



PROFESSIONAL &
CONTINUING EDUCATION
UNIVERSITY *of* WASHINGTON

Data Visualization Theory

A practical introduction

Week 1
Oct 13, 2015

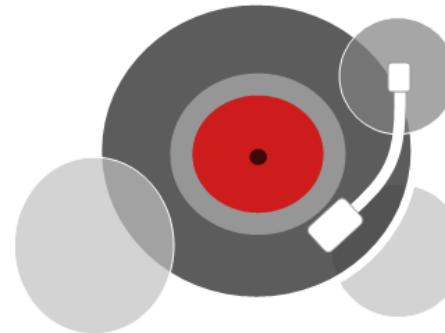
About Ben



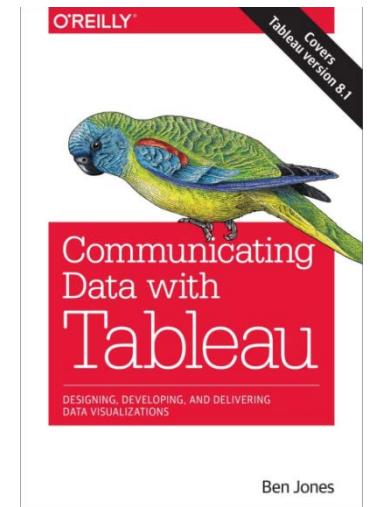
UCLA BSME
2000



CLU
MBA 2011



Blogger,
DataRemixed.com



Medtronic Diabetes
Lean Sigma MBB



Director of
Tableau Public



Author,
*Communicating
Data with
Tableau*
(O'Reilly 2014)

Course Goals

- Understand the foundational principles of data visualization
 - What works well, what doesn't work so well, and why
- Learn how to apply these principles to create effective data visualizations
 - How to use a handful of tools to turn data into insight
- Build a network of people interested in this topic

Required Readings



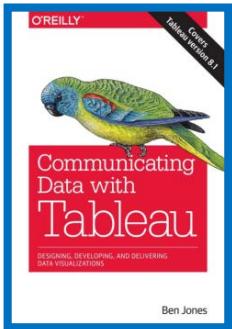
Munzner, Tamara. *Visualization Analysis & Design* CRC Press (2014)



Data Visualization

THEORY

a

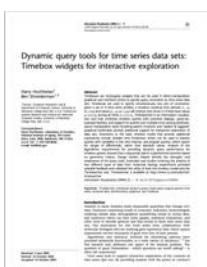


Jones, Ben. *Communicating Data with Tableau* O'Reilly Media; First Edition (2014)



PRACTICAL

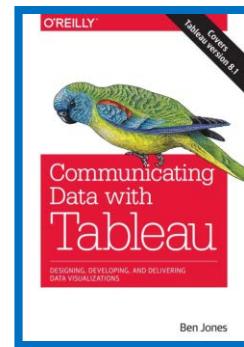
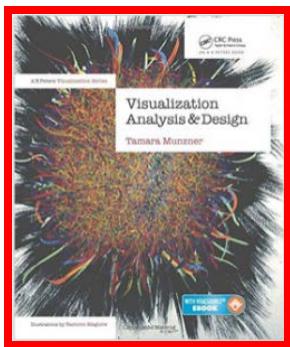
Introduction



Additional research readings relevant to topics

Course Design

We have 3 hours together each week....



Hour 1: Theory

*Understand the
concepts and principles*

Hour 2: Practical

See how it's done

Hour 3: Workshop

Do it yourself

How Will You be Graded?

This class is **Pass** / **No Pass** / **Incomplete**

You will get a **PASS** if...

1. You **attend class** - 8 of 10 sessions required
2. You complete your **weekly assignments** – 6 of 8 assignments required
3. You turn in a satisfactory* **final project**

What to Bring to Class

- PC or Mac laptop
 - Excel
 - Tableau Public
- Required books
 - Communicating Data with Tableau
 - Visualization Analysis & Design

<https://canvas.uw.edu/courses/1019792>

W DATAVIS 100 A: Data Visu x Ben

https://canvas.uw.edu/courses/1019792

Ben Jones Inbox Settings Logout Help

DATAVIS 100 A

Courses Grades Calendar

DATAVIS 100 A

Autumn 2015

Home Announcements Modules Discussions Grades People Syllabus UW Libraries Info & Help Assignments Collaborations Conferences Files Outcomes Pages Quizzes Settings

DATAVIS 100 A: Data Visualization Theory: A Practical Introduction

Welcome to DATAVIS 100: Data Visualization Theory—A Practical Introduction

Go to Modules

2012 Population

Click to

Life Expectancy by Country

Line represents life expectancy for a particular country from 1963 to 2013. The line thickness represents population. Source: Gap Minder

2012 Population: 10,000,000 - 1,353,600,687

Japan Australia South Korea Cuba Mexico Vietnam Tunisia Iran Indonesia Iraq Cambodia India Ethiopia Tanzania Zimbabwe Mali United States

Life Expectancy Rank: Top Bottom

Africa 60.1 Asia 72.9 Europe 78.6 North America 75.9 Oceania 73.6 South America 74.8

Information visualization is the use of computer-supported interactive visual representations of abstract data to amplify cognition (Card, Mackinlay, Schneidermann, 1999).

Thanks to advances in computing, we now have the ability to collect, summarize and make visual representations of data that help us depict and discover relationships in the vast amounts of data being collected, and to make comparisons, view relationships, and see trends. In this course we will study techniques and tools for creating effective visualizations based on principles from visual design, perceptual psychology, and cognitive science. The goal of this course is to expose you to visual representation methods and techniques that increase the understandability of complex and varied data.

Choose Home Page

View Course Stream

Course Setup Checklist

New Announcement

View Course Analytics

Coming Up

View Calendar

Nothing for the next week

Course Deliverables

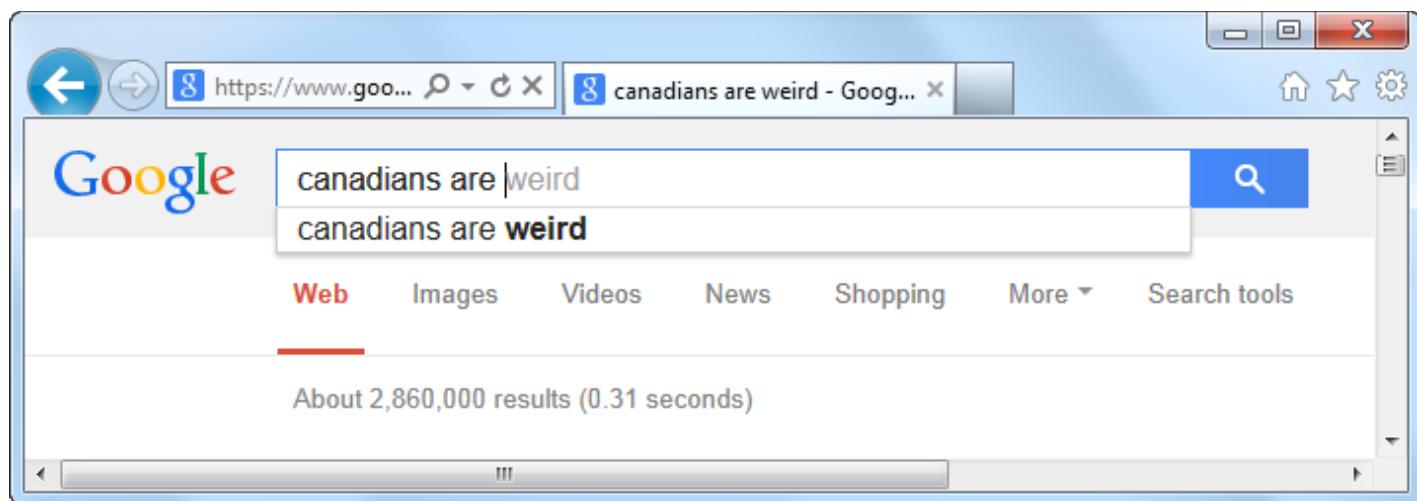
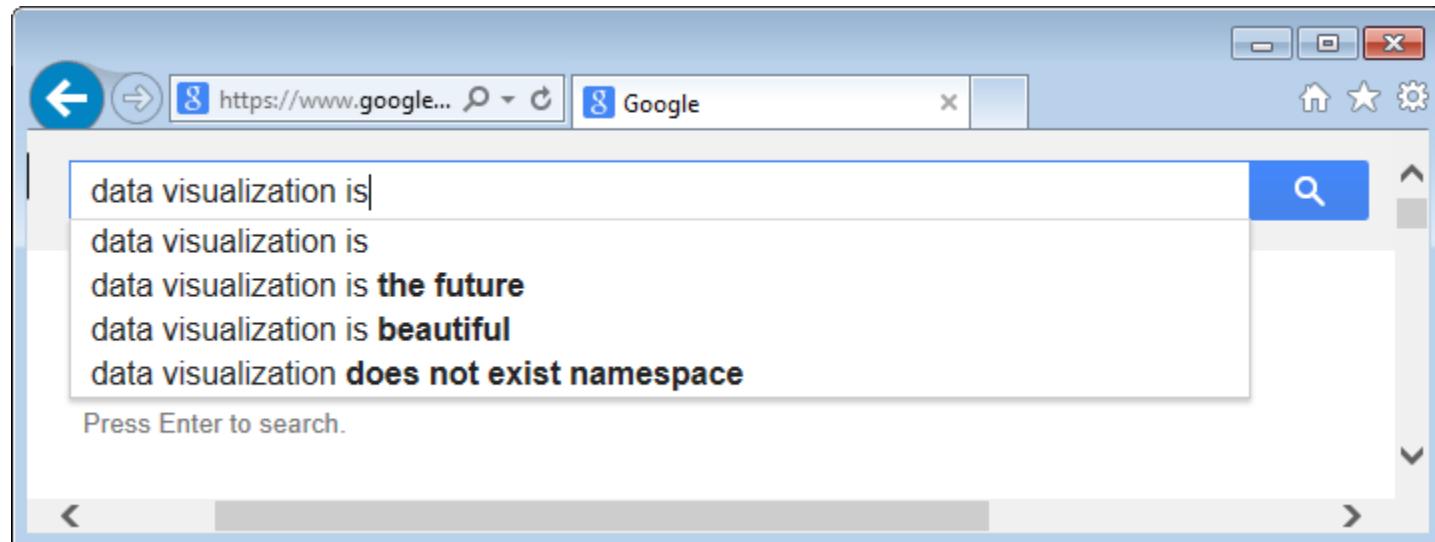
- In-class Exercises
- Weekly Assignments
- Final Project Presentation



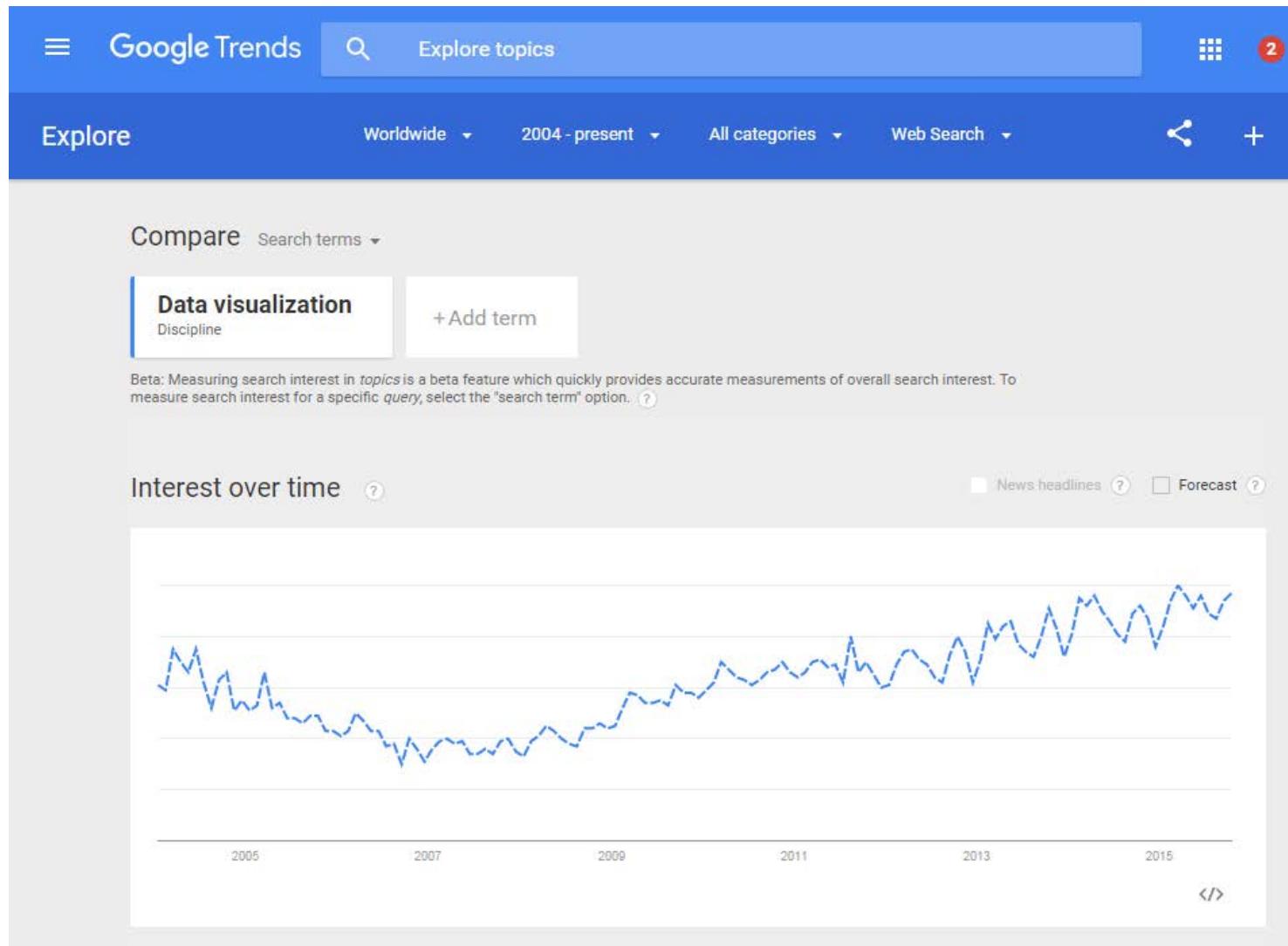
PROFESSIONAL &
CONTINUING EDUCATION
UNIVERSITY *of* WASHINGTON

data visualization is hot right now

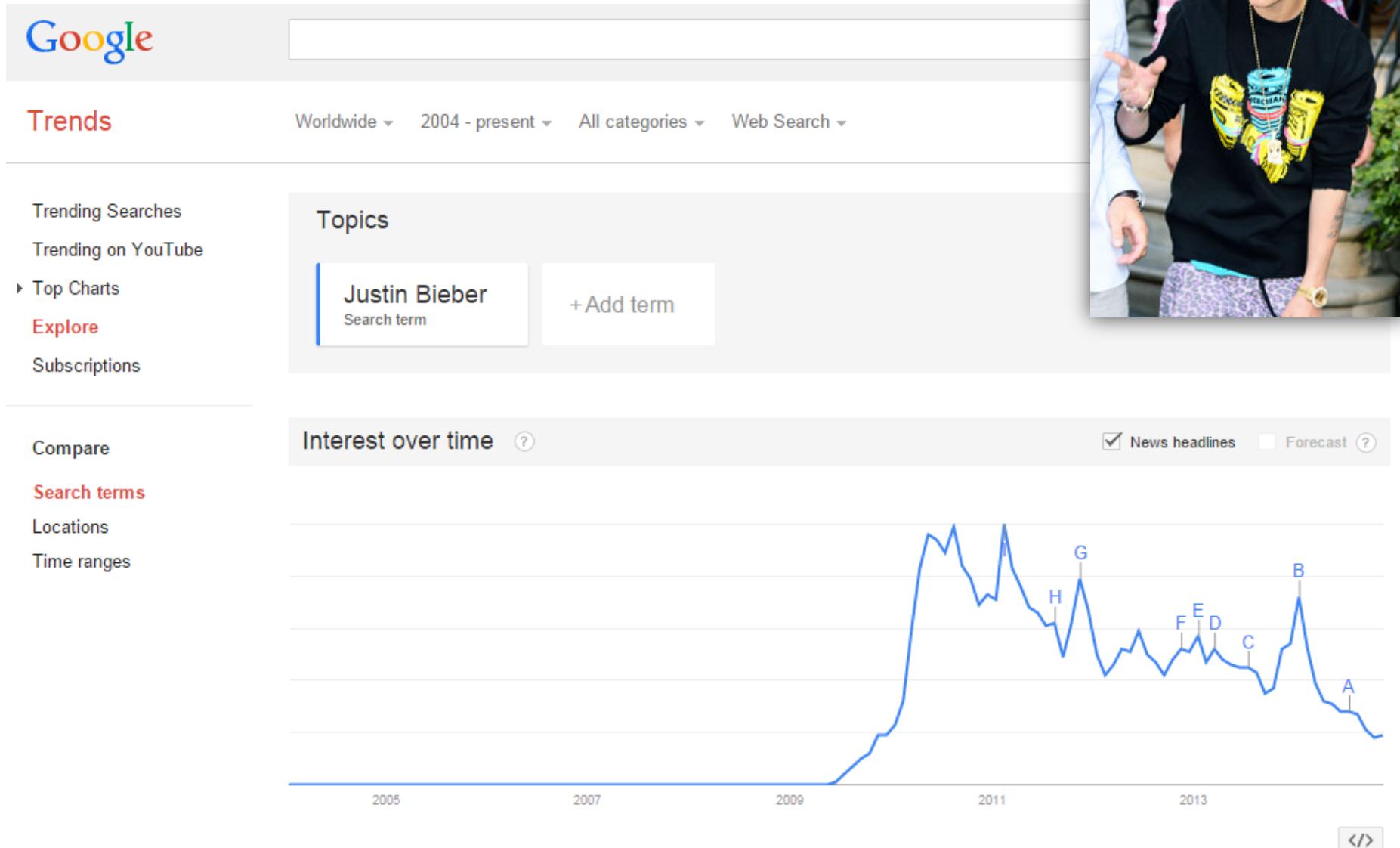
let's visualize the trend, and then talk about why...

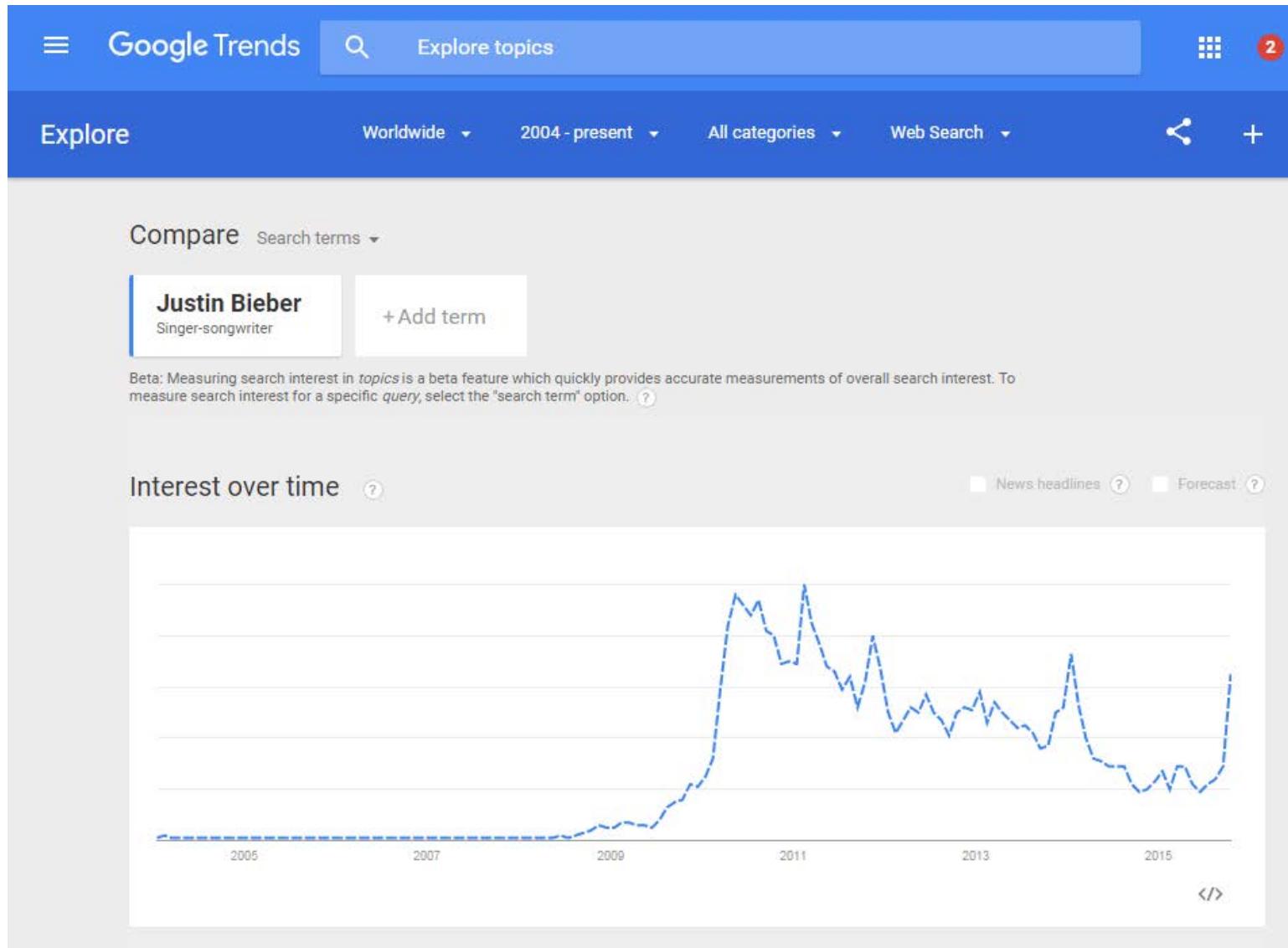


it's trending up in search



not everything is trending up...





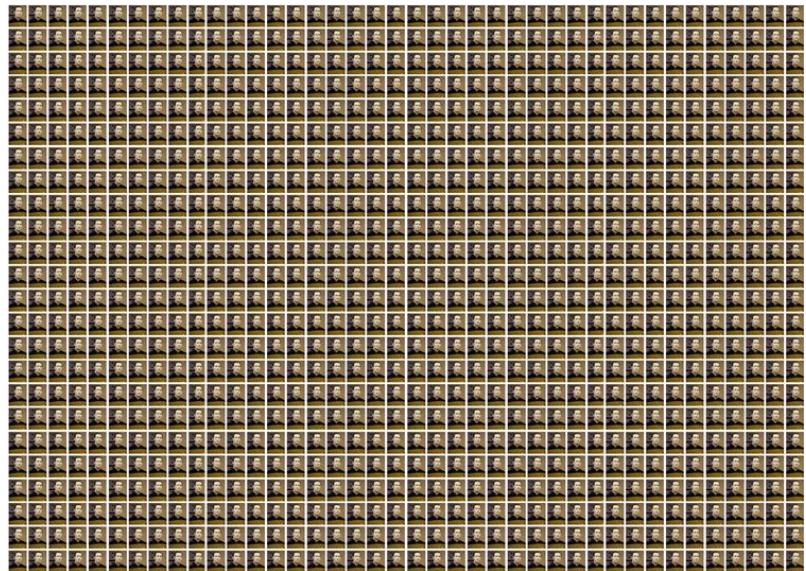
more
data

then



better
tools

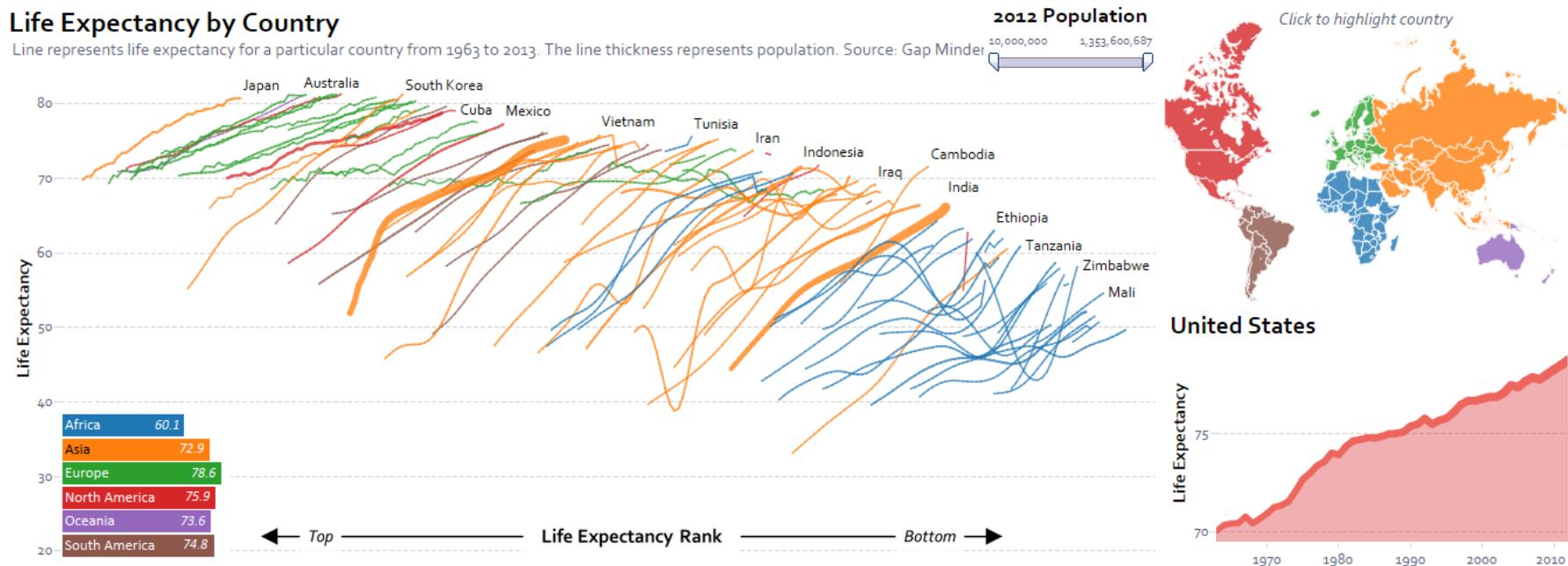
now



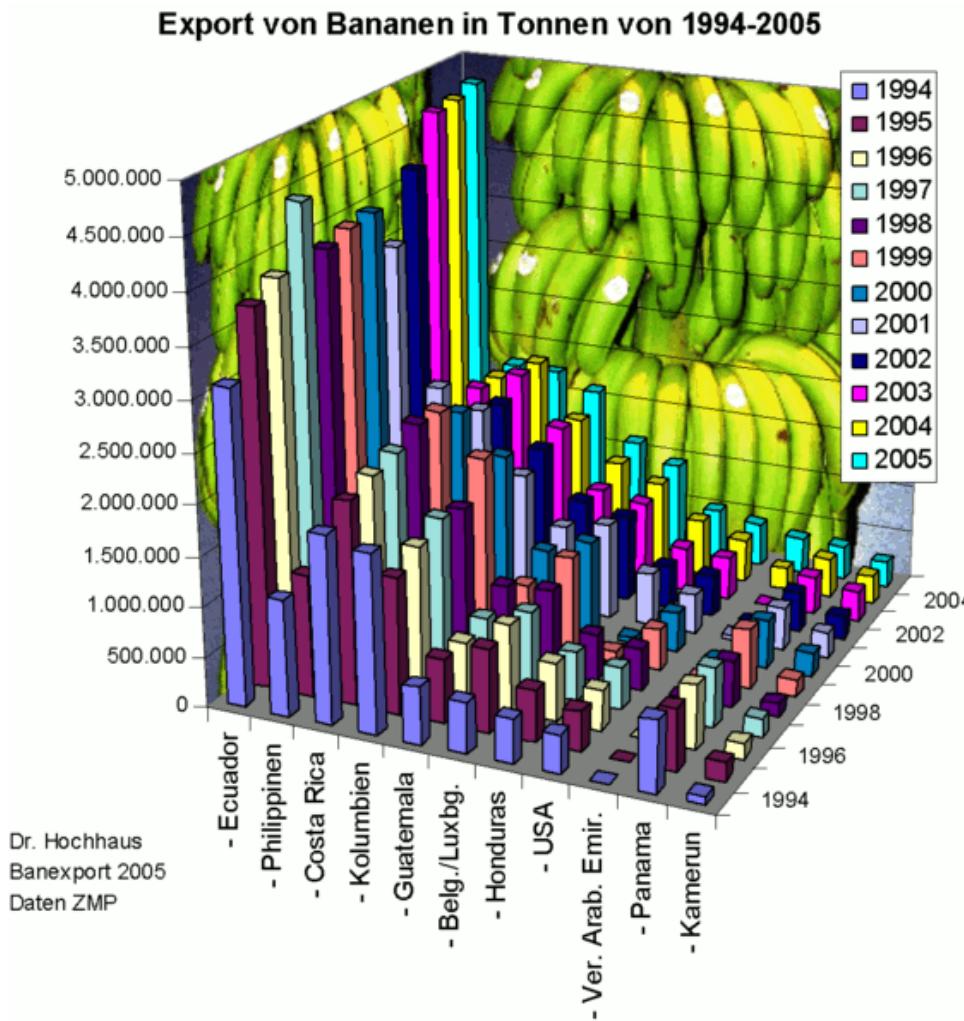
some of it is really great...

Life Expectancy by Country

Line represents life expectancy for a particular country from 1963 to 2013. The line thickness represents population. Source: Gap Minder



...and some of it is not so great





PROFESSIONAL &
CONTINUING EDUCATION
UNIVERSITY *of* WASHINGTON

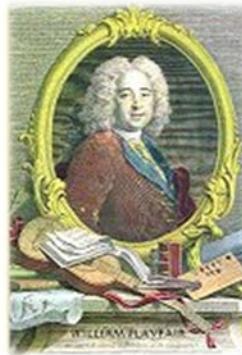
but it isn't new...

...it's been going on for centuries now

“Seize the Day”



A Timeline of Data Visualization Pioneers



Christoph Scheiner

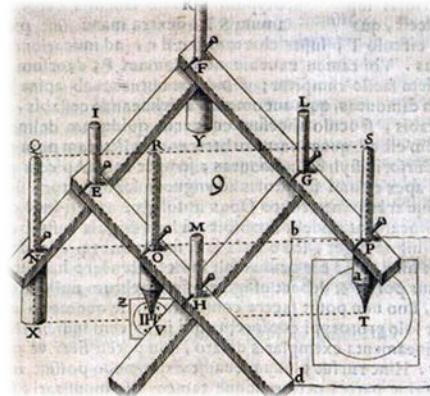
A Jesuit who looked to the heavens



1. Christoph Scheiner (1573-1650)



Diagram on sundials



Invented the pantograph



Observed sunspots with a telescope



Germany

MACVLAE IN SOLE APPARENTES, OBSERVATAE
anno 1611.ad latitudinem grad. 48. min. 40.

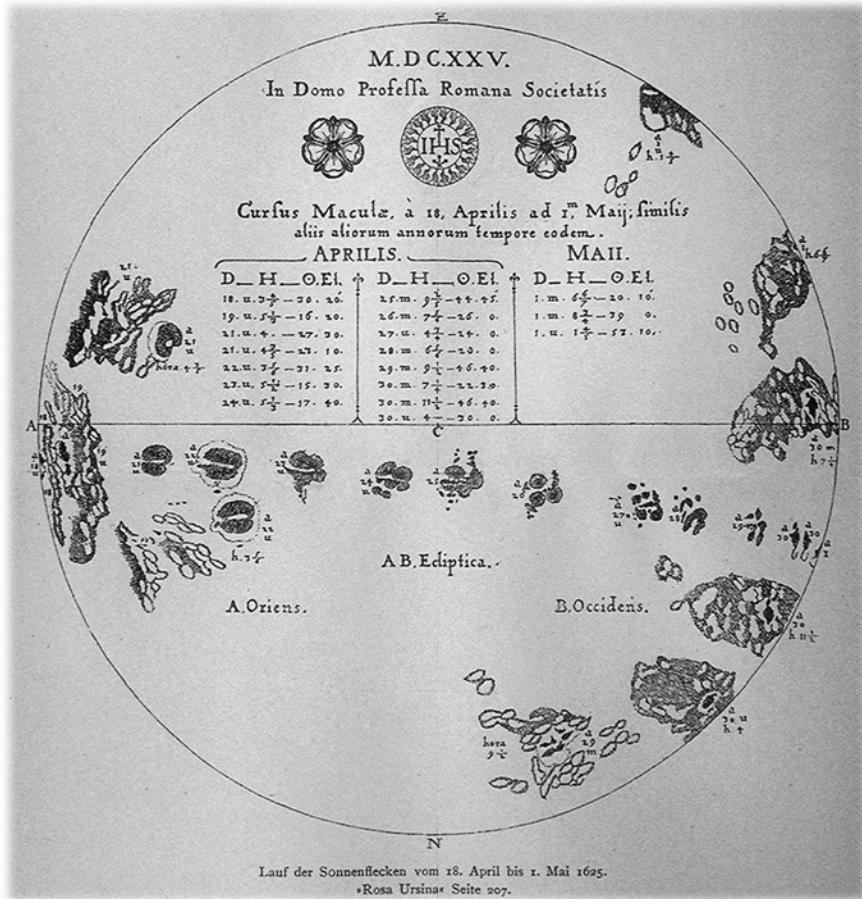
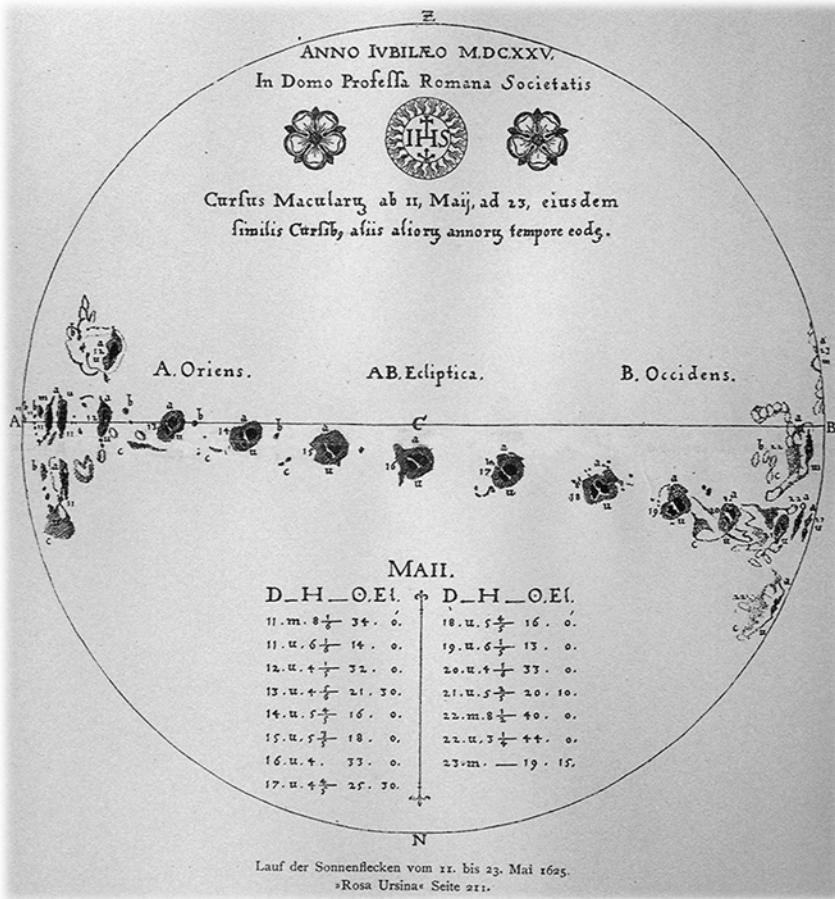
b



a c, horizon. a b c, arcus solis diurnus. Sol oriens ex parte a, maculas exhibet quas vides, occidens vero c, easdem ratione primi motus, non nihil inuerit. Et hanc matutinam vespertinamque mutationem, omnes maculae quotidie subeunt. Quod semel exhibuisse et monuisse, sufficiat.



From Rosa Ursina (1630)





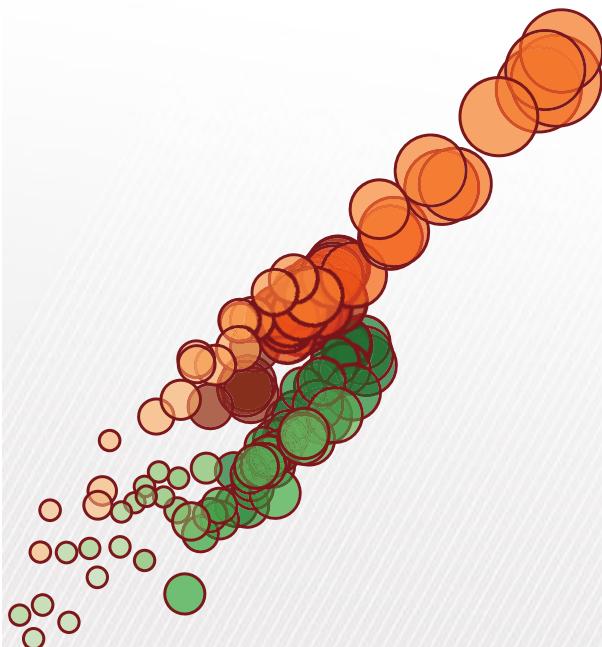
“Introductory Treatise in Favor of a Moving Sun and a Stable Earth against Galileo Galilei”

*- Title of Scheiner's last work,
published posthumously in 1650*

Lesson #1

Explore with an
open mind

(or, don't be on the wrong side of
history)

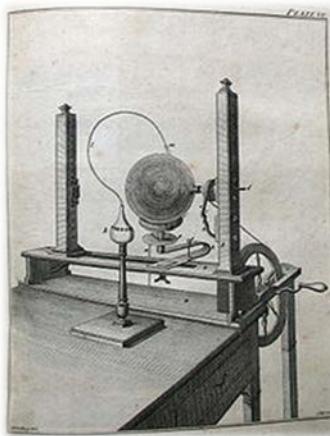


Joseph Priestley

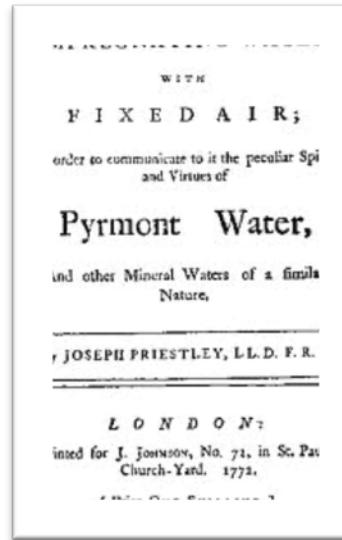
A master of many disciplines



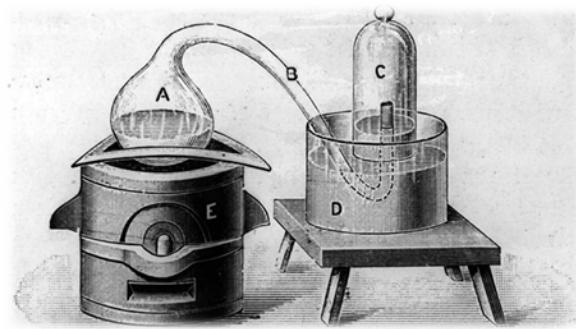
2. Joseph Priestley (1733-1804)



“Electrical machine
for amateur
experimentalists”



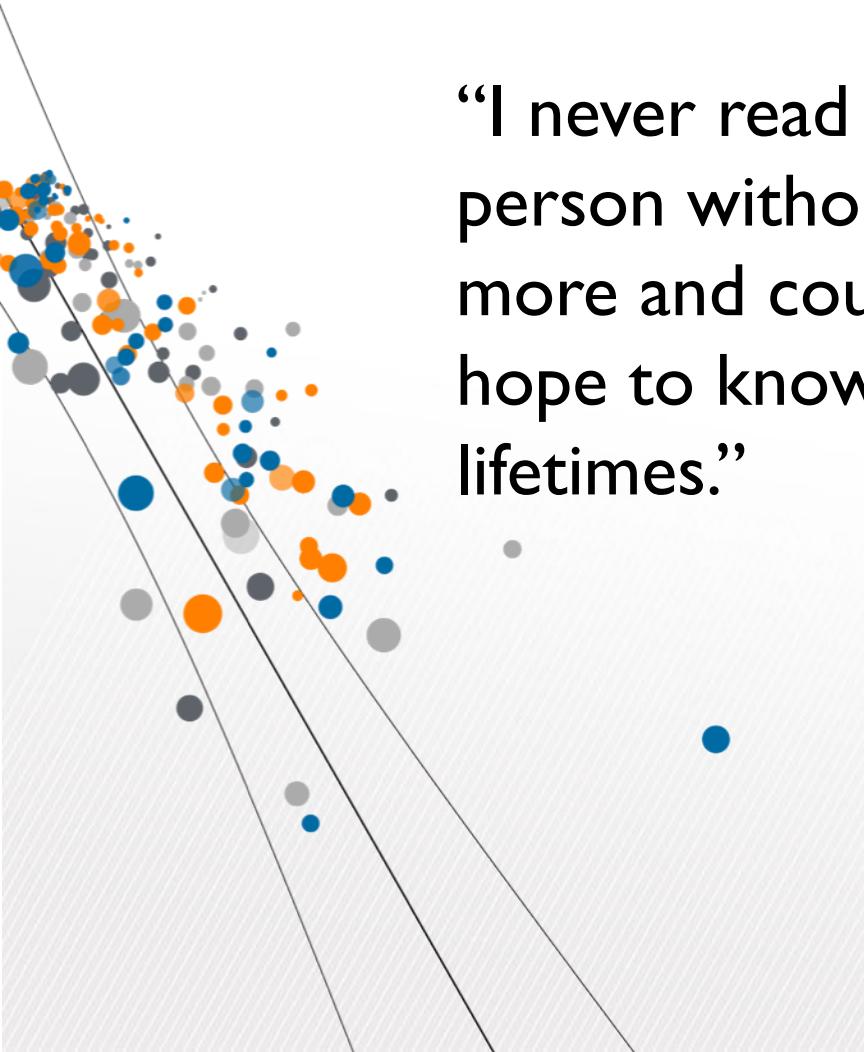
Invented Soda
Water



Discovered Oxygen



Leeds, England

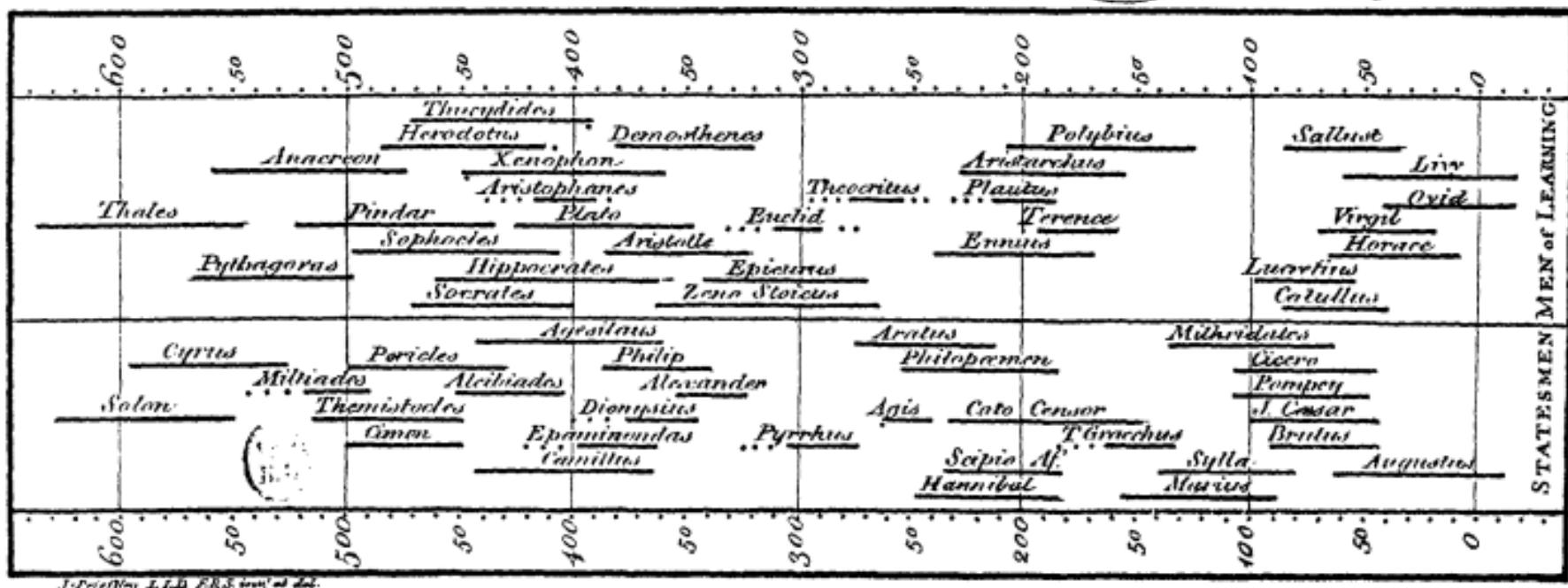


“I never read the life of any important person without discovering that he knew more and could do more than I could ever hope to know or do in half a dozen lifetimes.”

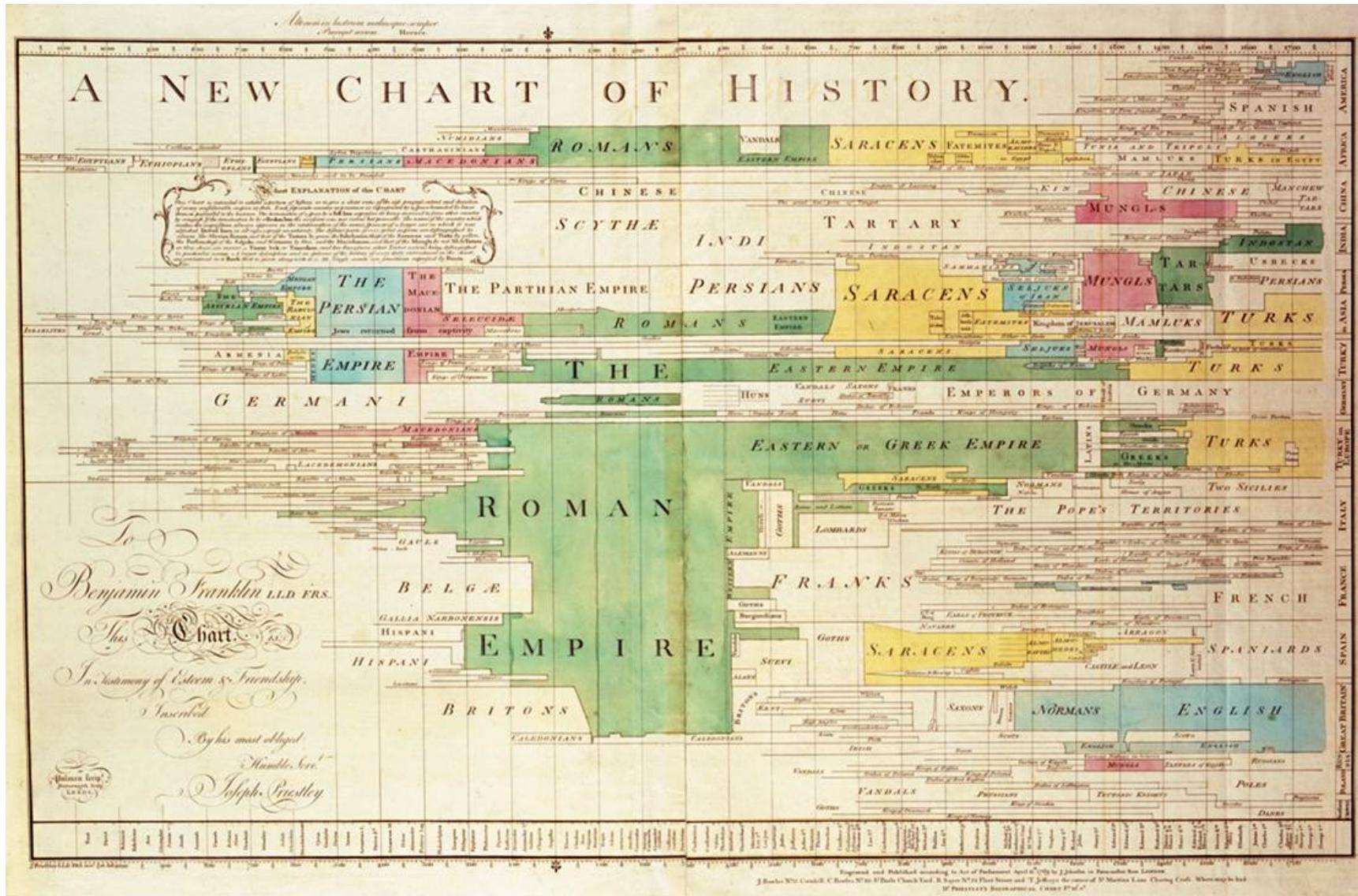
- Joseph Priestley

Chart of Biography (1765)

A Specimen of a Chart of Biography.



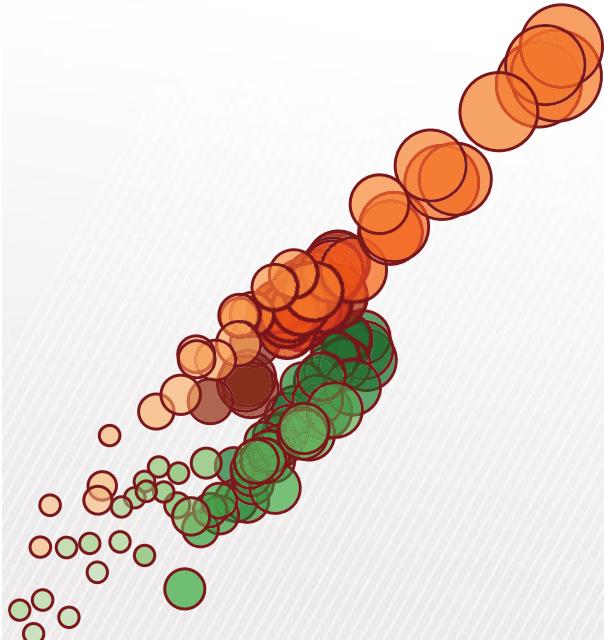
A New Chart of History (1769)



Lesson #2

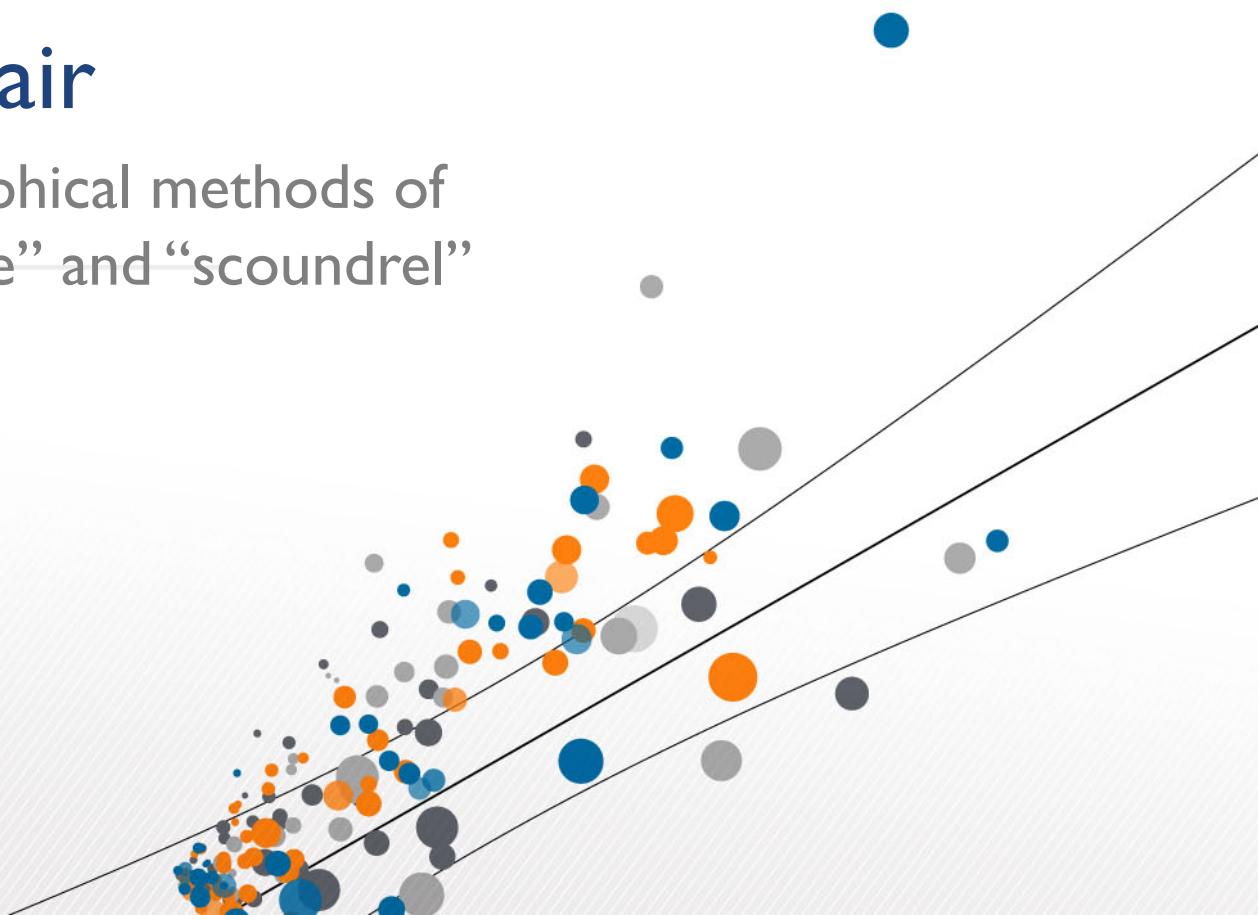
Seek to educate

(or, help others see the big picture)

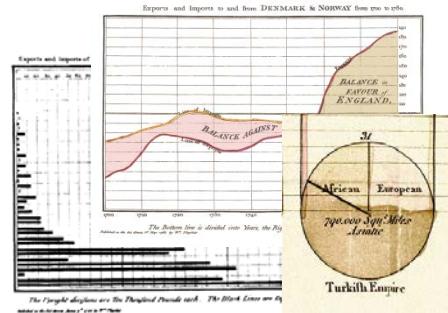
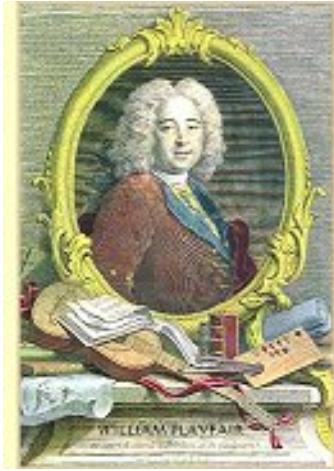


William Playfair

The founder of graphical methods of statistics, aka “rogue” and “scoundrel”



3. William Playfair (1759-1823)



Inventor of
multiple statistical
charts

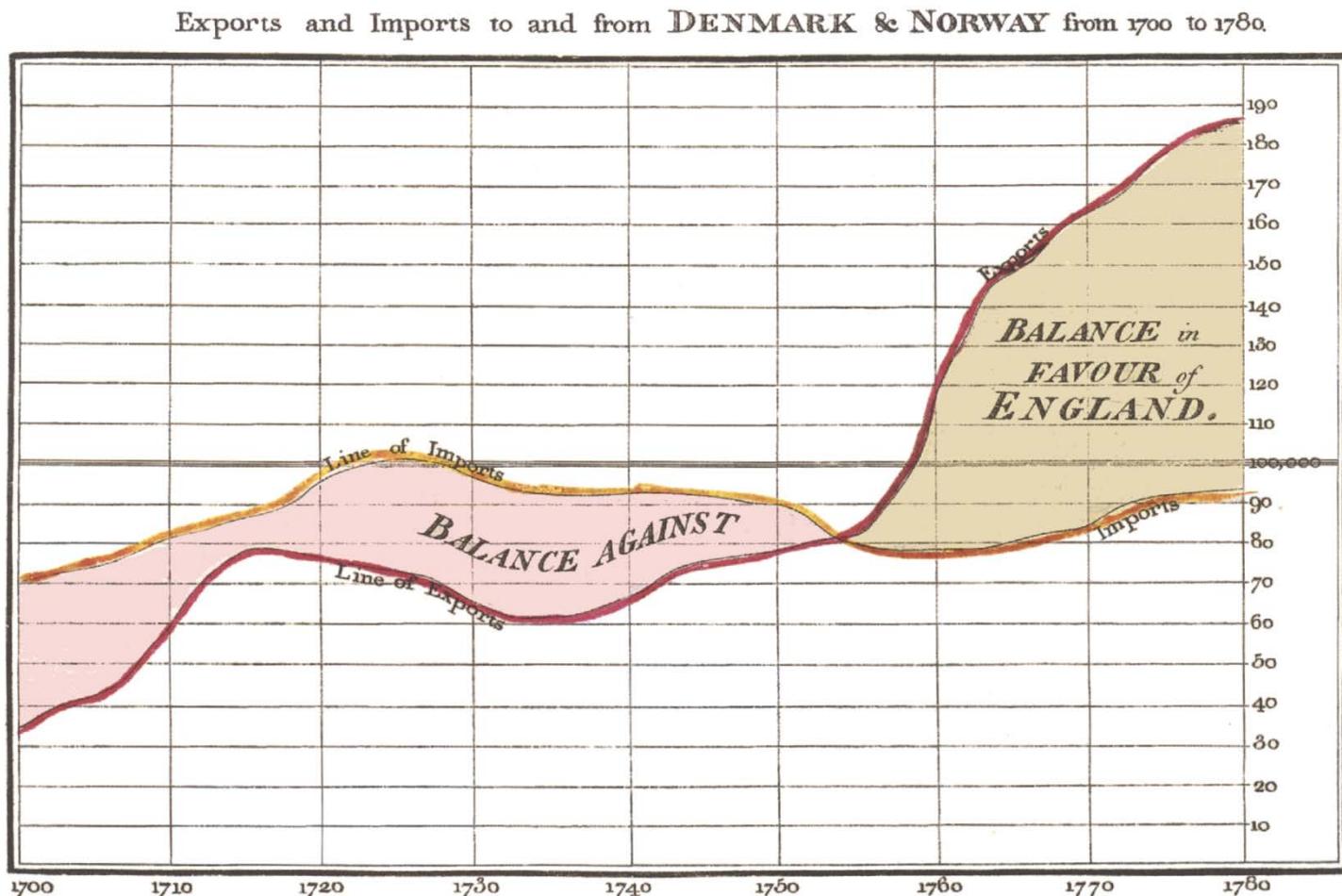


Dundee, Scotland



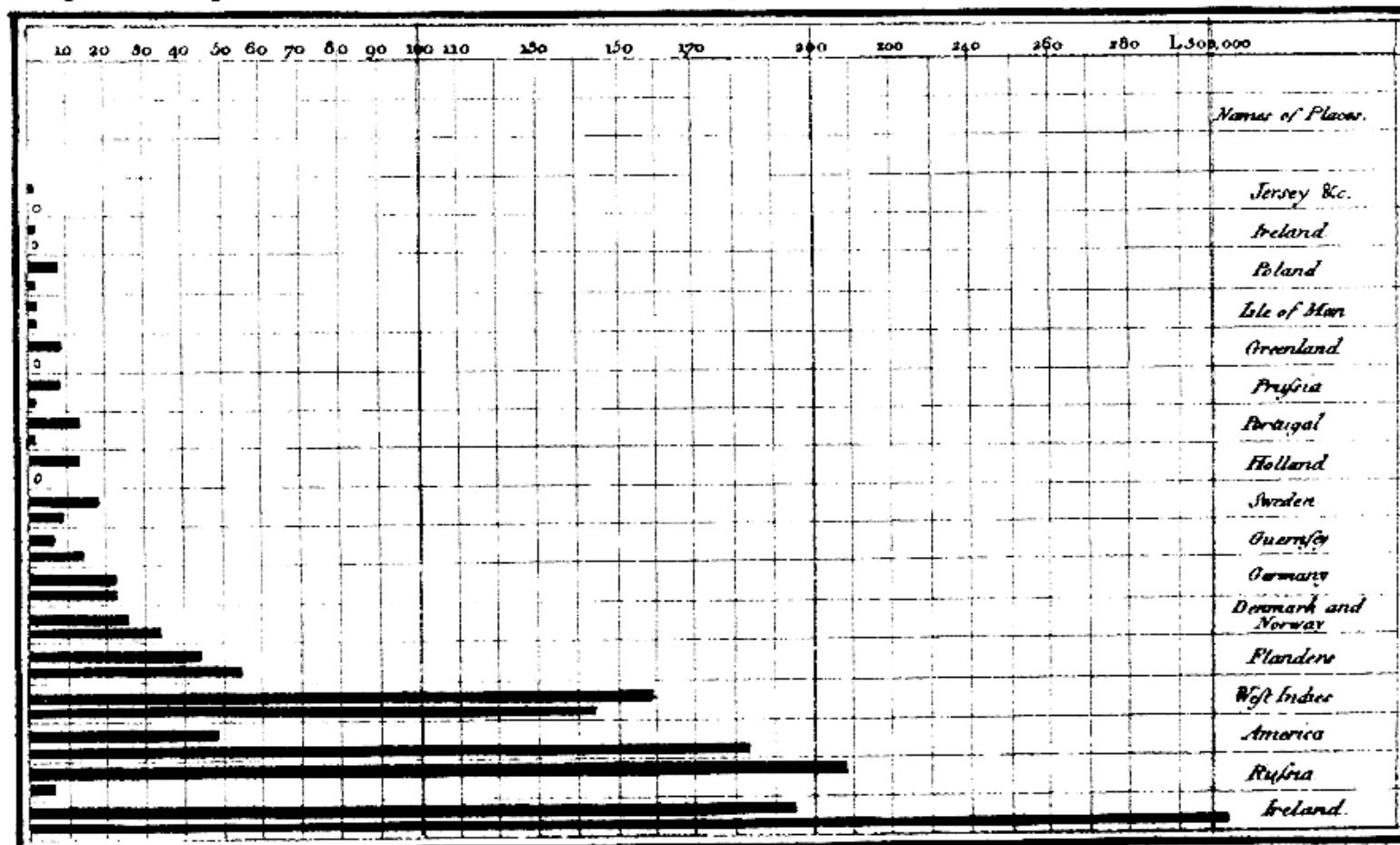
Storming of the Bastille

From “Commercial and Political Atlas” (1786)



From “Commercial and Political Atlas” (1786)

Exports and Imports of SCOTLAND to and from different parts for one Year from Christmas 1780 to Christmas 1781.

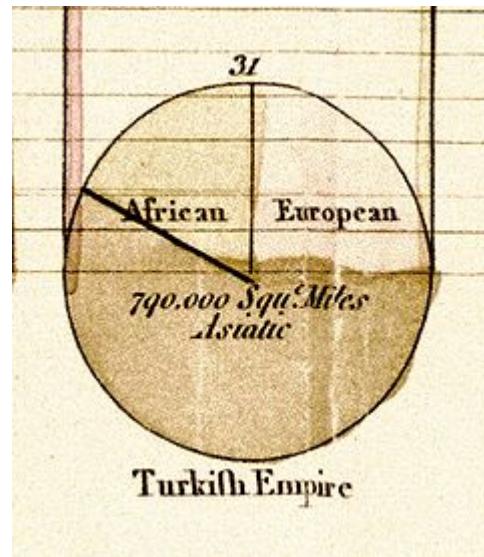


The upright divisions are Ten Thousand Pounds each. The Black Lines are Exports the Ribbed lines Imports.

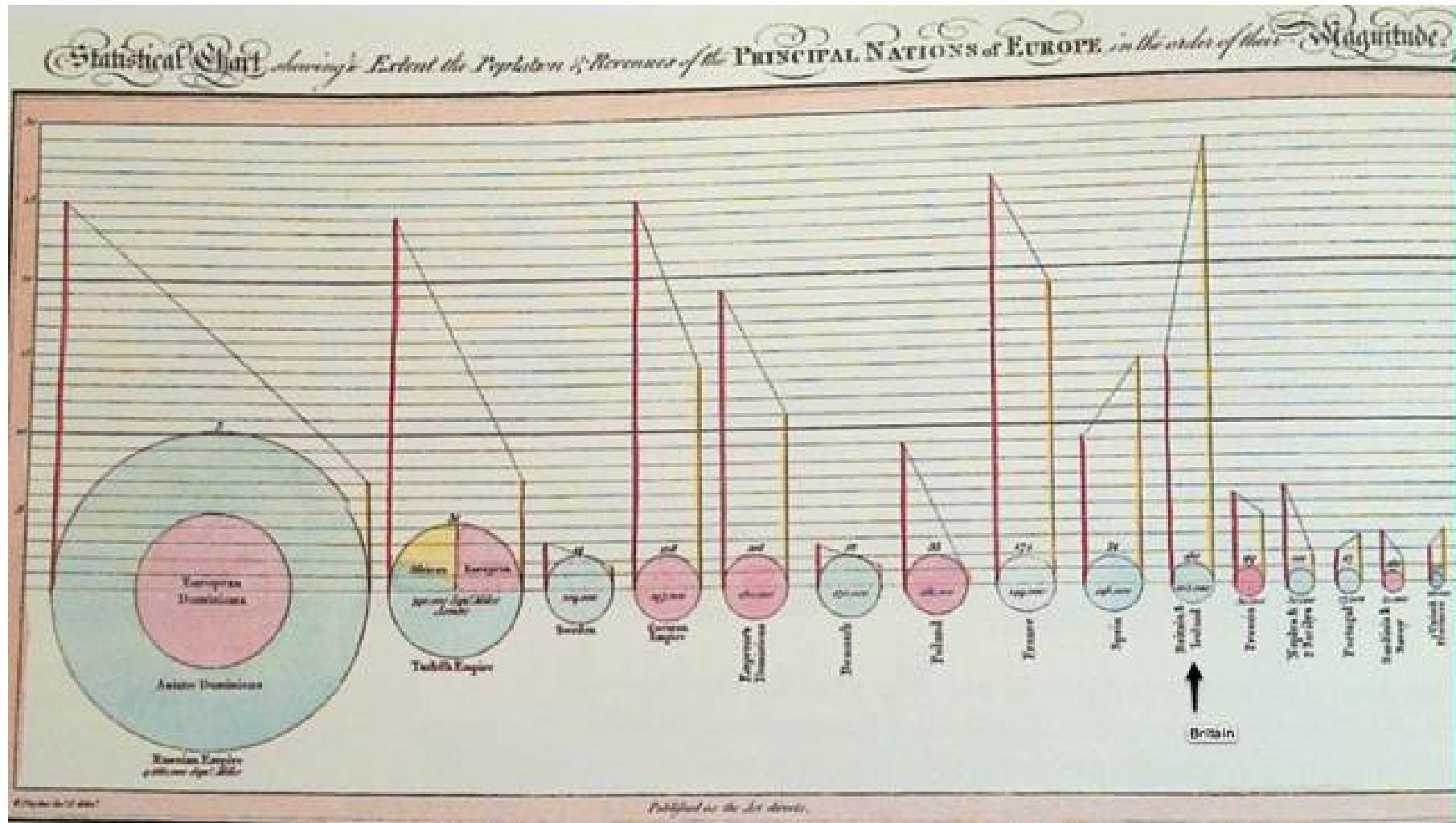
Published at the Author's Office June 7th 1786 by W. Playfair.

No. 100, Fleet-street, London.

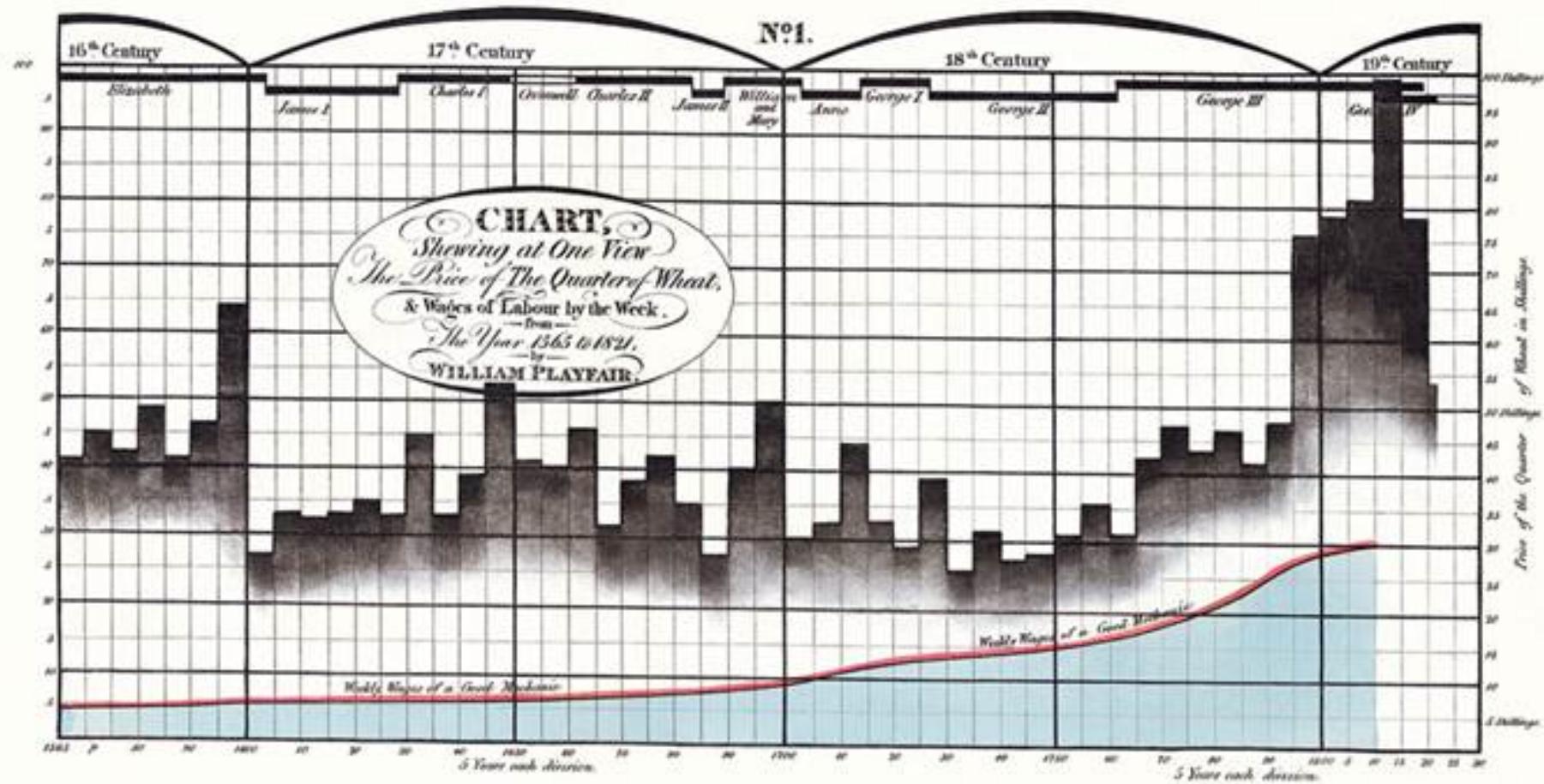
From “Statistical Breviary” (1801)



From “Statistical Breviary” (1801)



From “Agricultural Distresses” (1821)



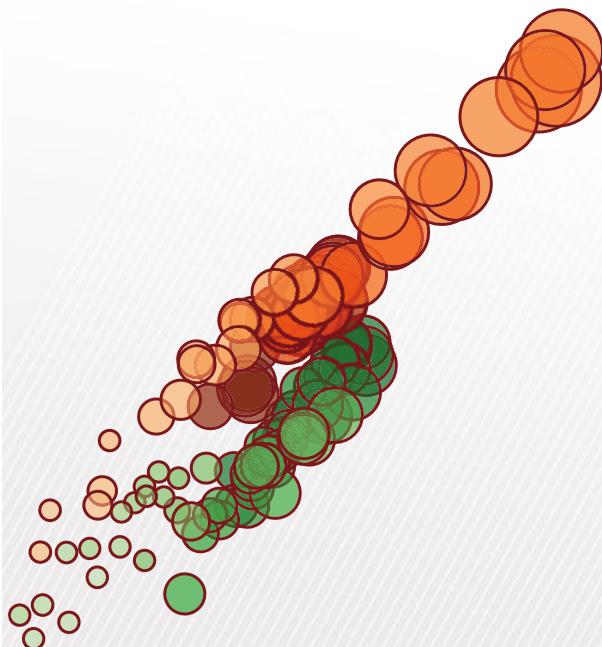


“No study is less alluring or more dry and tedious than statistics, unless the mind and imagination are set to work, or that the person studying is particularly interested in the subject; which last can seldom be the case with young men in any rank of life.”

- William Playfair

Lesson #3

Use your
imagination



(or, if at first you don't succeed...)

John Snow

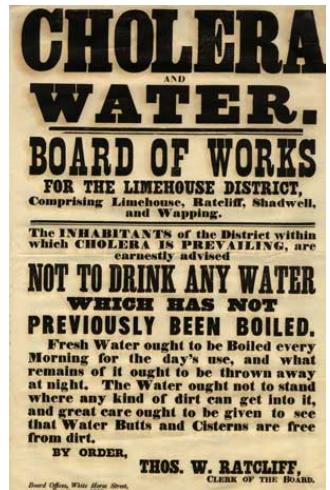
The Father of Epidemiology



4. John Snow (1813-1858)



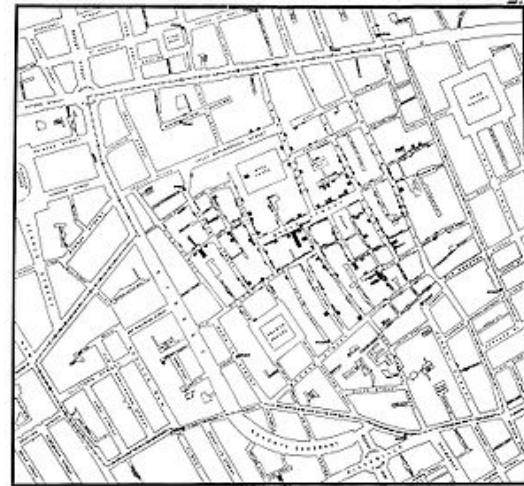
The Broad St.
Pump with handle
removed



Edict forbidding
drinking of water
which hasn't been
boiled

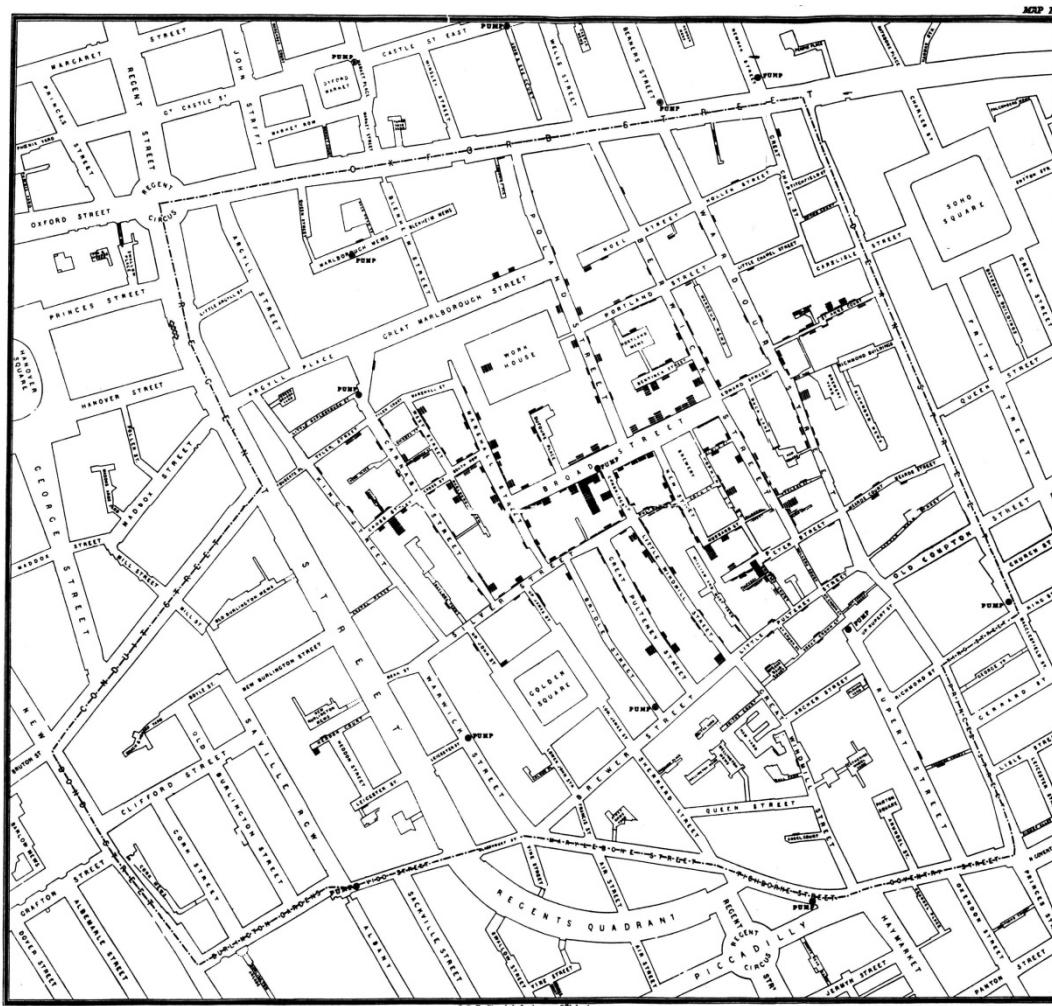


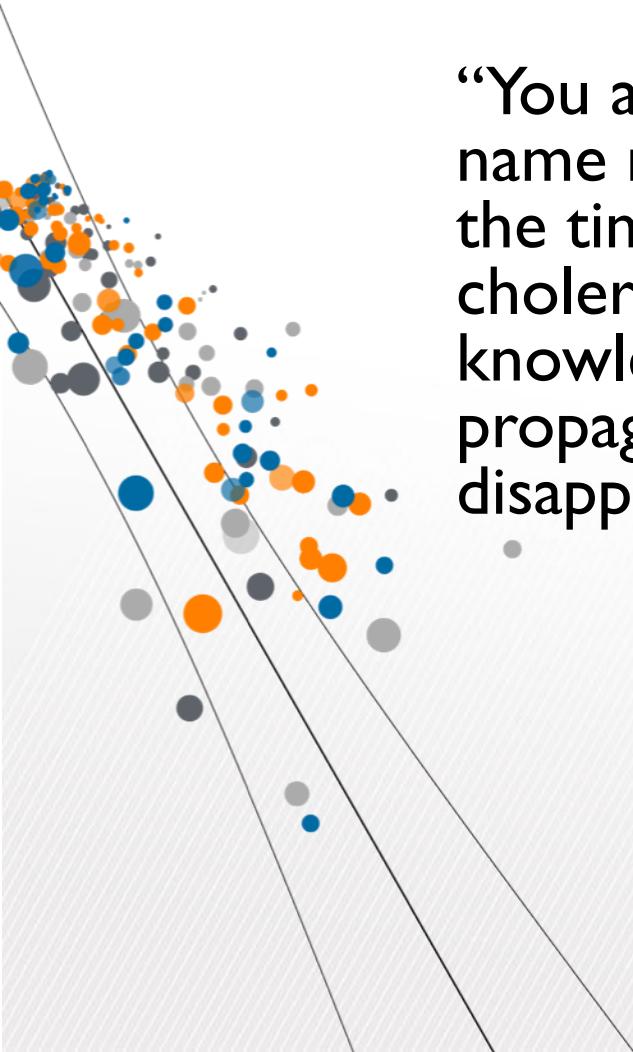
York, England



John Snow's "Cholera Map"

John Snow's Cholera Map (1854)





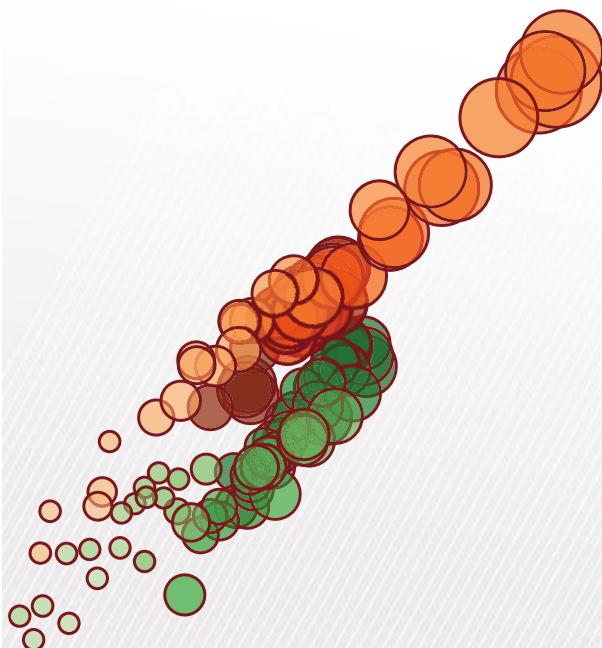
“You and I may not live to see the day, and my name may be forgotten when it comes, but the time will arrive when great outbreaks of cholera will be things of the past; and it is the knowledge of the way in which the disease is propagated which will cause them to disappear.”

- Dr. John Snow

Lesson #4

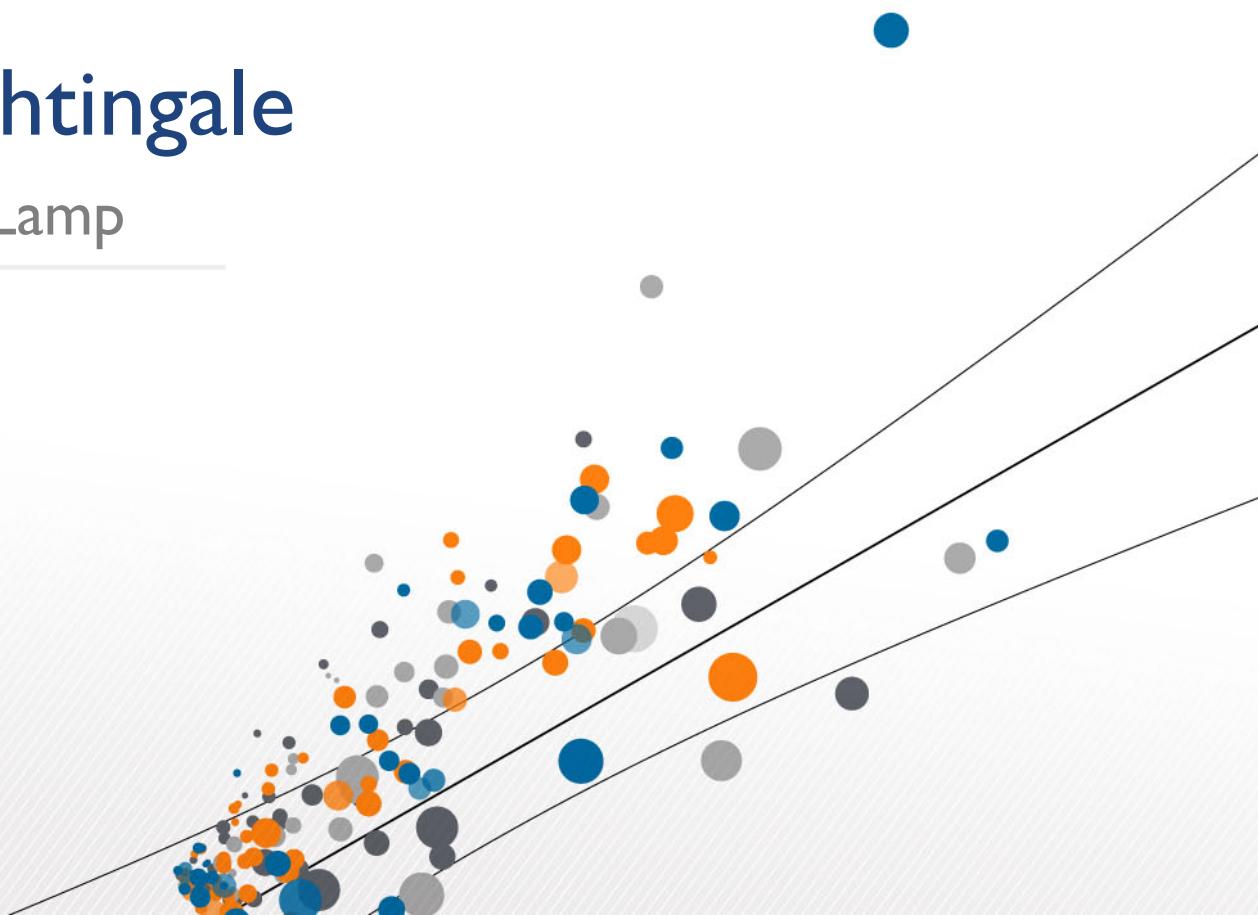
Go to the source

(or, drink beer, not water...)



Florence Nightingale

The Lady with the Lamp



5. Florence Nightingale (1820-1910)



Candle lantern
used at Scutari
Hospital

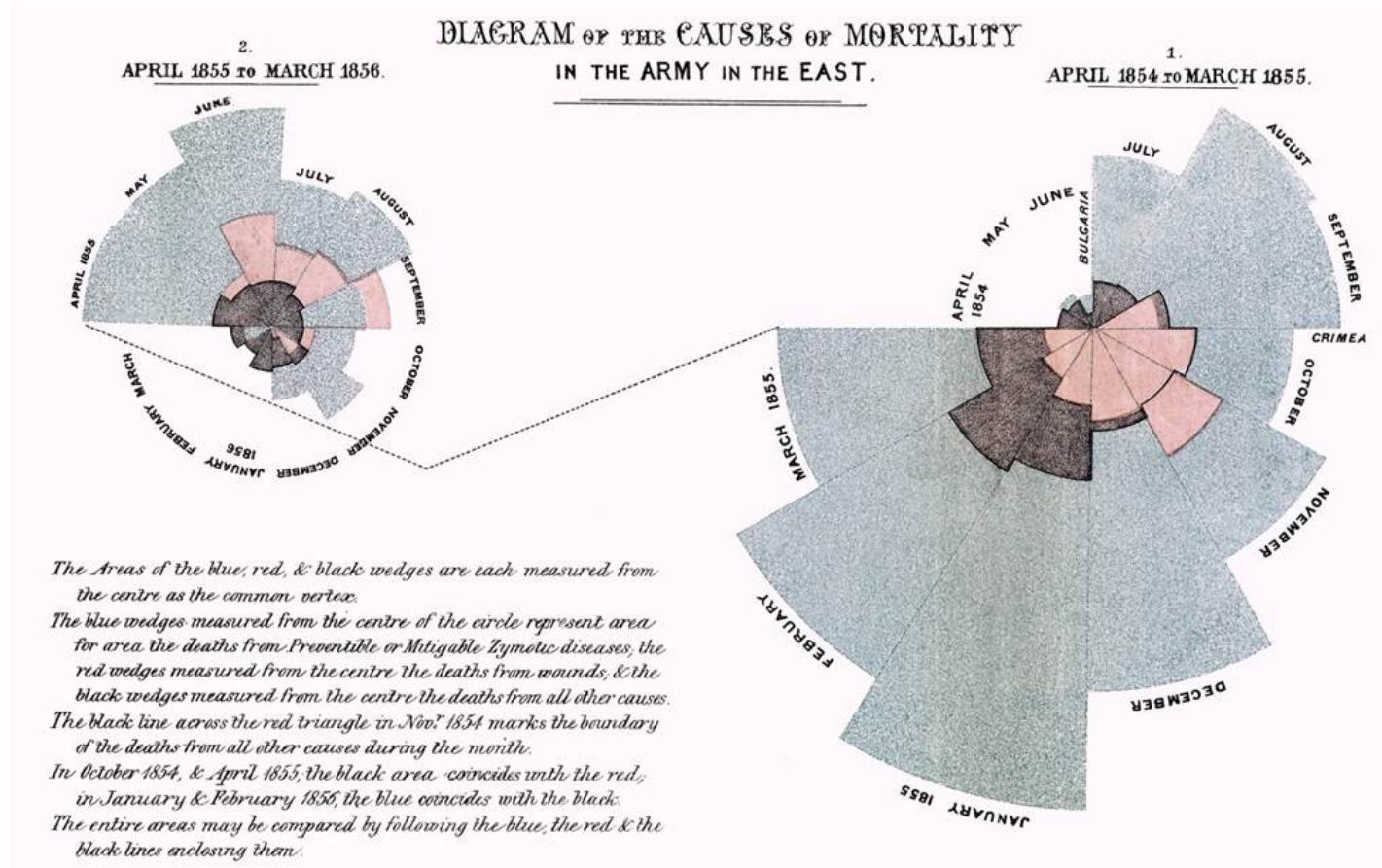


Nightingale's
medicine chest



Florence, Italy (born)

"Diagram of the causes of mortality in the army in the East" (1858)





“I attribute my success to this - I never gave or took any excuse.”

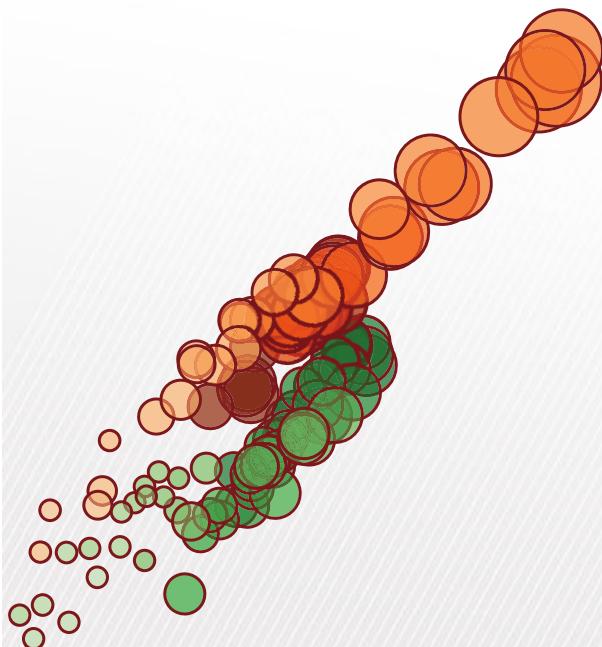
“How very little can be done under the spirit of fear.”

- Florence Nightingale

Lesson #5

- No excuses, no fear

- (or, don't let anyone get in your way)



Charles Joseph Minard

A Pioneer in Information Graphics



6. Charles Joseph Minard (1781-1870)



© Science Museum Pictorial / Science & Society Picture Library

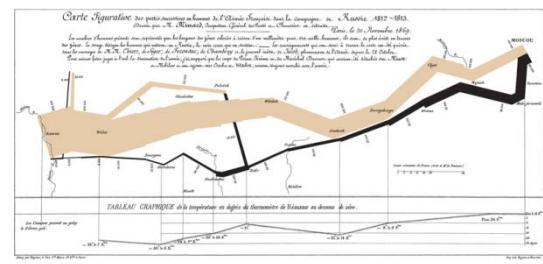


École des Ponts
ParisTech

Superintendent of
the School of
Bridges and Roads

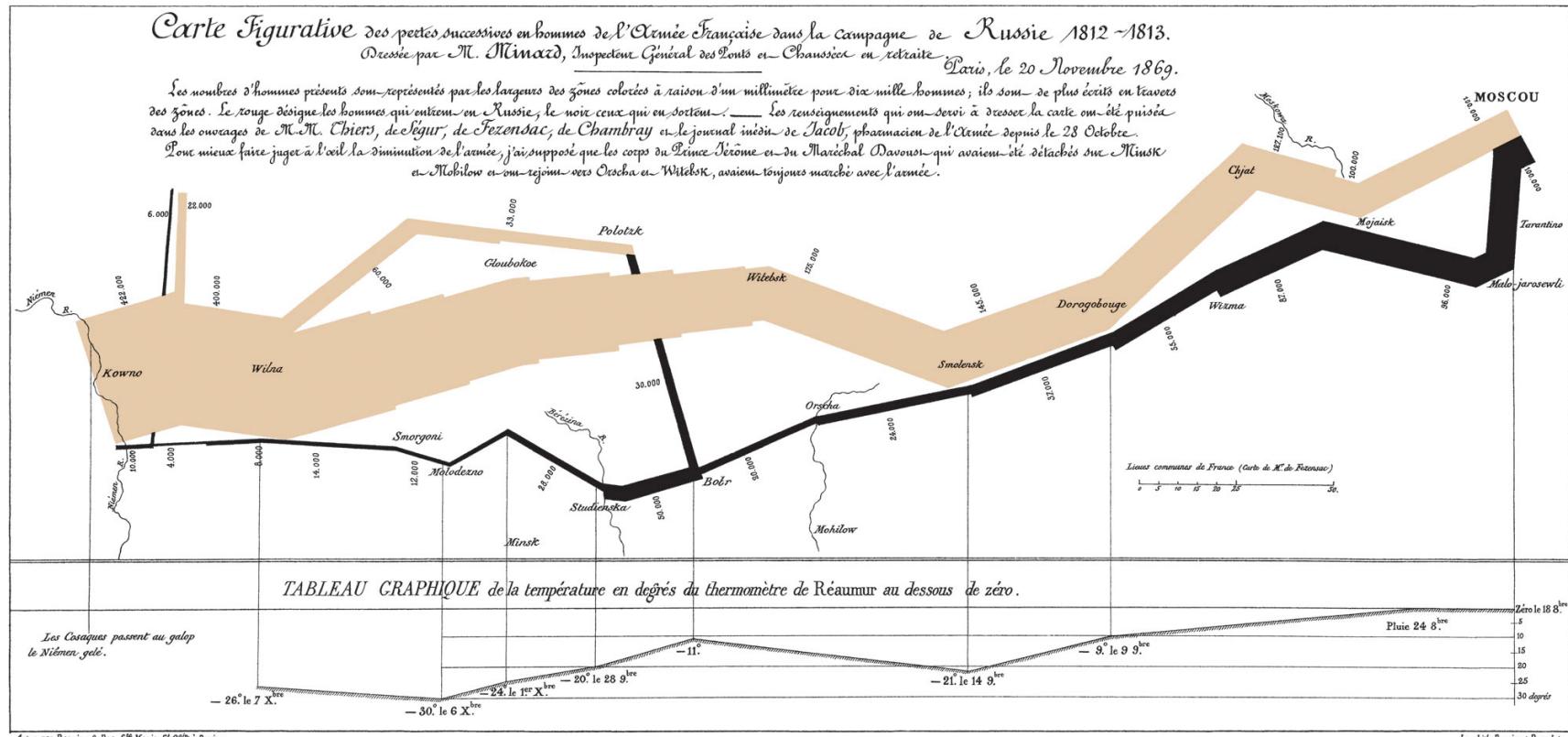


Dijon, France

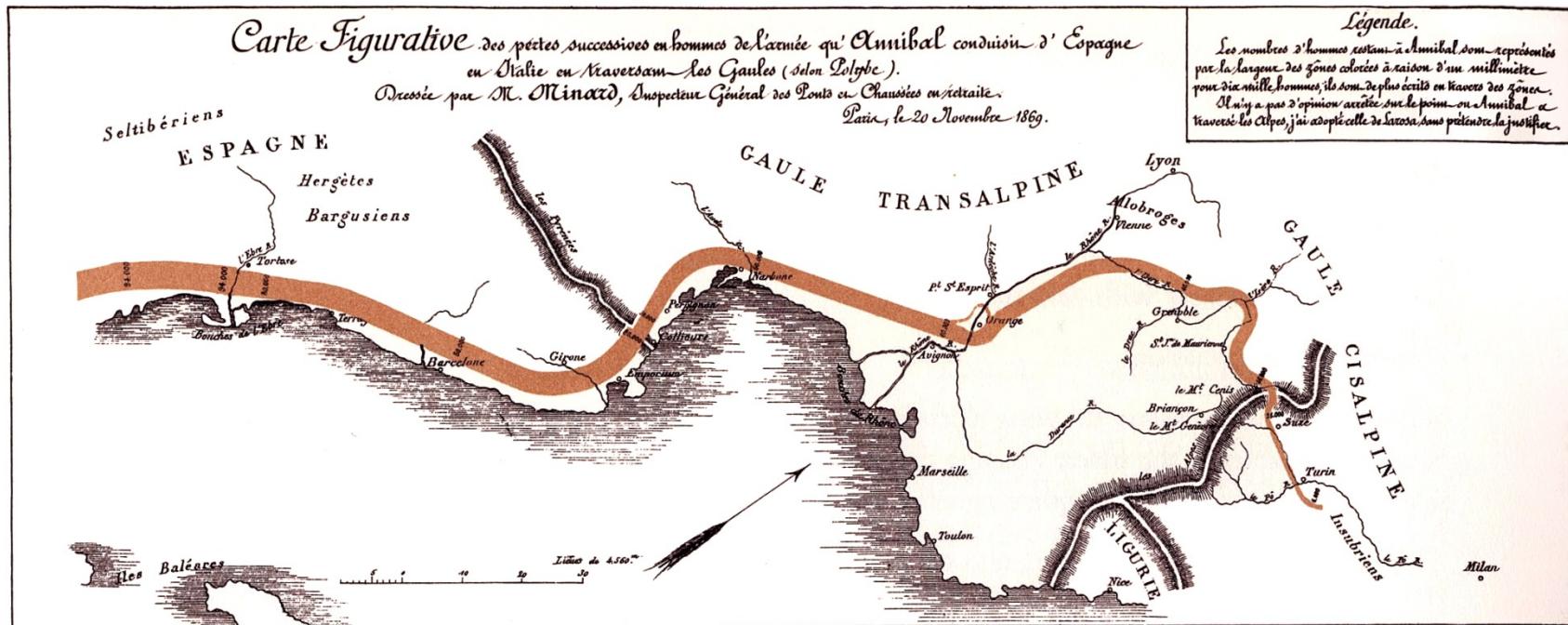


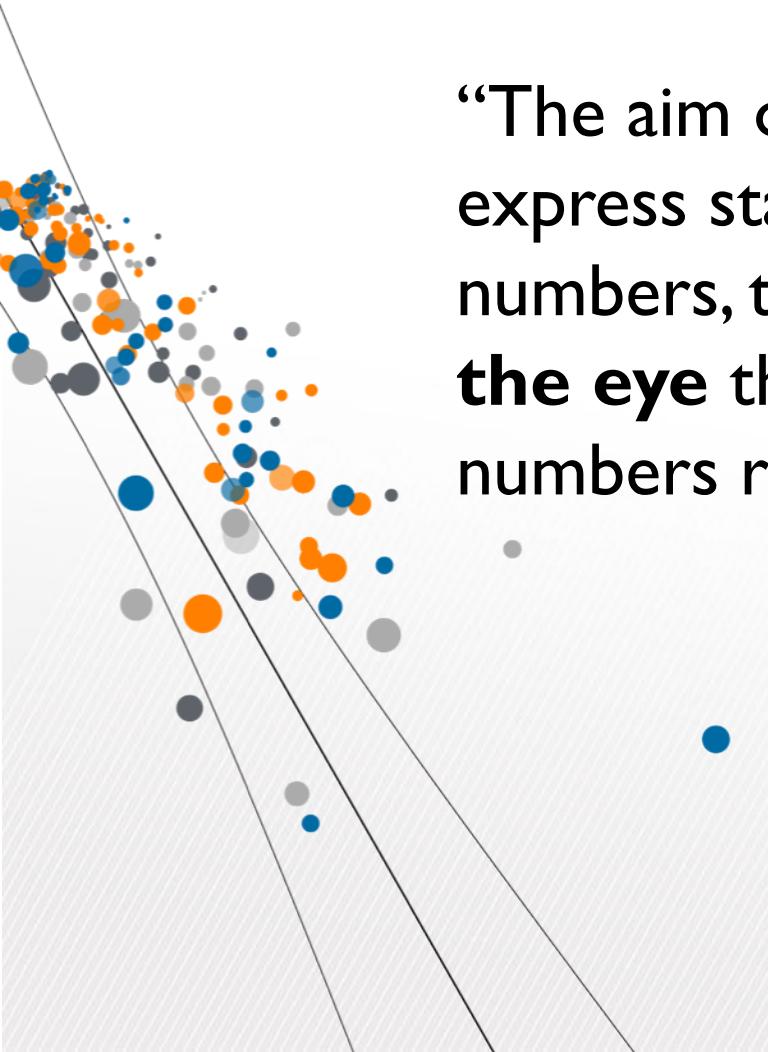
Napoleon's March

Flow map of Napoleon's 1812 Russian campaign (1869)



Flow map of Hannibal's Raid (1869)





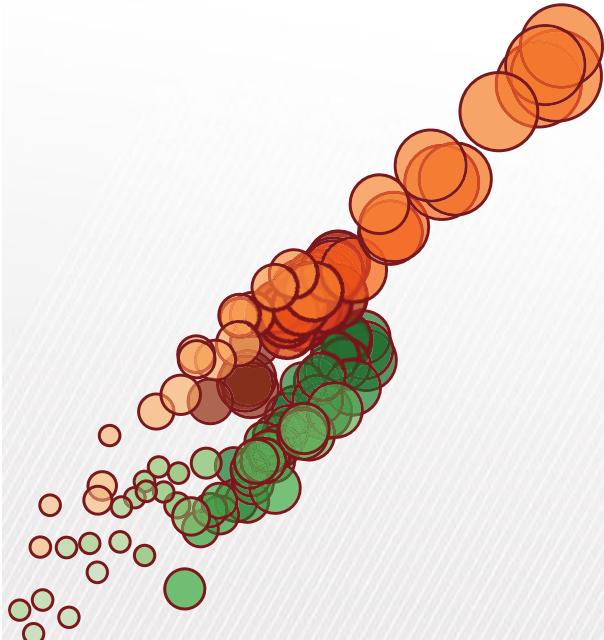
“The aim of my carte figurative is less to express statistical results, better done by numbers, than **to convey promptly to the eye** the relation not given quickly by numbers requiring mental calculation.”

- Charles Joseph Minard

Lesson #6

- Apply your unique perspective

- (or, better late than never)

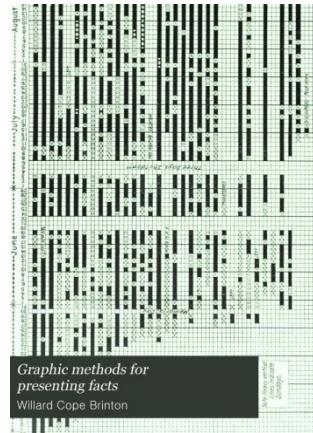


7. Willard Cope Brinton

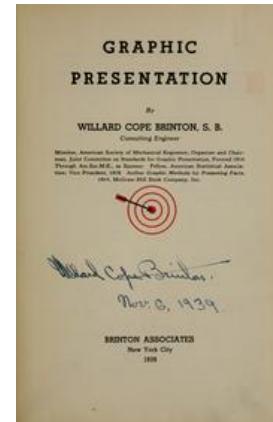
The pioneer time almost forgot



7. Willard Cope Brinton (1880-1957)

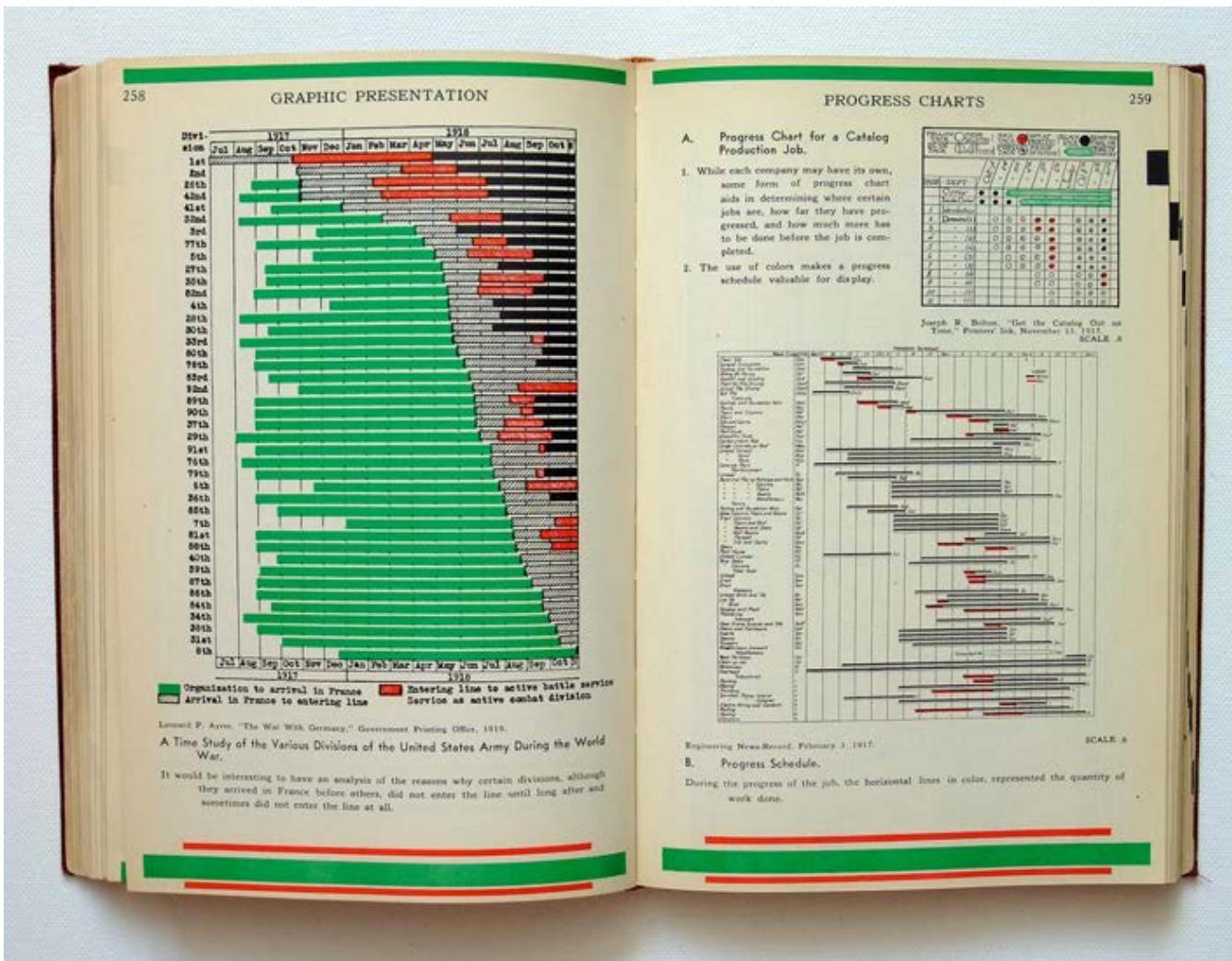


Graphic methods
for presenting fact
(1914)

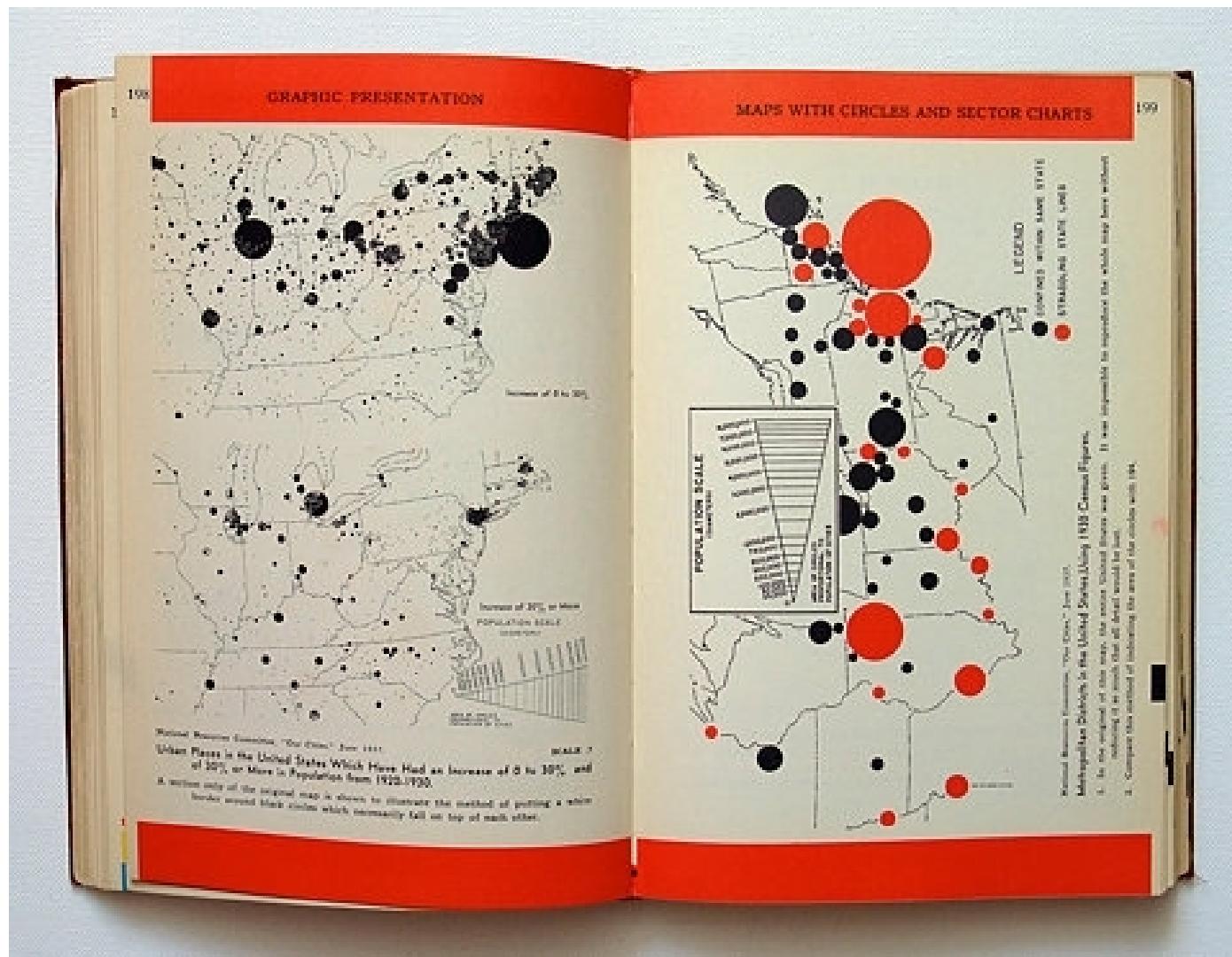


Graphic
Presentation
(1937)

From “Graphic Presentation” (1937)



From “Graphic Presentation” (1937)



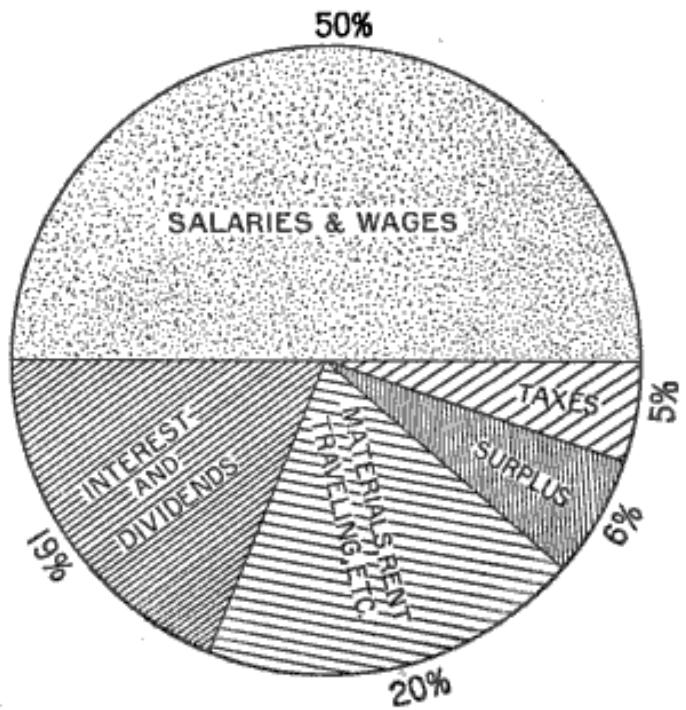


Fig. 2. Disposition of the Gross Revenue of the Bell Telephone System for the Year 1911

This chart was taken from the annual report to the stockholders of the American Telephone and Telegraph Company for the year ending December 31, 1911.

The circle with sectors is not as desirable an arrangement as the horizontal bar shown in Fig. 1

*"Fig 2 is a form of chart used probably more widely than any other form to show component parts. **The circle with sectors is not a desirable form of presentation** however because it does not have nearly such flexibility as the method shown in Fig 1" Brinton, p.6 (Fig 1 is a horizontal bar broken into sections)*

From “Graphic Methods for Presenting Facts” (1914)

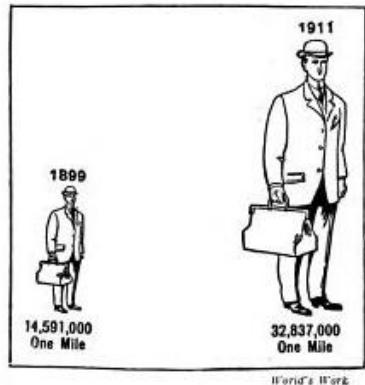


Fig. 40. Passengers Carried on the Railroads of the United States in 1899 and in 1911 Compared

This illustration has all the bad features mentioned for Fig. 39. Here the numerical data are given and we can prove for ourselves that the two pictured men are compared on the basis of height. Because of the disproportionate area, the right-hand picture gives the reader a false and exaggerated impression of growth. See Fig. 41.

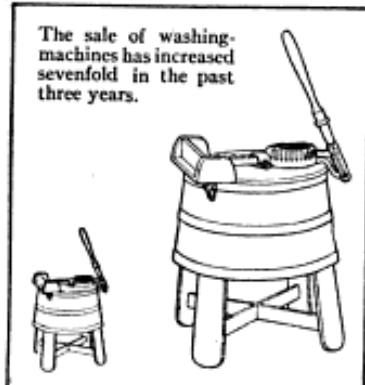


Fig. 18. Illustration Intended to Show that the Sale of Washing Machines has Increased Sevenfold in the Past Three Years

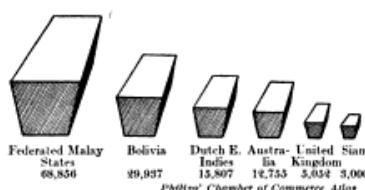


Fig. 26. A Year's Production of Tin in Tons
This illustration, taken from the same source as Fig. 25, is even more confusing. The perspective of the tops of the pigs of tin is such that there is no way of telling whether visual comparison should be made by height, area or volume

Fig. 26 is an even greater atrocity than Fig. 25. In Fig. 26, the observer is entirely unable to tell whether comparison is made in one, two, or three dimensions and he has an additional puzzle because of the large amount of perspective shown for the top of the pigs of tin. It would be surprising if one man in a thousand could guess anything near the ratio intended to be expressed between the largest and smallest pigs shown. In general, graphic work of this kind is much worse than the use of figures alone. There are times when an absence of knowledge is better than incorrect knowledge.

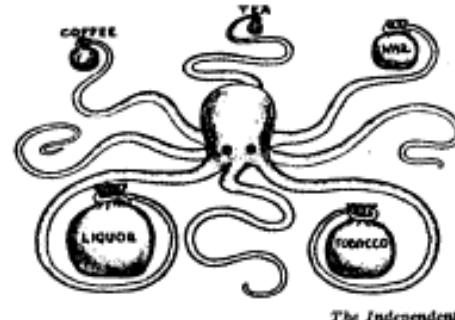


Fig. 17. Five Forms of Our National Waste

A cartoon type of chart like this will reach a popular audience. Accuracy of statement should not, however, be sacrificed as it has been here, in that there is no way of correctly comparing the money bags

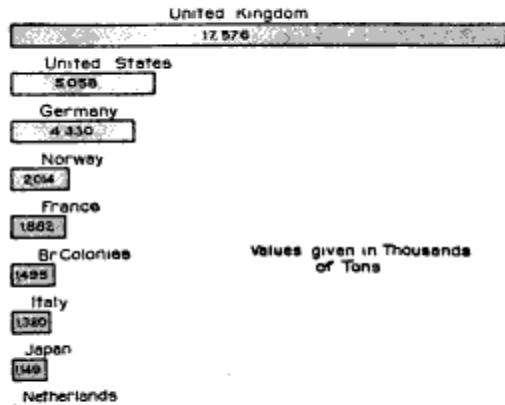


Fig. 23. Comparison of the Registered Shipping of the Principal Countries of the World

The picture at the top of the chart assists in attracting the attention of the reader. After the attention is gained, the bars set forth the comparison more accurately than it could be given by any pictures of ships of different sizes

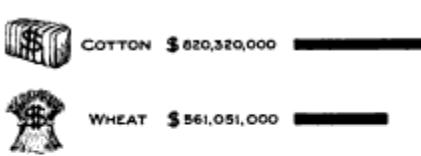


Fig. 27. Value of Cotton and of Wheat Produced in the United States in 1910

Here is a suggestion for a standard arrangement for horizontal-bar comparisons. The illustrations at the left make the presentation popular in form, yet actual figures for the data are given at the left-hand end of the bars



Fig. 41. Number of Passengers Carried on the Railroads of the United States in 1899 and in 1911 Compared

Here is a chart drawn from the same data as Fig. 40. It was not a larger passenger, but more passengers, that the railroads carried. The ratio expressing increase in business can be clearly and accurately seen from this method of portraying the facts

"Nevertheless the cartoonist style should not be broadly condemned, for it has tremendous possibilities. It is possible to combine the cartoonist's wonderful power of arousing interest with methods of presenting facts which will give a numerical interpretation that cannot be misunderstood. There is a great opportunity waiting for the man who can combine cartoon methods with accuracy of numerical statement." Brinton, p.21

“...judicious embellishment of charts...”

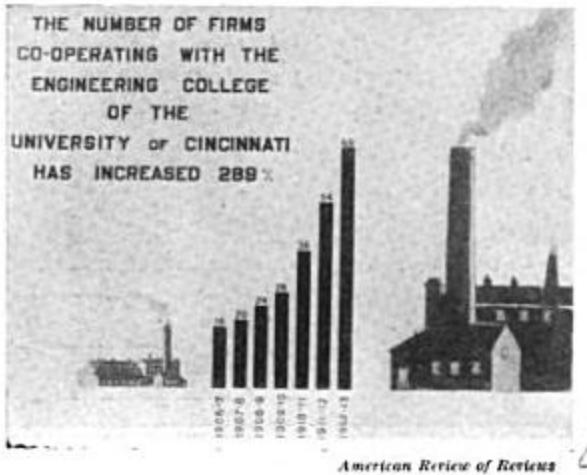


Fig. 51. The Increasing Number of Business Firms Co-operating with the Engineering College of the University of Cincinnati

When the bars represent years or other divisions of time, a vertical arrangement of the bars is usually more desirable than the horizontal arrangement seen in Fig. 44. With the vertical arrangement a line may be imagined joining the tops of the bars so as to give a "curve".

Note, in this illustration of a wall chart, the popular touch given by the pictures of manufacturing plants with smoke-stacks of the same height as the first and the last vertical bars

“Fig 51 is an illustration photographed down from a large drawing used in a wall exhibit. It is a fair example showing what can be done to arouse interest by the judicious embellishment of charts, especially of those for wall exhibits intended to reach a miscellaneous audience...” Brinton, p.21



“As the cathedral is to its foundation so is an effective presentation of facts to the data”

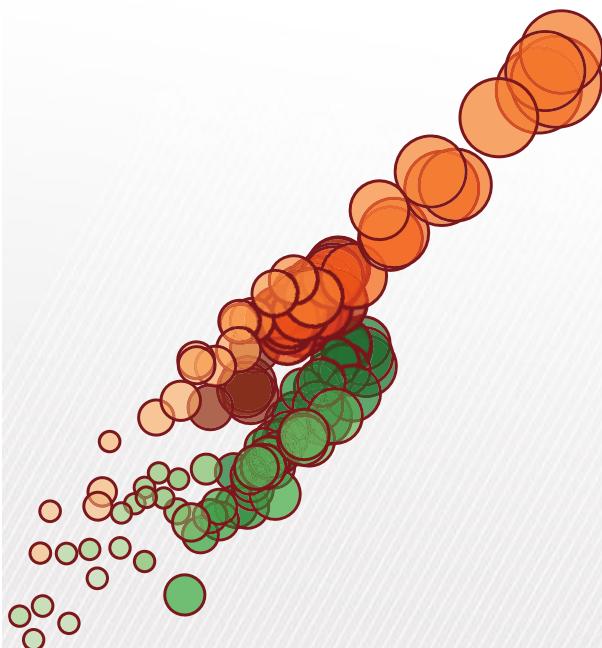
“One of a business man’s chief assets is his ability to show things to others in their true proportions.”

- Willard Cope Brinton

Lesson #7

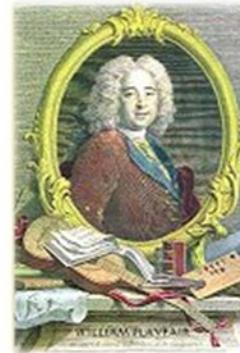
Respect the data

(or, don't worry if no one knows your name...)



7 Things we can Learn from the Pioneers

1. Explore with an open mind
2. Seek to educate
3. Use your imagination
4. Go to the source
5. No excuses, no fear
6. Apply your unique perspective
7. Respect the data





PROFESSIONAL &
CONTINUING EDUCATION
UNIVERSITY *of* WASHINGTON

Introduction to Tableau





Free Mac & Windows software to quickly create and share interactive data graphics on the web



lanacion.co



THE VANCOUVER SUN

THE WALL STREET JOURNAL
Digital Network

the guardian

The Seattle Times
Winner of 11ine Pulitzer Prizes

THE AGE

DAILY NEWS
NYDAILYNEWS.COM

dallasnews.com
The Dallas Morning News



ESPN

Austin
American-
Statesman

For Next Week

Readings

- Read Munzner's *Visualization Analysis & Design* ch 1-2
- Read Jones's *"Communicating Data with Tableau"* ch 1-3

Homework Assignment #1

- Complete your bio on the class site and respond to the discussion thread "*Hello Class – Introduce Yourself!*"
- Install Tableau Public or Tableau Desktop
 - <http://www.tableau.com/tft/activation>
- Find 3 visualizations online and write:
 - A short paragraph describing what the visualization shows, and what you learned from it
 - One "plus" – something you like about the visualization
 - One "delta" – something you would change about it to make it better

Places to Look for Visualizations

- Popular news sites & social media
- <http://public.tableau.com/s/gallery>
- <https://www.reddit.com/r/dataisbeautiful>
- <http://visualoop.com/>
- <https://plot.ly/feed/>
- <https://www.graphiq.com/search-about>