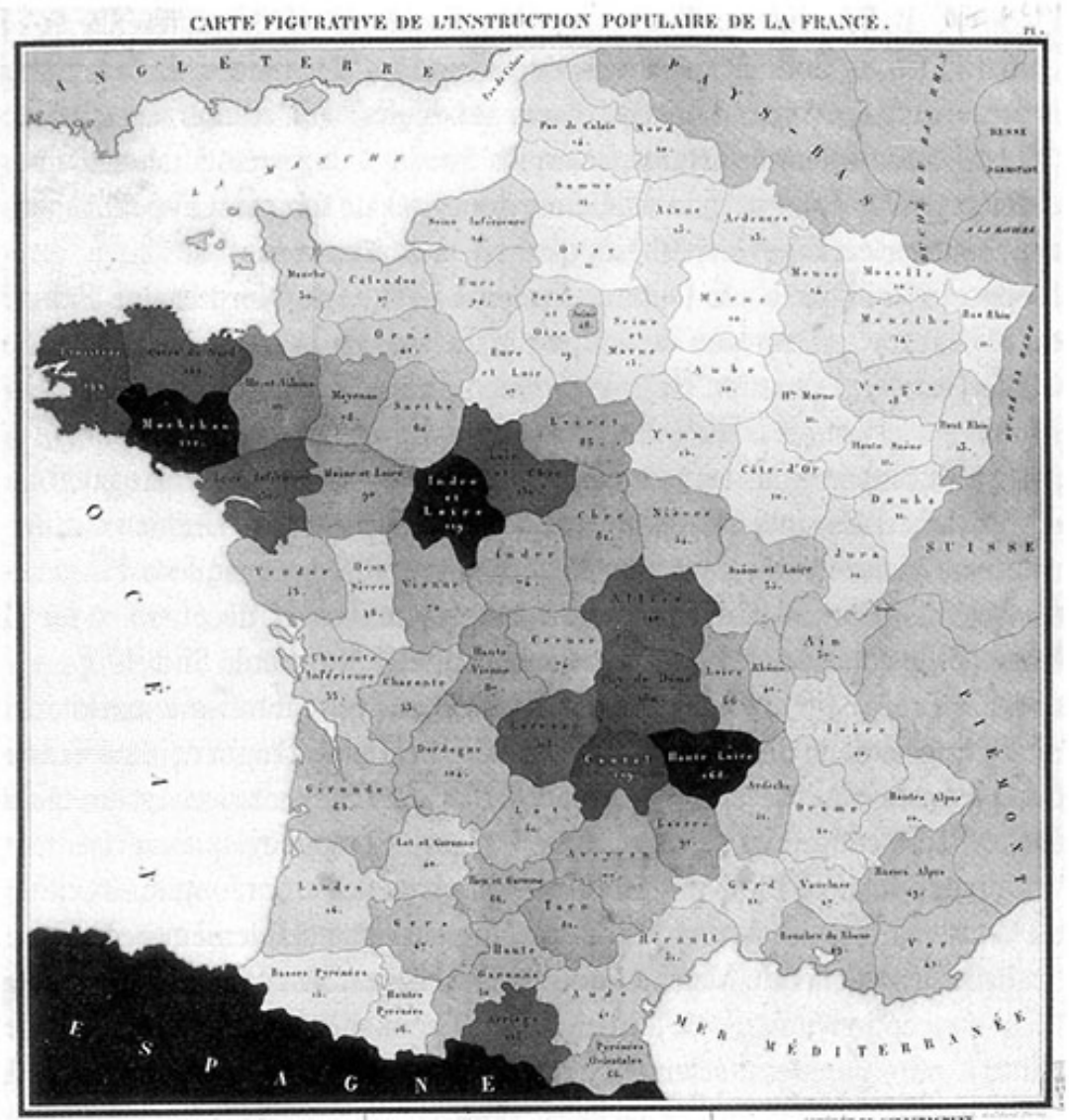
Charles de Fourcroy: 1782

- Visual layout of data into geometric blocks filling space
- Proportional representation of blocks
- 1782: (preceded Playfair)



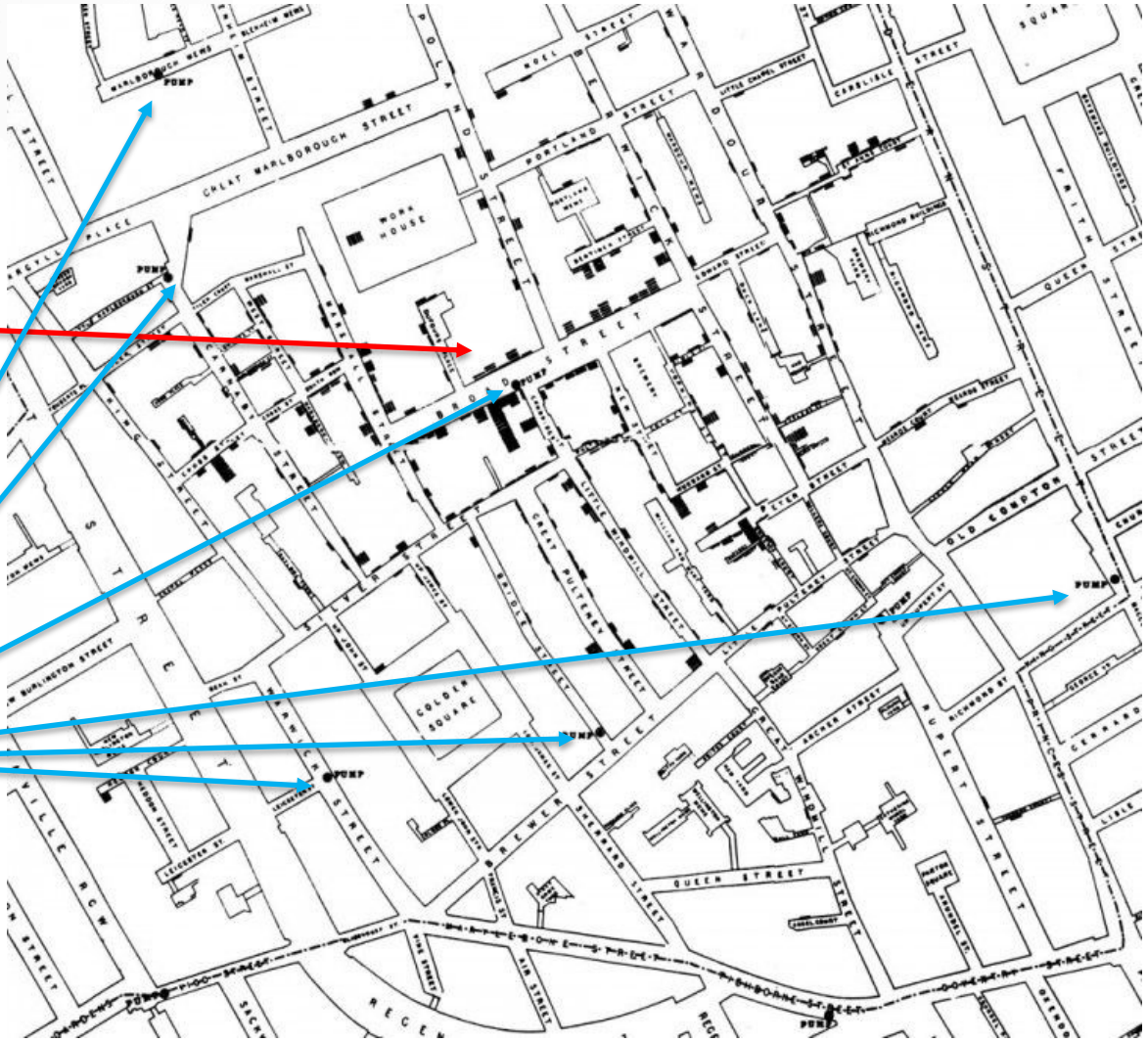
Charles Dupin: 1826

- First Chloropleth map (where regions of a a map are colored based on a value)



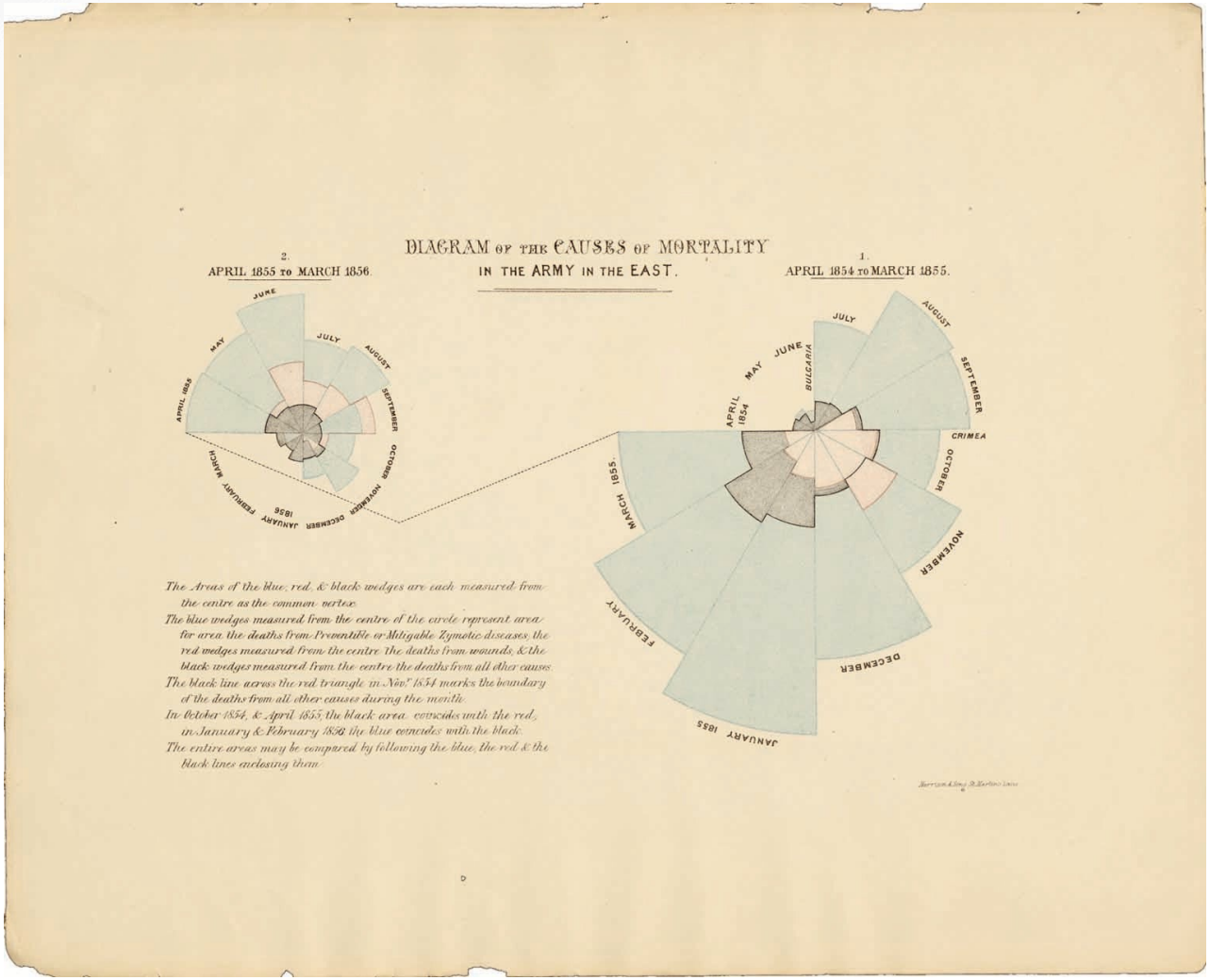
John Snow: 1854

- 1854 Cholera Epidemic
- Plotted cholera cases with lines (like bar)
- Labeled pumps
- Visual Analytics



Florence Nightengale: 1858

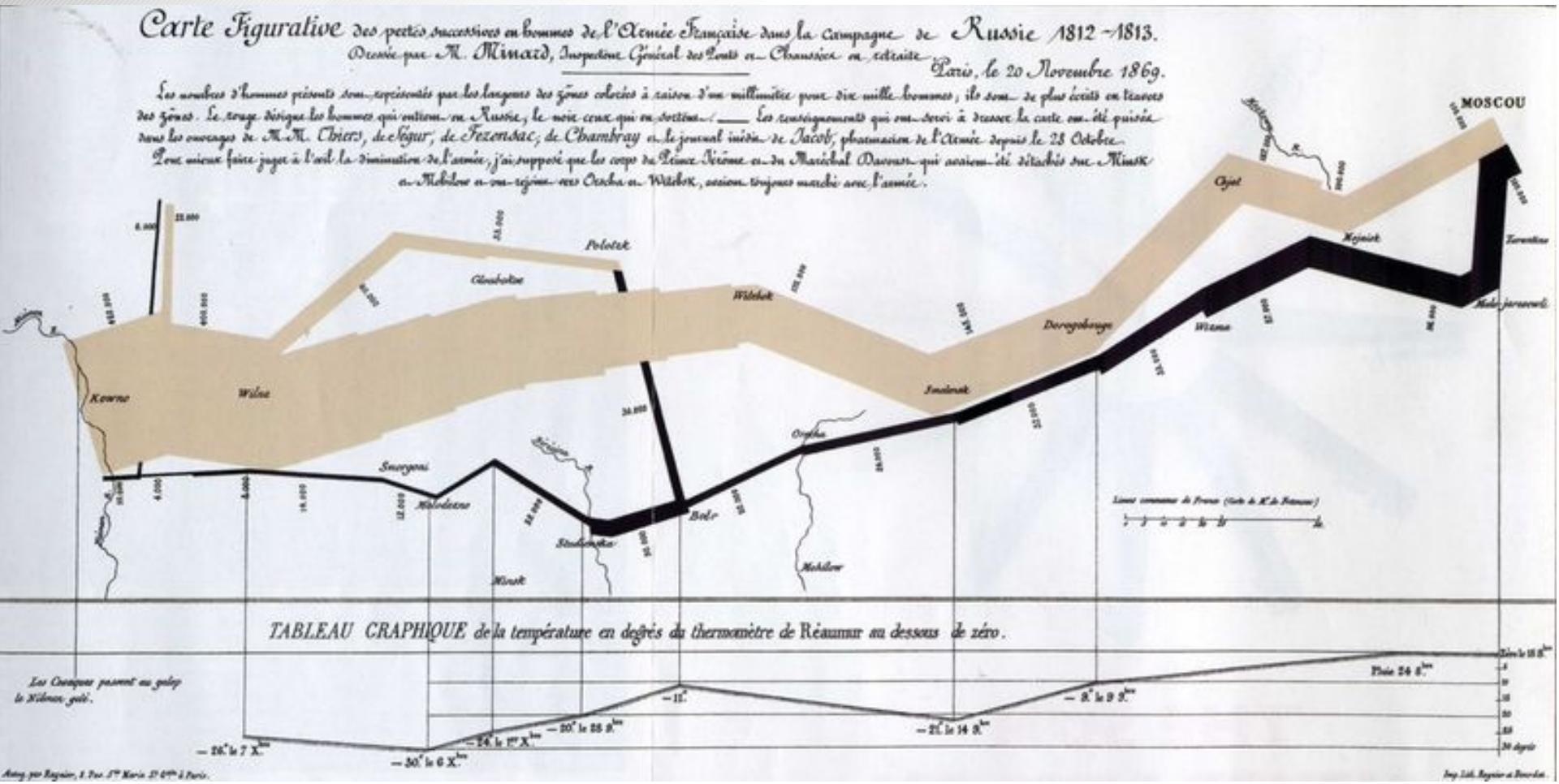
- Radial display (like radar or sunburst chart)
- Used to persuade government for support



Emile Levasseur: 1868

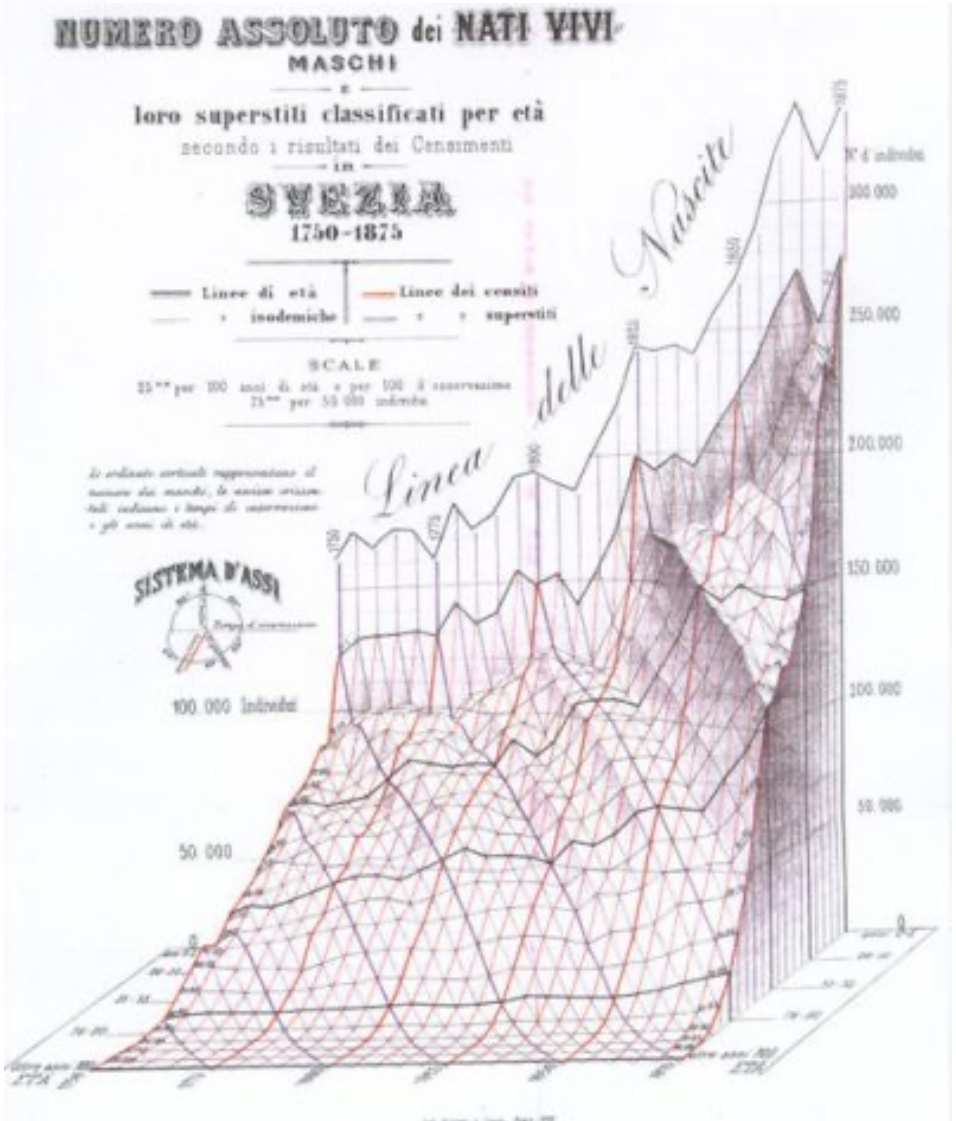
- Proportional map
- Layout still roughly corresponds to geography

Charles Minard: 1869



Luigi Perozzo: 1880

- Use of 3D for general data representation (as a heightmap)
- Data actually plotted 3 dimensions of data



The "Dark Period"

- Many fundamental types/concepts of data visualization had been developed by late 1800s
- Statisticians/mathematicians/scientists moved away from visualizations for a while
  - Seen as less precise/accurate
- However visualizations became more widely used in popular culture/media

Modern Times

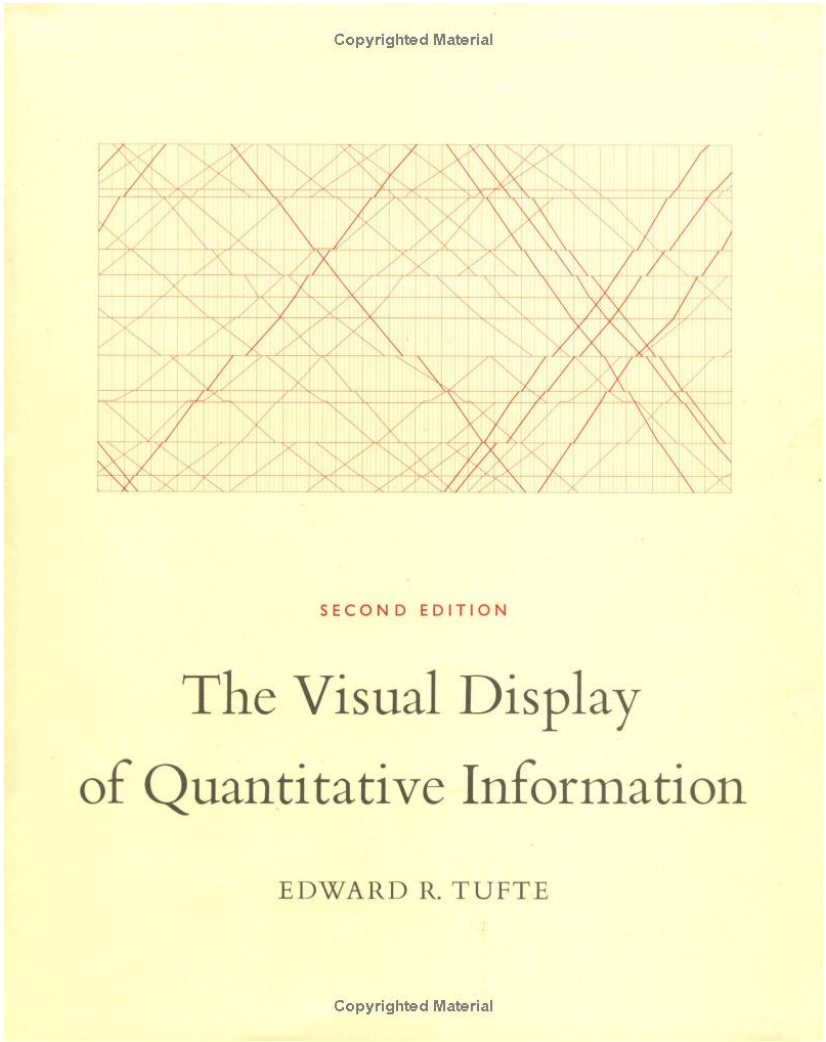
- Visualization work on the academic side picked up in the 1960s, especially with the work of:
- Jacques Bertin
  - Cartographer. Tried to give more theoretical foundation to information visualization
- John Tukey
  - Satistician. Many key statistical contributions, including visualizations of statistics
  - Introduced the box plot
  - Also known for coining “bit”, first publishing “software”, inventing the FFT, etc.

The Rise of Computers

- With computers rose the ability to handle far more data than ever before, creating both needs and opportunities:
- Need:
  - More data could be produced than could be understood with traditional approaches
    - Need statistical summaries, or visualizations
- Opportunities:
  - Ability to create visual representations more easily, automatically
  - Opens ability for interaction

Edward Tufte

- Political scientist, developed course for journalist, taught seminars with Tukey
- 1983 book: *The Visual Display of Quantitative Information* is considered a classic, seminal book in information visualization
- Published multiple other books, lectured widely, and became very influential



William Cleveland

- Statistician at Bell Labs then Purdue
  - Like Tukey, continued push for visualization in statistics
- Known for interactive data visualization
- Defined/named the field of “Data Science” in 2001

The Visualization Report

- 1987 NSF "Panel on Graphics, Image Processing, and Workstations":
  - chaired by Bruce McCormick, Tom Defanti, Maxine Brown
- Produced report: "Visualization in Scientific Computing" a.k.a. the "McCormick report"
- This is where the now-common use of "visualization" started
  - Initially applied mainly to scientific visualization, but the report and later use had a broader view, including info vis, entertainment application, etc.
  - Led to later funding, research, projects (such as the Visible Human Project

Side Note: Visualization at Texas A&M

- Bruce McCormick was the first department head in Computer Science at Texas A&M
  - And report was written while he was at A&M
- When there was discussion here at A&M about putting a program together, McCormick was an influence in its formation,
  - Including that it should not fall under CS/Engineering
  - And naming it Visualization
- This led to the program (which later became a department) named “Visualization”
- Though Visualization took on more specialized meaning (Data Visualiztion) later, the name preceded this

IEEE Visualization

- Conference started in 1990
- Has been the central focus of
- Has gone through several variations
  - e.g. at one time split into 3 tracks: SciVis, InfoVis, Visual Analytics
- Journal: IEEE Transactions on Visualization and Computer Graphics
- Other conferences also have aspects of Vis:
  - SIGGRAPH and Graphics in general
  - SIGCHI and HCI-oriented conferences

Growth from There

- With ongoing research, visualization research has progressed along several axes
  - General rendering/graphics methods to improve efficiency
  - New methods for displaying data
  - Greater incorporation of interaction
  - Domain-specific methods
  - Scaling to greater amounts of data