

# A Celebration of *Les Chevaliers des Albums de Statistique Graphique*

Oct. 18-20,  
2023

Michael Friendly, York University

 @datavisFriendly



Barry Lawrence Ruderman Conference on Cartography



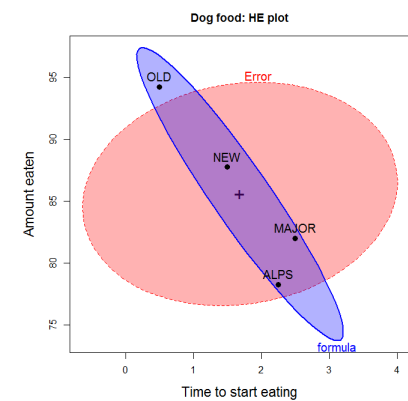
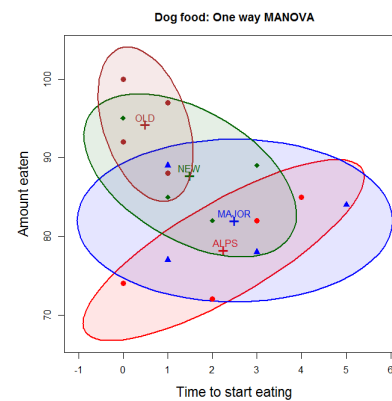
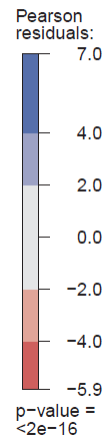
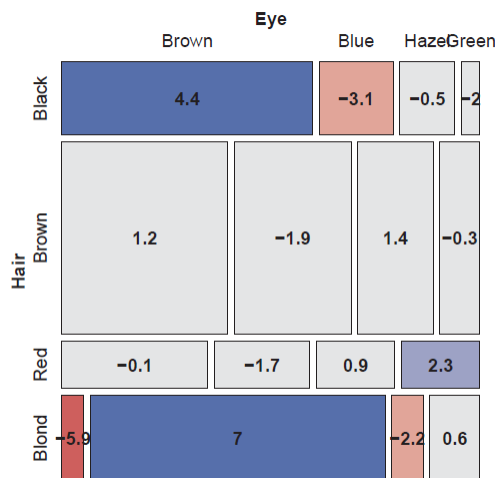
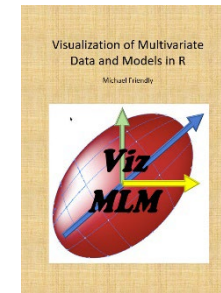
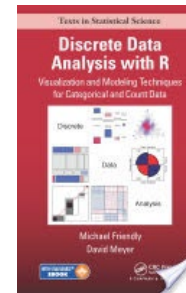
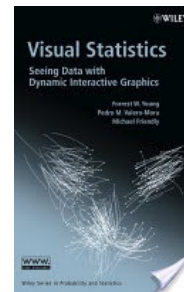
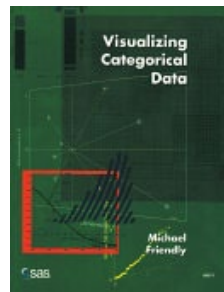
# Introducing: me

I wear two hats, both reflected on my license plate:

Statistical graphics developer (categorical & multivariate data analysis)



Yours to discover!



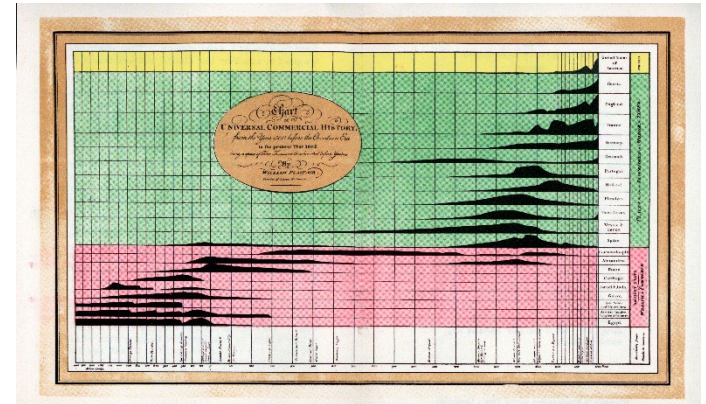
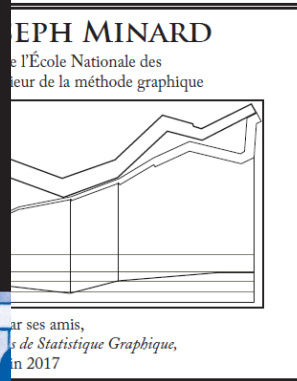
mosaic plots for frequency tables

HE plots for MANOVA

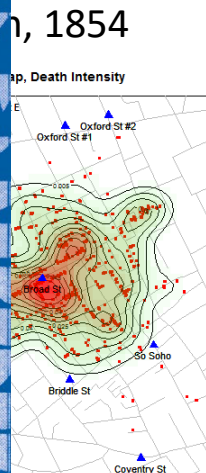
# Introducing: me

History of data visualization: *Les Chevaliers*; Friendly & Wainer (2021)

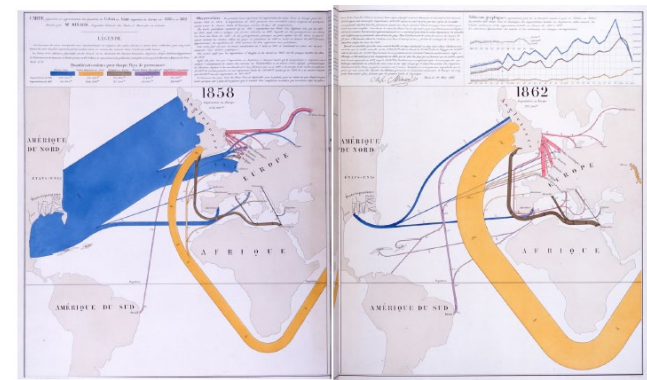
A History of  
Data Visualization &  
Graphic Communication



MICHAEL FRIENDLY  
HOWARD WAINER



C. J. Minard: Flow maps of cotton trade



hancement

Visual explanation: What happened in  
the US Civil War?

# Mosaic plots

Table: Hair-color eye-color data

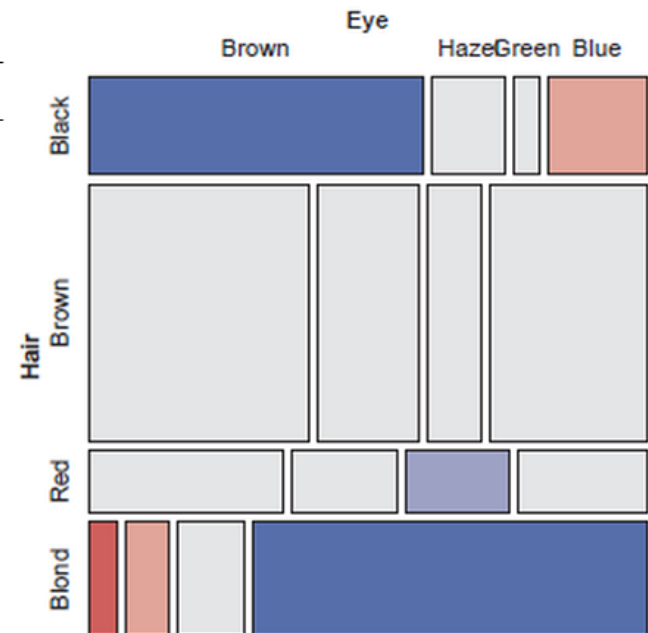
Eye Color	Hair Color				Total
	Black	Brown	Red	Blond	
Brown	68	119	26	7	220
Blue	20	84	17	94	215
Hazel	15	54	14	10	93
Green	5	29	14	16	64
Total	108	286	71	127	592

Students in a large statistics class were categorized by hair color and eye color

Questions:

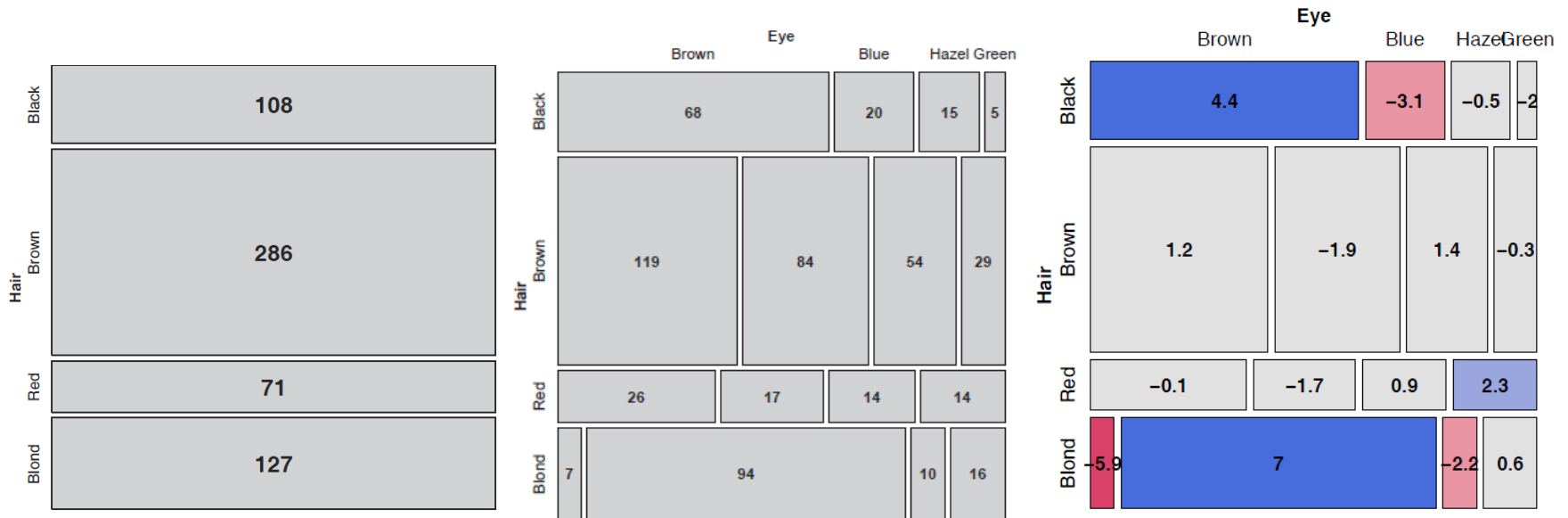
- Are hair color and eye color associated?
- How to visualize?
- How to understand the **pattern** (nature) of association?

Answer: mosaic displays



# Mosaic plots

Area proportional display of frequencies in  $n$ -way table  
 Shaded according to **deviation** (residual) from independence



Divide unit square  $\sim$  V1  
 marginal frequencies

Subdivide each  $\sim$  V2 | V1  
 conditional frequencies

Shade  $\sim$  residual ( $d_{ij}$ )

**positive:**  $O > E$

**negative:**  $O < E$

Visual test for NO association: Mosaic is unshaded  
 Fit a better model: "clean" the mosaic!

$$d_{ij} = \frac{(O_{ij} - E_{ij})}{\sqrt{E_{ij}}} \quad \chi^2 = \sum d_{ij}^2$$

# Race & Crime

Toronto Star investigation of racial disparities in treatment by Toronto Police Services

FOI request → ½ M arrests, 1997—2002

Evidence for racial profiling?

Only look at discretionary charges:

Simple marijuana possession  
Non-moving auto infractions

# THE SATURDAY STAR

The photo that never was

GARTH WOOLSEY, C3



Also inside . . .

- **Waterfront:** Dreams of what could be, B1, B4-5
- **Hydro woes:** Insulating against price spikes, E1
- **Wheels:** The Bug goes rootless, G1
- **Paul Martin:** The man who would be king, H1
- **Carol Shields:** Her last novel? Unless . . . J1

Periods of rain; windy. High 14 C

October 19, 2002

thestar.com ONTARIO EDITION

## AN INVESTIGATION INTO RACE AND CRIME



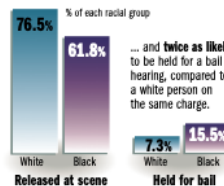
**SUING POLICE:** Jason Burke, falsely accused of dealing drugs during Caribana two years ago, says he was a victim of racial profiling.

# Singled out

Star analysis of police crime data shows justice is different for blacks and whites

### Telling numbers

Police records show that a black person in Toronto arrested on a single drug possession charge was **less likely** to be released at the scene.



... and twice as likely to be held for a bail hearing, compared to a white person on the same charge.

Blacks arrested by Toronto police are treated more harshly than whites, a Toronto Star analysis of crime data shows.

Black people, charged with simple drug possession, are taken to police stations more often than whites facing the same charge.

Once at the station, accused blacks are held overnight, for a bail hearing, at twice the rate of whites.

The Toronto crime data also shows a disproportionate number of black motorists are ticketed for violations that only surface following a traffic stop. This difference, say civil libertarians, community

### Managing Editor's notebook, A2

leaders and criminologists, suggests police use racial profiling in deciding whom to pull over.

The evidence is contained in a massive police database recording more than 480,000 incidents in which an individual was arrested or ticketed, for an offence dating back to 1996. It included almost 800,000 criminal and other charges.

The Star obtained that data through a freedom of information request, marking the first time access to these numbers was granted to anyone outside the police

community.

Police are forbidden, by their governing board, from analyzing this data in terms of race, but The Star has no such restriction. The findings provide hard evidence of what blacks have long suspected

—race matters in Canadian society especially when dealing with police.

Chief Julian Fantino disputed the findings, saying the colour of a person's skin has nothing to do with how they're treated by his officers.

"We don't treat people different-

## Chrétien expected to keep cabinet minister

Ethics report has 'wiggle room' to save MacAulay

BY TIM HARPER AND LES WHITTINGTON OTTAWA/BUREAU

OTTAWA — Jean Chrétien receives a report from his ethics counsellor today that is expected to give him enough "wiggle room" to keep his solicitor-general, Lawrence MacAulay, in the federal cabinet.

Ethics counsellor Howard Wilson completed his report and delivered it to the Prime Minister's Office last night, where it was received by Chrétien's chief of staff, Percy Downie.

It was then to be relayed to Chrétien by secure fax to Beirut, where the Prime Minister is attending a summit of French-speaking nations. It was 1:30 a.m. in Beirut when the fax arrived so Chrétien would likely be reading it this morning.

Senior sources said last night that unless there is a surprise in Wilson's report, the Prince Edward Island minister will remain, Chrétien will return to Ottawa and weather the inevitable storm of opposition and media protest and forge ahead with an ethics package by mid-week.

Wilson has been investigating whether MacAulay broke ethics guidelines for cabinet ministers in the awarding of a contract and extension worth \$100,000 to Everett Roche, a Charlottetown political friend of the solicitor-general's.

Chrétien will not fire MacAulay unless he is given incontrovertible evidence of wrongdoing for two key reasons, source-

■ Please see MacAulay, A8

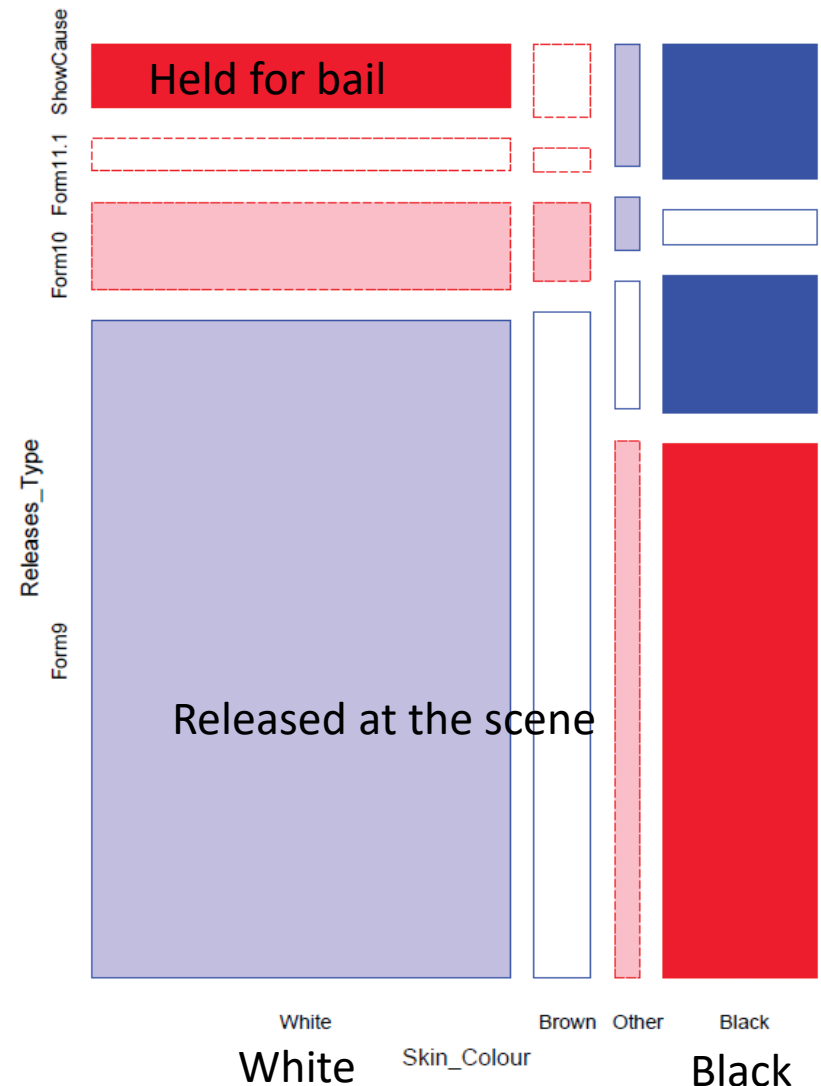
### INSIDE

Barclay L2  
Birtles B7  
Ellie Teshler L2  
James Travers L2

■ Please see Toronto, A12

# Racial profiling: Analysis graph

- Police actions on a charge of simple possession of marijuana
  - release with a summons (Form 9) vs. hold for bail (Show cause)
  - Evidence for racial bias?
- First graph: mosaic display
  - area  $\sim$  frequency
  - shading:  $\sim$  residual
    - Obs > Expected in blue
    - Obs < Expected in red



# Racial profiling: The process

How to **communicate** these results most effectively?

- What is the message? What features are directly comprehensible to the audience?

B SECTION > TORONTO STAR < WEDNESDAY, DECEMBER 11, 2002 ★ thestar.com

*Race and Crime*

Graphic designer's  
early attempts



My early  
attempts

York University professor Michael Friendly's expert statistical analysis provided confirmation for the Toronto Star's series on racial profiling by city police.

## Man behind the numbers



# Racial profiling: Presentation graphic

Together, we created this (nearly) **self-explaining** infographic

Title gives the main conclusion

Text description gives details

Bar width ~ charges  
Divided by % release

numbers shown in the cells

Legend gives a layman's description of shading levels

## Same charge, different treatment

Statistical analysis of single drug possession charges shows that blacks are much less likely to be released at the scene and much more likely to be held in custody for a bail hearing. Darker colours represent a stronger statistical link between skin colour and police treatment.

Degree of likelihood

- *Much less* likely to occur
- *Much more* likely to occur
- *More* likely to occur

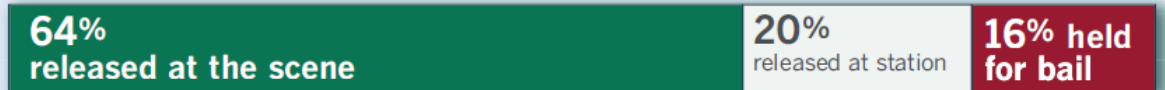
**Whites** are more likely to be released at the scene

6,662 charges laid



**Blacks** are much more likely to be held for bail hearings

2,446 charges laid

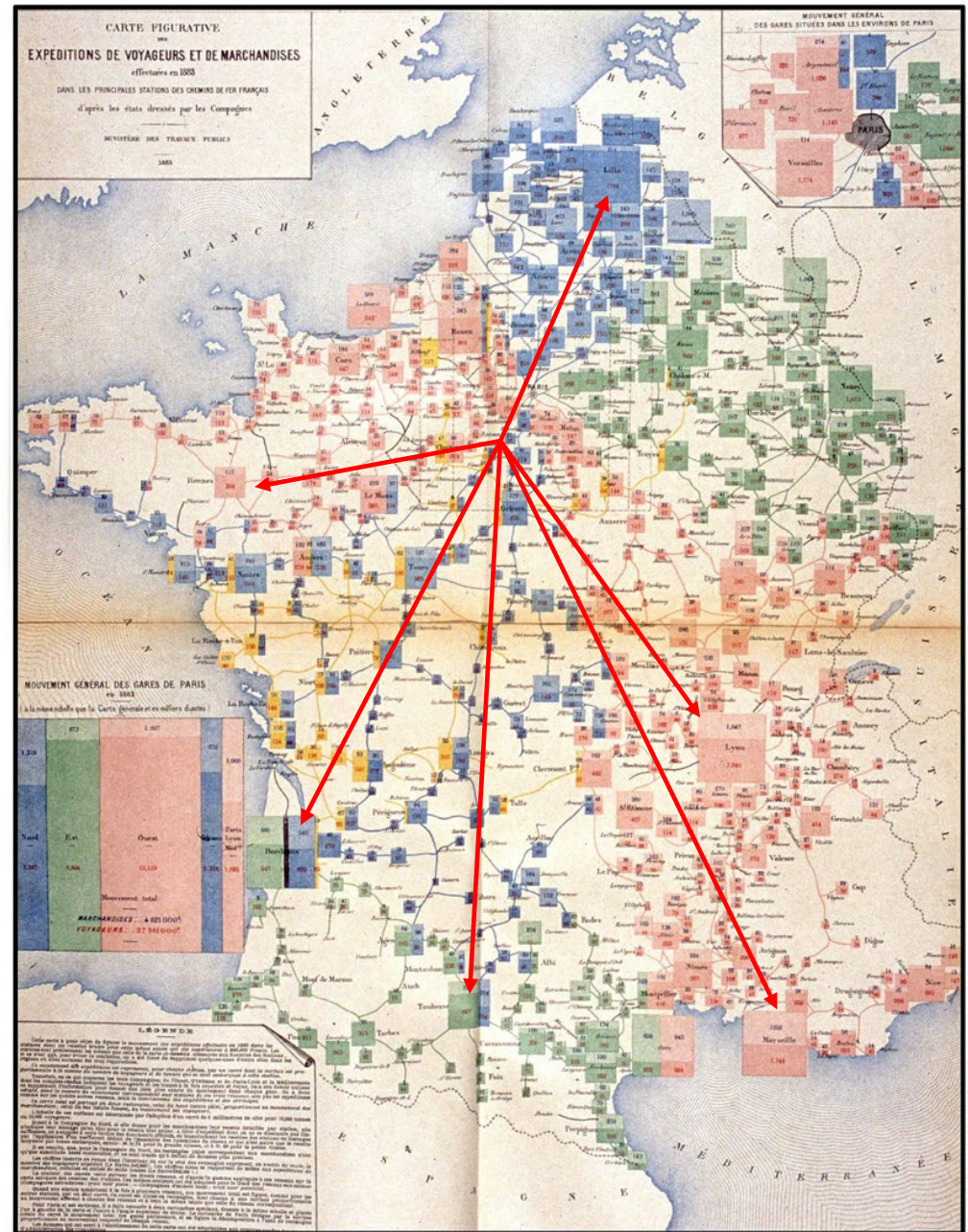


SOURCE: Toronto police arrest records 1996-2002

# Why study history of #datavis?

*Those who don't know history are doomed to plagiarize it.*

**Recursive mosaic:** Distribution of passengers and goods from the Paris railways to the rest of France  
[Album, 1884, pl. 11]







# Quest for the Albums

- British library, BNF, Library of Congress: just a few copies
- Richard Langdon, U of T Fisher Rare Book Library: check out this bookshop, 3 rue des Beaux Arts, Paris
  - A complete set: all albums 1879 – 1899!
- Les Chevaliers
  - Collective purchase, owned by all, each held “in trust” by one member
  - “chevaliers”: Foster a spirit of collegial study of history of data visualization & thematic cartography
  - Conference sessions: RC33 (Cologne, 2000), GFKL (Dortmund, 2004), JSM (Toronto, 2004), ...
  - Regular “Chevalier Lunch”



# Les Chevaliers des Albums

Antoine de Falguerolles



Gilles Palsky



Antony Unwin



Ian Spence



Howard Wainer



Michael Greenacre



RJ Andrews



Sandra Rendgen



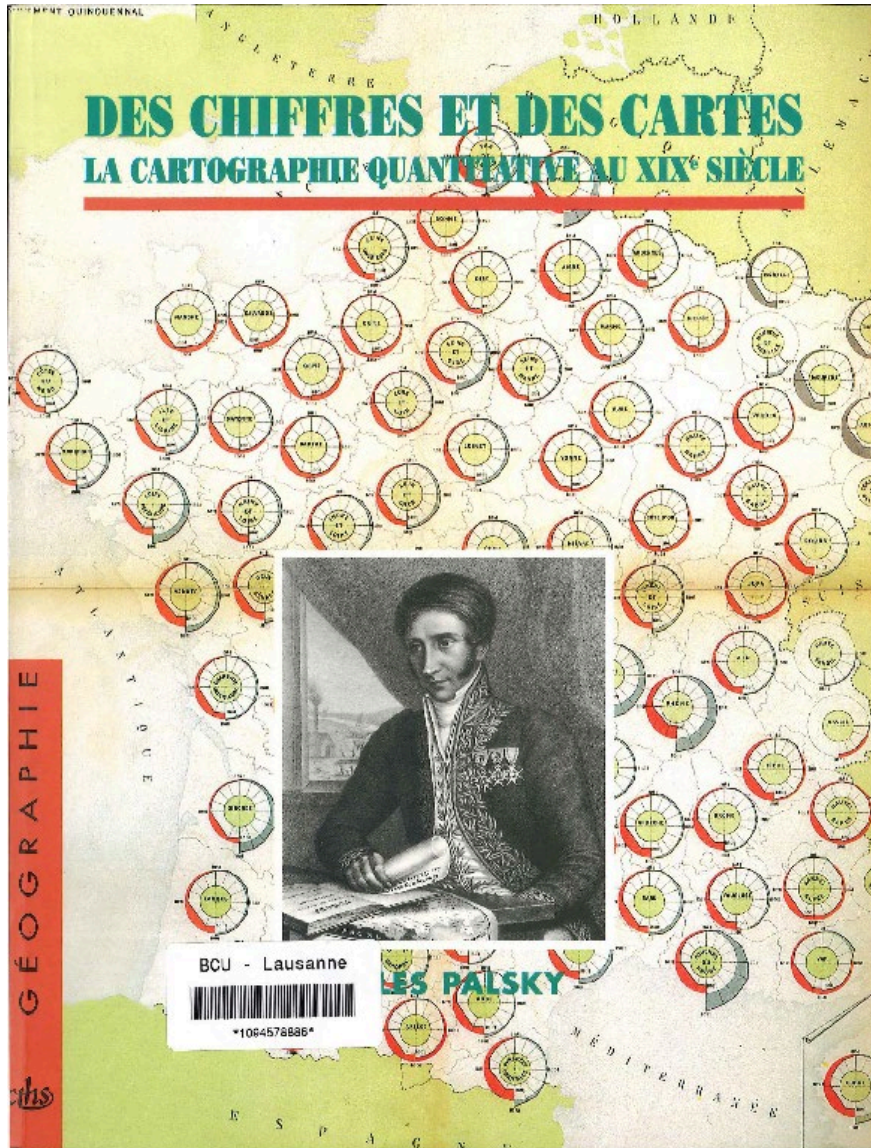
Stephen Stigler



David Rumsey

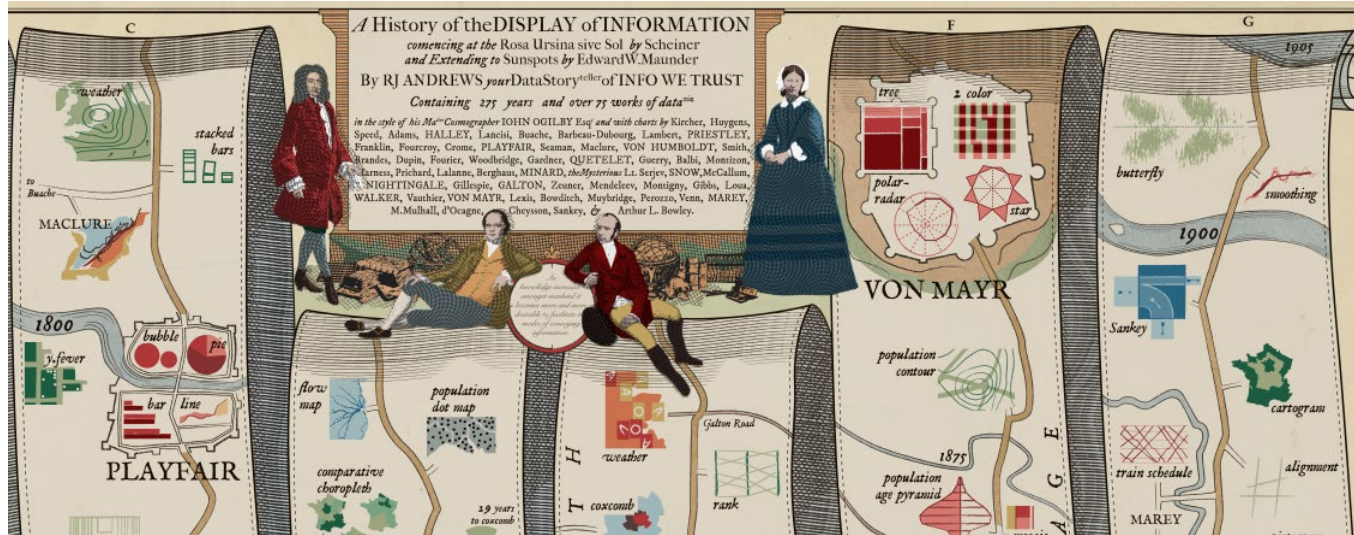


# Palsky (1996): Chiffres et Cartes



The first comprehensive treatment of quantitative cartography in 19<sup>th</sup> C France

- Dupin: 1<sup>st</sup> statistical choropleth map
- A-M Guerry: social cartography (crime, literacy, suicide)
- CJ Minard & engineers of the ENPC
- 1<sup>st</sup> catalog of Minard's works
- The "Age of Enthusiasm" and Cheysson's Albums de Statistique Graphique



# A whirlwind tour of the history of Data Visualization

- The *Milestones Project*
- Statistical historiography
- Graphic heroes
- Graphical excellence: Albums de Statistique Graphique

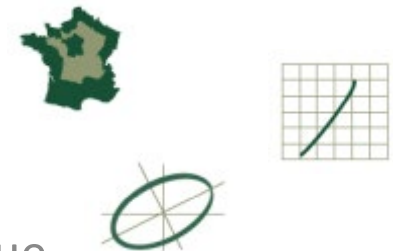


Image: RJ Andrews, <http://infowetrust.com/history/>

# The Milestones Project

<https://datavis.ca/milestones/>

## Milestones in the History of Thematic Cartography, Statistical Graphics, and Data Visualization

An illustrated chronology of innovations by Michael Friendly and Daniel J. Denis

Introduction | Milestones Project | Varieties of Data Visualization | Related | References | Keyword Index

Search

Pre-1600

1600s

1700s

1800+

1850+

1900+

1950+

1975+

## Timeline

This page provides a graphic overview of the events in the history of data visualization that we call "milestones." These milestones are shown below in the form of an *interactive timeline*. The timeline is divided into *two vertical sections*. You can *drag each section left or right* to see milestones of different time periods. You can also click one of the links at the bottom of the timeline to jump to a particular epoch.

Each of the milestone's in the timeline can be clicked to reveal its summary that includes both a link to its category. The category can also be clicked to initiate a search of other milestone's based on that category.

Item categories: ● Cartography ● Statistics and graphics ● Tech



**1st data graph**

**1644 (Spain)** [Statistics & Graphics](#)

**Michael F. van Langren (1598-1675)**  
First visual representation of statistical data: variations in determination of longitude between Toledo and Rome.

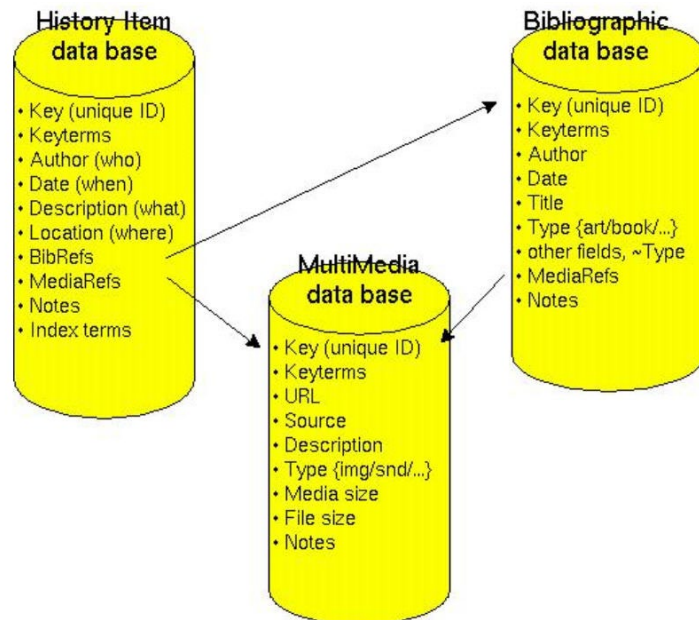
[Milestone Detail](#)

The web site: <http://datavis.ca/milestones> has an interactive timeline, allowing different kinds of search



# Milestones Project: Goals

- Comprehensive catalog of historical developments in *all fields* related to data visualization.
  - → Collect representative bibliography, images, cross-references, web links, etc.
  - → Enable researchers to find/study themes, antecedents, influences, patterns, trends, etc.



## January

1		died: <a href="#">Grace Hopper</a> 1992 (Arlington, Virginia, USA)
3		event: <a href="#">Francis Galton</a> 1889 --- Galton's Natural Inher
4		born: <a href="#">Isaac Newton</a> 1643 (Lincolnshire, England)
5		died: <a href="#">Francis Amasa Walker</a> 1897 (Boston, MA, USA)
8		born: <a href="#">Jean Talon</a> 1626 (Chalons-en-Champagne, Fran
8		died: <a href="#">Galileo Galilei</a> 1642 (Arcetri, Italy)
10		died: <a href="#">Adrien Marie Legendre</a> 1833 (Paris, France)
12		died: <a href="#">Pierre de Fermat</a> 1665 (Castres, France)



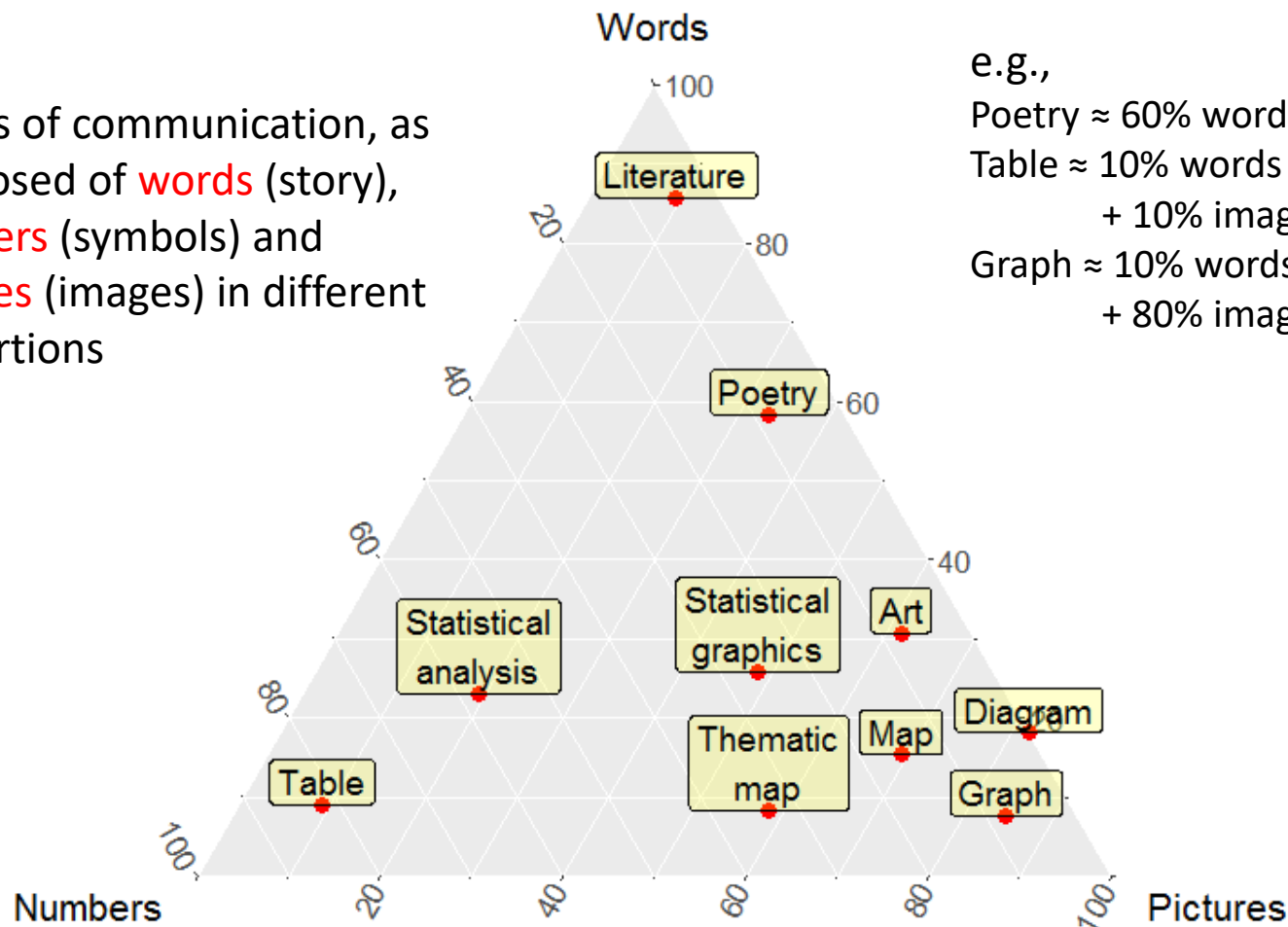
# Milestones: Conceptual Overview

- Roots of Data Visualization
  - **Cartography:** map-making, geo-measurement, thematic cartography, GIS, geo-visualization
  - **Statistics:** probability theory, distributions, estimation, models, stat-graphics, stat-vis
  - **Data:** population, economic, social, moral, medical, ...
  - **Visual thinking:** geometry, functions, mechanical diagrams, EDA, ...
  - **Technology:** printing, lithography, computing...
- How to connect them?
- Understand the innovators --- what were they thinking?

# Words, numbers and pictures

## Maps, thematic maps & data graphics in a wider context

Modes of communication, as composed of **words** (story), **numbers** (symbols) and **pictures** (images) in different proportions



e.g.,

Poetry  $\approx$  60% words + 40% images

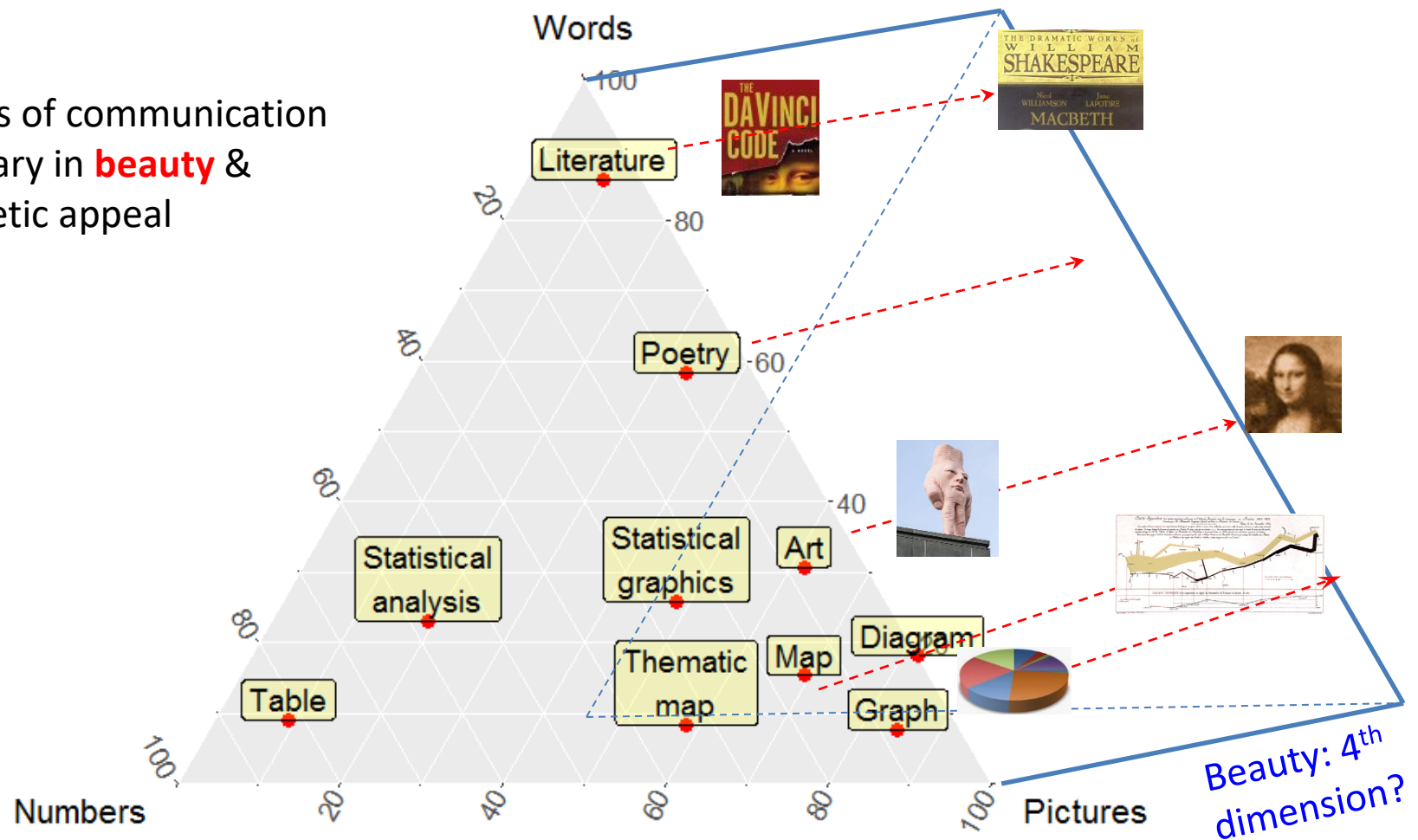
Table  $\approx$  10% words + 80% numbers  
+ 10% images

Graph  $\approx$  10% words + 10% numbers  
+ 80% images

# Words, numbers and pictures

## Beauty: The 4<sup>th</sup> dimension

Modes of communication also vary in **beauty** & aesthetic appeal

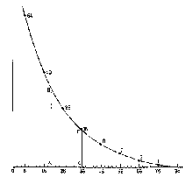


# Milestones Tour: Epochs



Early maps & diagrams

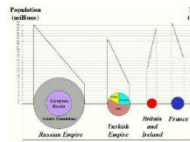
Measurement & Theory



New graphic forms



Modern graphics



Golden Age of Graphics



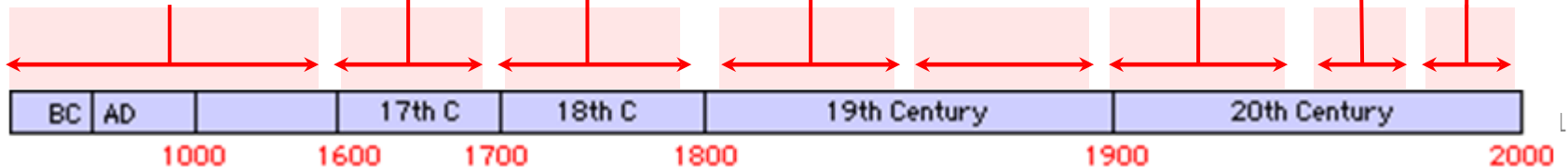
Modern Dark Ages



Re-birth

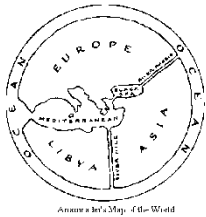
VISUAL VARIABLES	LEVEL OF ORGANISATION	
SIZE	Q	O
VALUE	O	≠
INTENSITY	O	≠
GRANULATION	O	≠
ORIENTATION	≠	≠
COLOR	≠	≠

High-D data vis

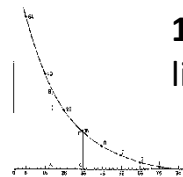


# Milestones: Content Overview

*Every picture has a story* – Rod Stewart



**c. 550 BC:** The first world map? (Anaximander of Miletus)

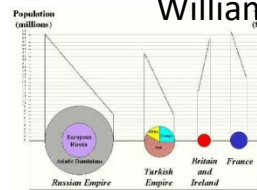


**1669:** First graph of life expectancy (Gaunt's life table) – Christiaan Huygens.

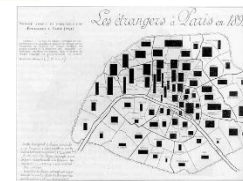
**1701:** First isogonic map – Edmund Haley



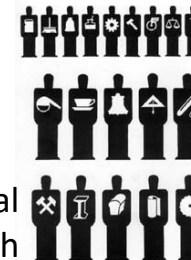
**1801:** Pie chart, circle graph – William Playfair



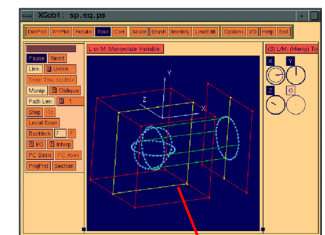
**1896:** Area rectangles to display two variables and their product – Jacques Bertillon



**1924:** Museum of Social Statistical Graphics – Otto Neurath

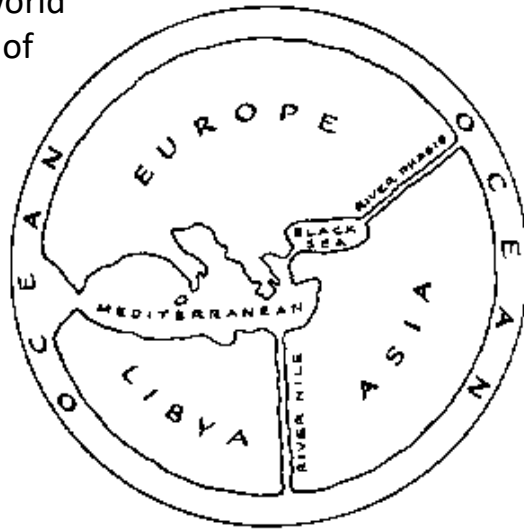


**1991-1996:** Interactive data visualization systems (Xgobi, ViSta)



# Pre 17<sup>th</sup> C: Early maps & diagrams

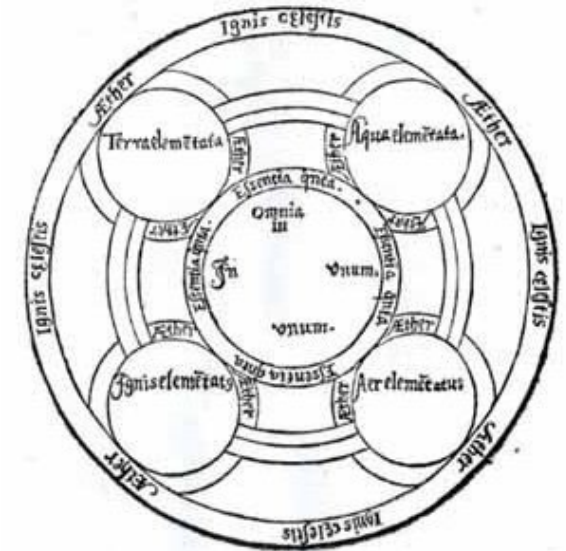
c. 550 BC: The first world map? (Anaximander of Miletus)



1350: Bar graph of theoretical function- Nicholas Oresme, France



1305: Mechanical diagram of knowledge- Ramon Lull, Spain



the World

1375: Catalan Atlas, an exquisitely beautiful visual cosmography, perpetual calendar, and thematic representation of the known world- Abraham Cresques, Spain

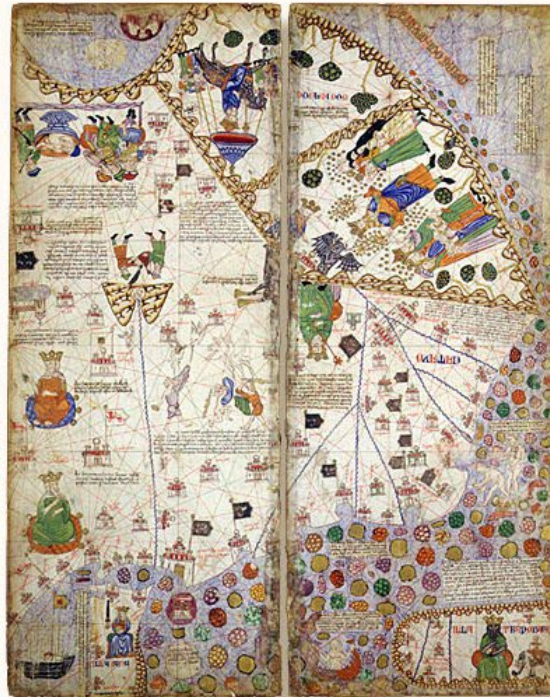


**1375:** Catalan Atlas, an exquisitely beautiful visual cosmography, perpetual calendar, and thematic representation of the known world- Abraham Cresques, Majorca, Spain [BNF: ESP 30]

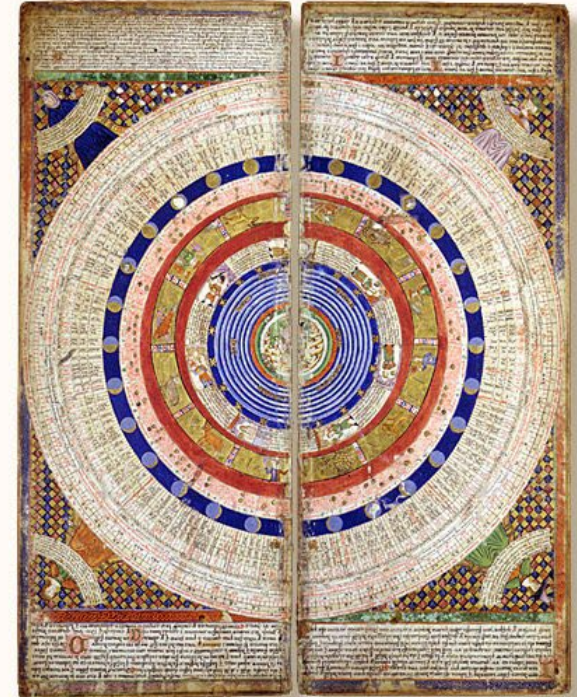
Western world



Eastern world (Marco Polo)



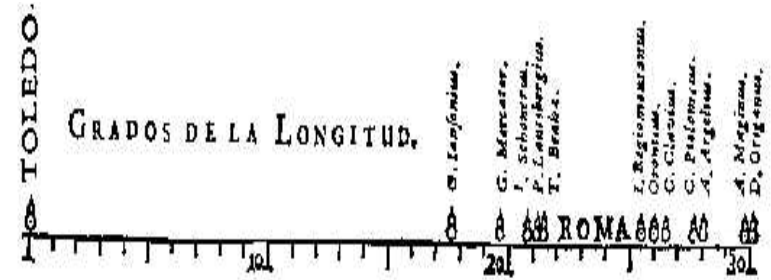
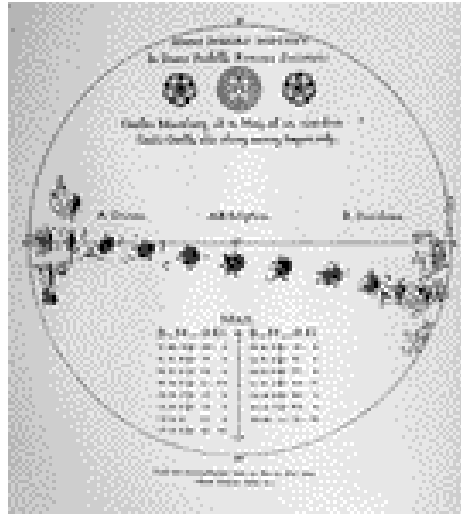
Perpetual calendar



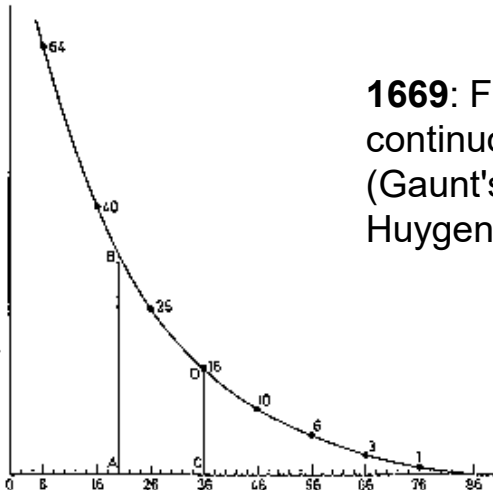


# 1600-1699: Measurement and Theory

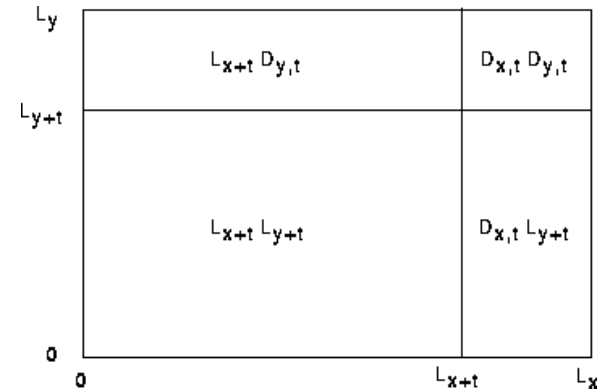
**1626:** Visual representations used to chart the **changes** in sunspots over time- Christopher Scheiner



**1644:** First visual representation of **statistical data**- M.F. van Langren, Spain



**1669:** First graph of a continuous distribution **function** (Gaunt's life table)- Christiaan Huygens.



**1693:** First use of areas of **rectangles** to display probabilities of independent binary events- Edmund Halley, England



# Sunspots: Galileo



1608: telescope (Hans Lippershey, NL)

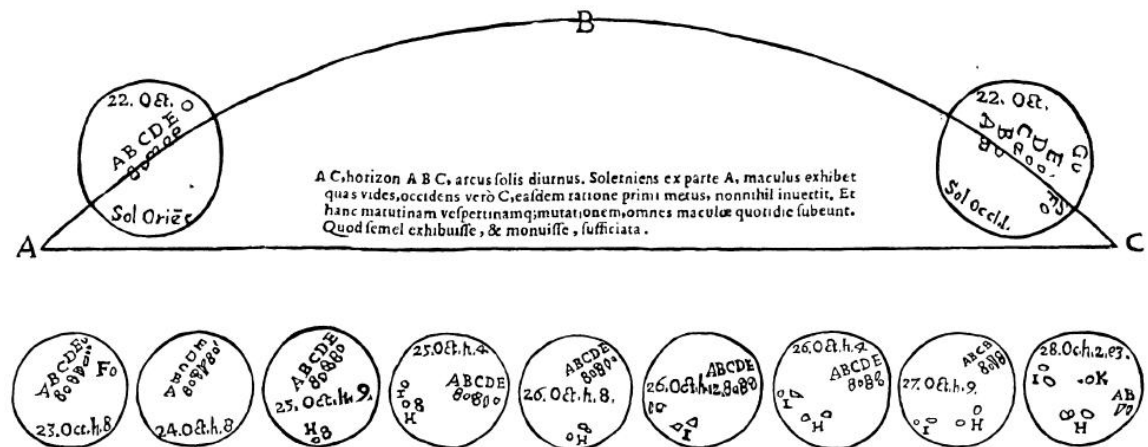


1610: Galileo (*Sidereus Nuncius*)

1611: Galileo records **movement** of sunspots over time (*Three letters on sunspots, 1613*)

## Visual ideas:

- Animated graphic
- “Small multiples”
- Allows comparison
- Self-explaining diagram

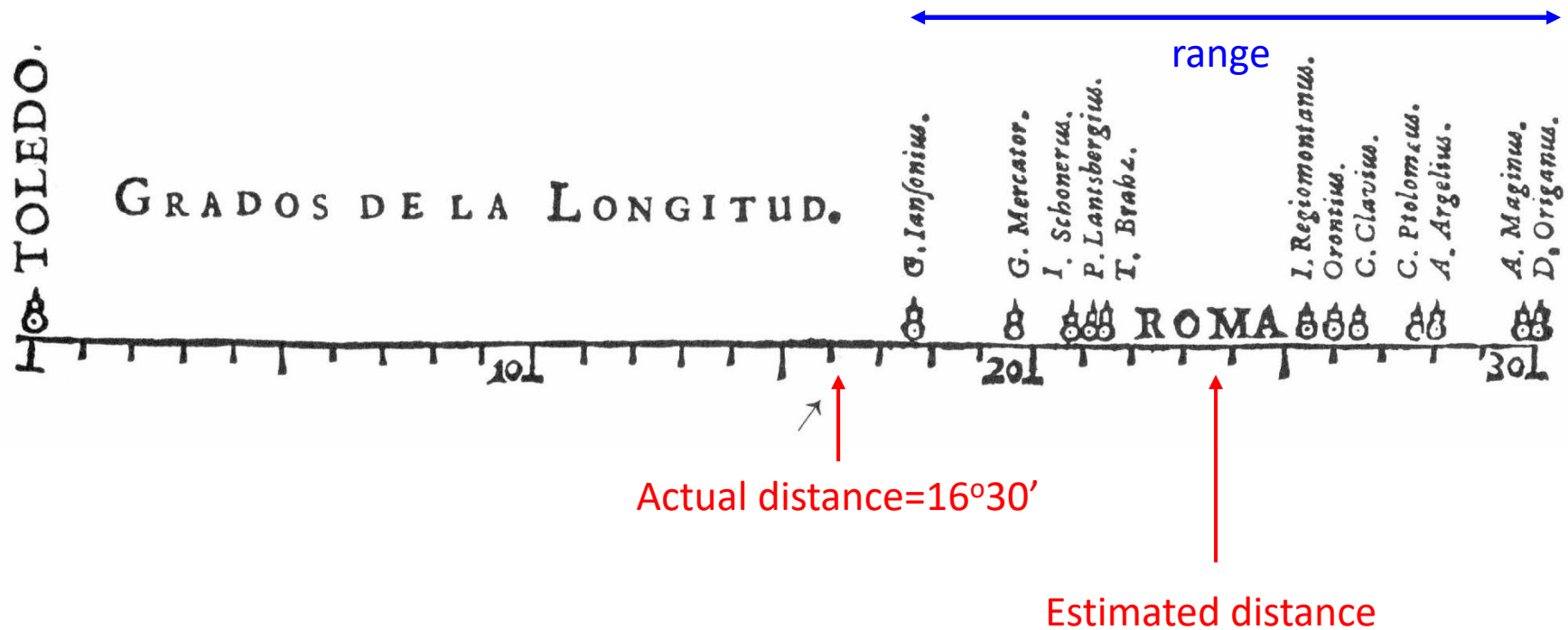


A+ for info design!

The idea of diagrams for **visualizing phenomena** had arrived.

# First statistical graph

**1644:** First visual representation of statistical data: determination of longitude between Toledo and Rome- M. F. van Langren, Spain



# What else could he have done?

- What would occur to men of his time to convey a message to the King?
- ... he could used a *table* have sorted by *year* to establish *priority* (or show change).

Answers: Who did it when?

Sorted by Priority

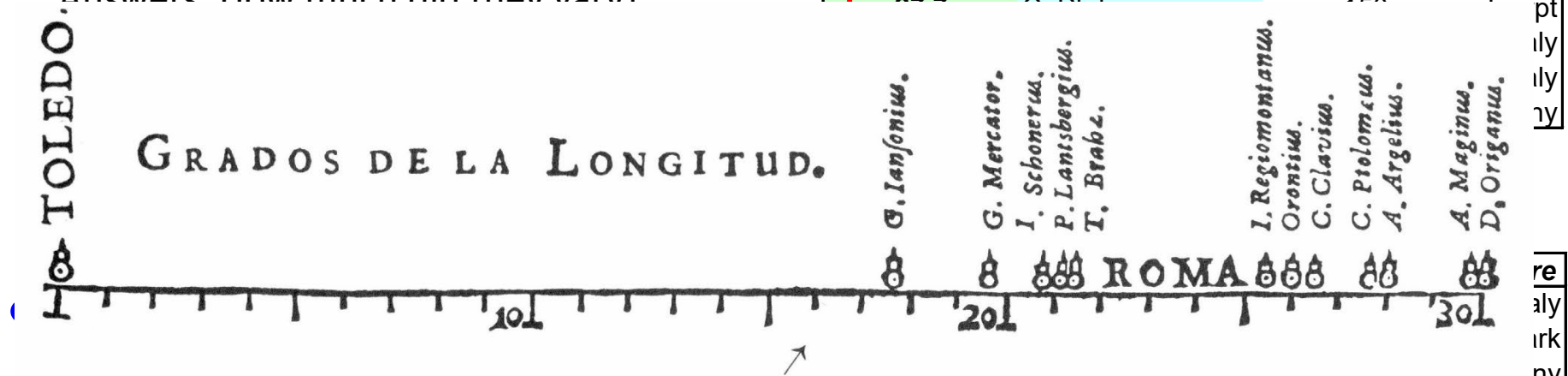
Year	Name	Longitude	Where
150	Ptolomeus, C.	27.7	Egypt
1463	Regiomontanus,	25.4	Germany
1530	Lantsbergius, P.	21.1	Belgium
1536	Schonerus, I.	20.8	Germany
1542	Ortonius	26.0	France
1567	Mercator, G.	19.6	Flanders
1567	Clavius, C.	26.5	Germany
1578	Brahe, T.	21.5	Denmark
1582	Maginus, A.	29.8	Italy
1601	Organus, D.	30.1	Germany
1605	Iansonius, G.	17.7	Flanders
1610	Argelius, A.	28.0	Italy

Sorted by Longitude

- ... he could have sorted by *longitude*, to show the *range*.

Longitude	Name	Year	Where
17.7	G. Iansonius	1605	Flanders
19.6	G. Mercator	1567	Flanders
20.8	I. Schonerus	1536	Germany
21.1	P. Lantsbergius	1530	Belgium
21.5	T. Brahe	1578	Denmark
25.4	I. Regiomontanus	1463	Germany
26.0	Orontius	1542	France
26.5	C. Clavius	1567	Germany

Answers: How much did they vary?



- ... he could have sorted by *longitude*, to show the *range*.

Answers: What did XXX say?

Iansonius, G.	17.7	1605	Flanders
Lantsbergius, P.	21.1	1530	Belgium
Maginus, A.	29.8	1582	Italy
Mercator, G.	19.6	1567	Flanders
Organus, D.	30.1	1601	Germany
Orontius	26.0	1542	France
Ptolomeus, C.	27.7	150	Egypt
Regiomontanus, I.	25.4	1463	Germany
Schonerus, I.	20.8	1536	Germany

# What was he thinking?

## The first graph in context

From van Langren (1644), *The Truth about Longitude for Sea and Land*.

### Patronage:

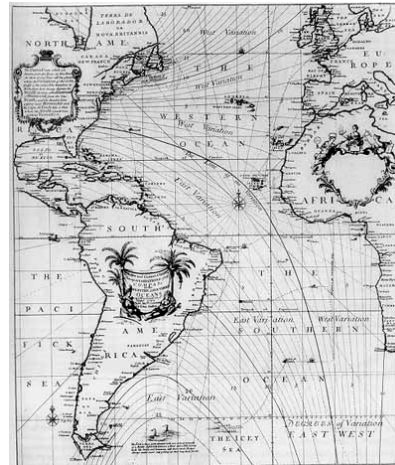
- **Credentials:** I am your chief mathematician & cosmographer
- **Problem:** Navigation at sea is most important problem for you to prosper. Many others have studied this, without success.
- **Demonstration:** I show the **great errors from all previous scholars.**
- **Supplication:** I have a solution, if you will grant me the magnificent awards you have given to others, less worthy than I am.



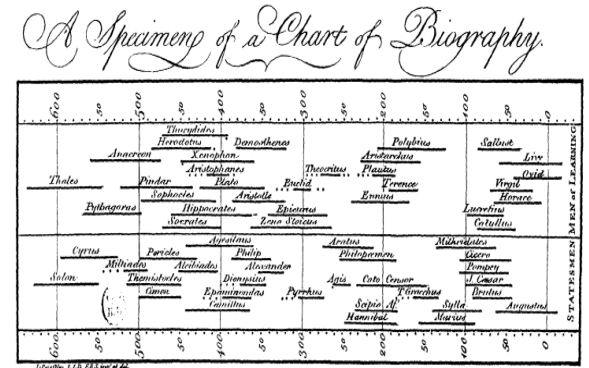
# 1700-1799: New graphic forms

Mapping the **invisible**, inventing new ways to visualize history & information

**1701:** Isogon map, lines of equal magnetic declination – Edmund Halley

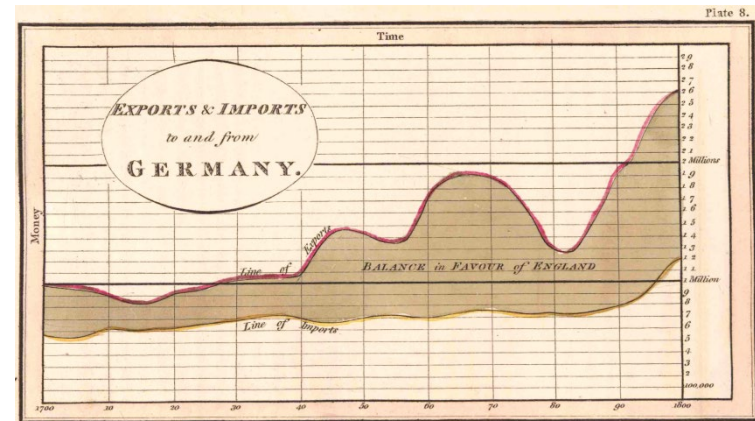


**1765:** Historical time line (life spans of famous people) Joseph Priestley

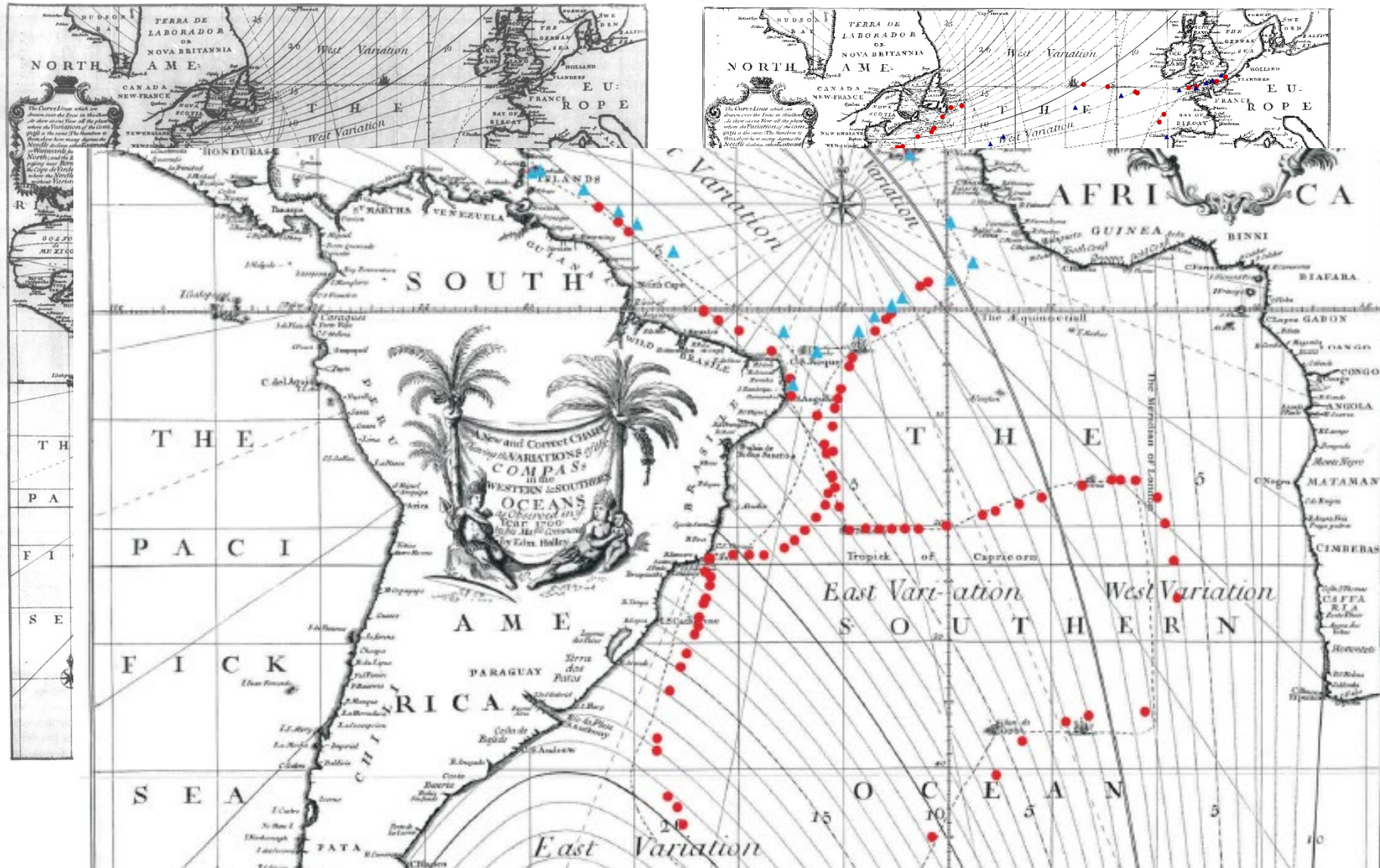


**1782:** First topographical map- Marcellin du Carla-Boniface

**1786:** Bar chart, line graphs of economic data- William Playfair



# 1701: Halley's isogonic map of magnetic declination



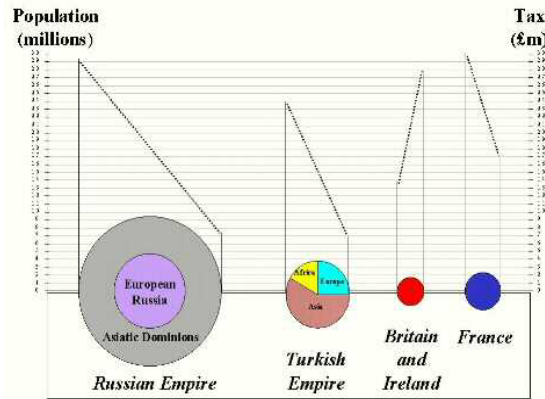
Murray, L. L., & Bellhouse, D. R. (2017). How Was Edmond Halley's Map of Magnetic Declination (1701) Constructed? *Imago Mundi*, 69(1), 72–84. <https://doi.org/10.1080/03085694.2017.1242841>



# 1800-1849: Beginning of modern data graphics

An age of **data**, and **enthusiasm** for graphics

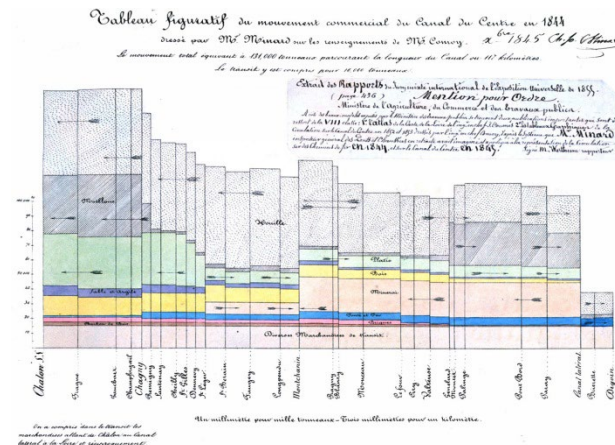
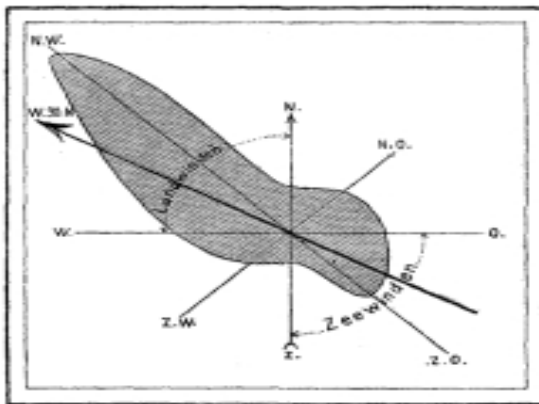
**1801:** Pie chart, circle graph invented- William Playfair



**1819:** First modern statistical map (illiteracy in France)- Charles Dupin



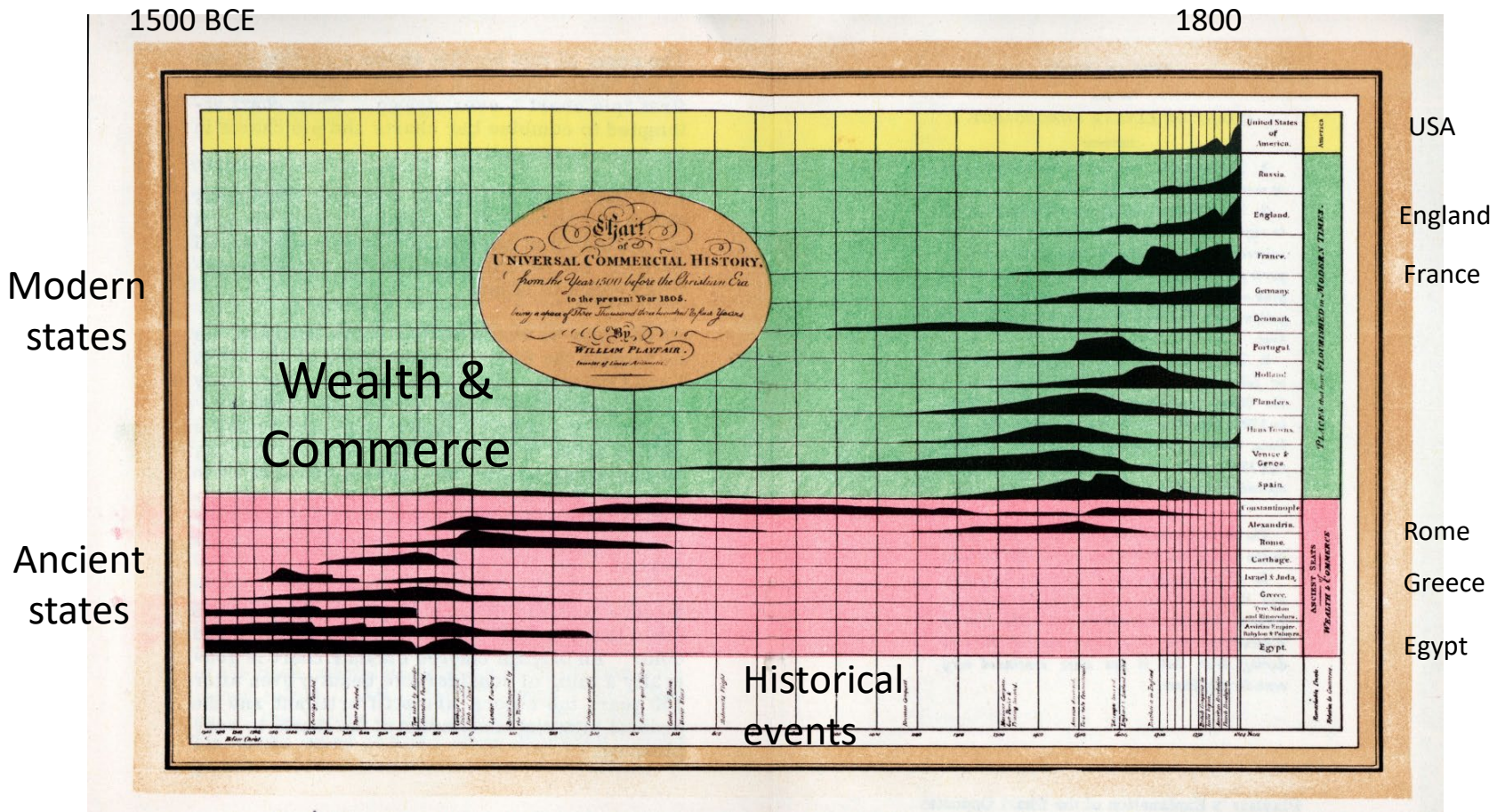
**1843:** Wind-rose (polar coordinates)- L. Lalanne



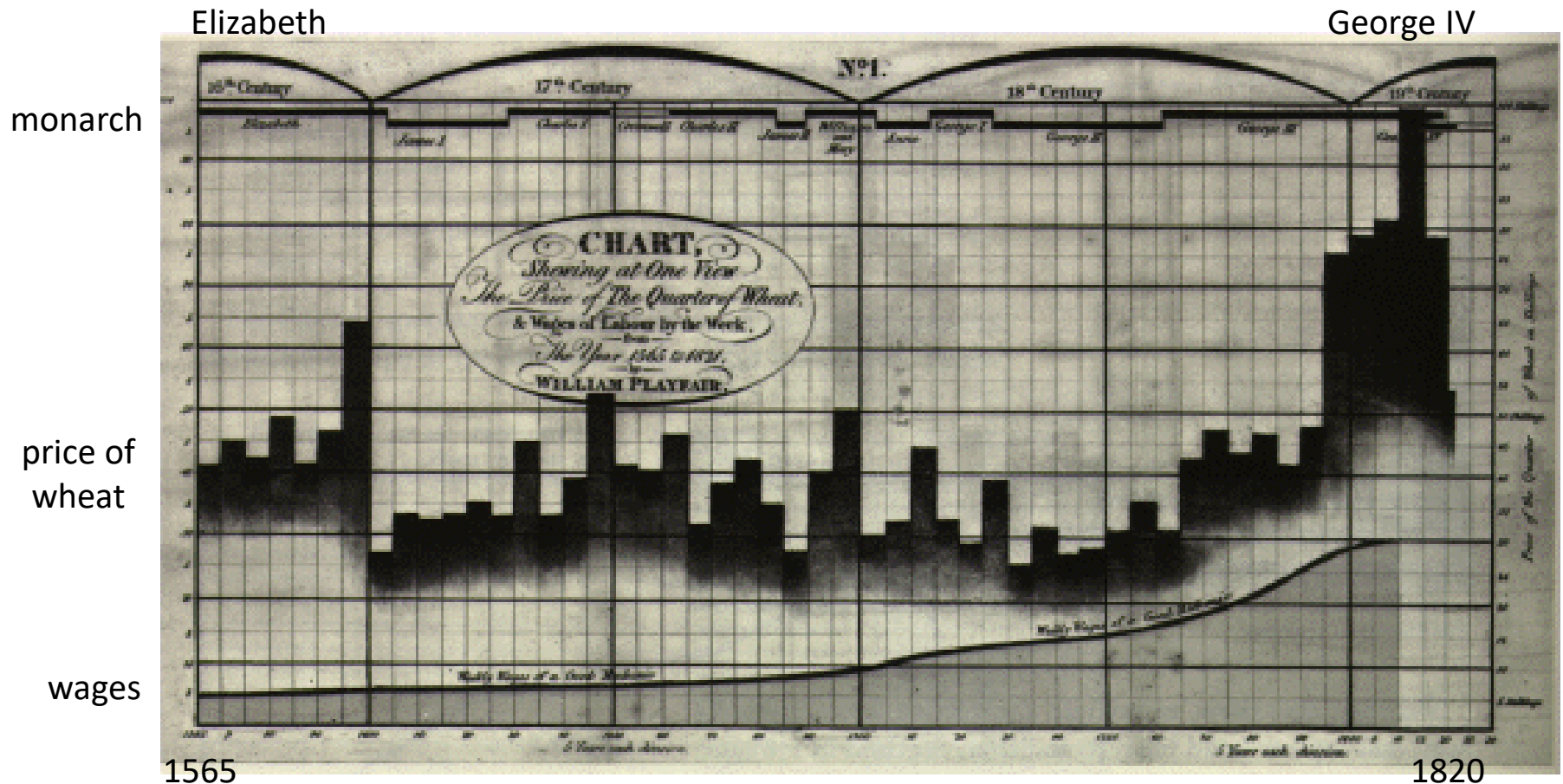
**1844:** variable-width, divided bars, area ~ cost of transport- C. J. Minard



**1805:** Visualizing the rise and fall of civilizations from ancient times to the present-  
 William Playfair, *An Inquiry Into the Permanent Causes of the Decline and Fall of  
 Powerful and Wealthy Nations*



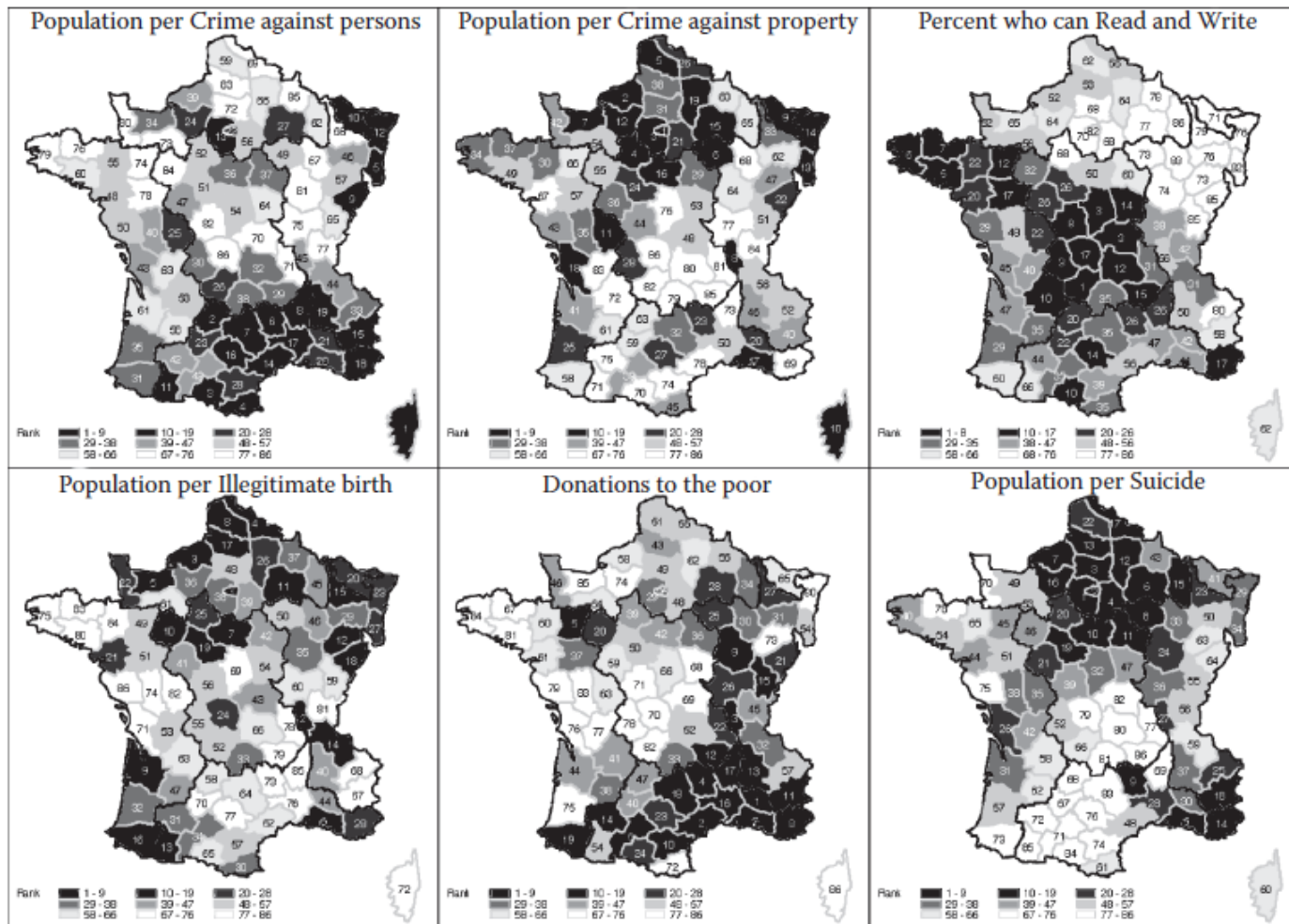
**1821:** Bar chart and line graph showing **three time series**: Price of wheat, weekly wages and reigning monarch over a 250+ year span- William Playfair, *Letter on our Agricultural Distresses...*



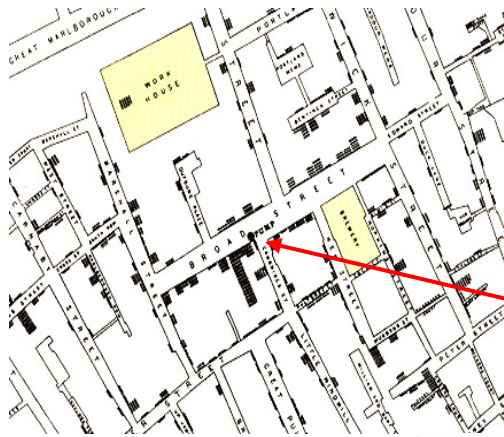


1832: Multivariate, comparative maps of social phenomena, idea of **social laws, akin to those of physics** – André-Michel Guerry, *La Statistique Morale de la France*

Before the invention of correlation, maps of different phenomena allowed thinking about **relations** among disparate social variables [Darker = WORSE]

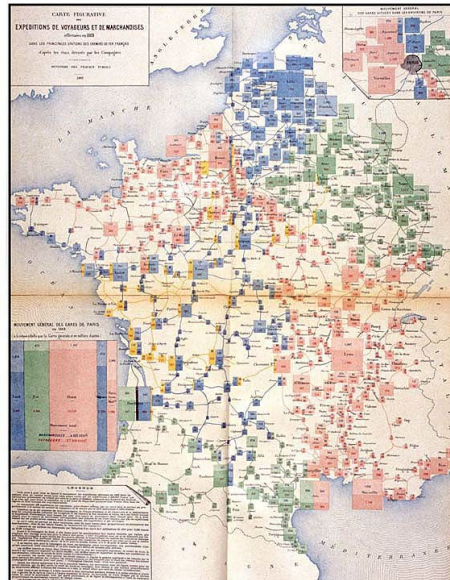


# 1850-1900: Golden Age



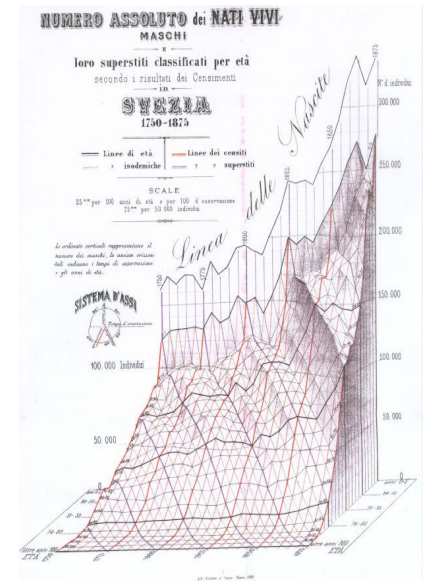
**1855:** Dot map of disease data (cholera)- John Snow

Broad St. pump

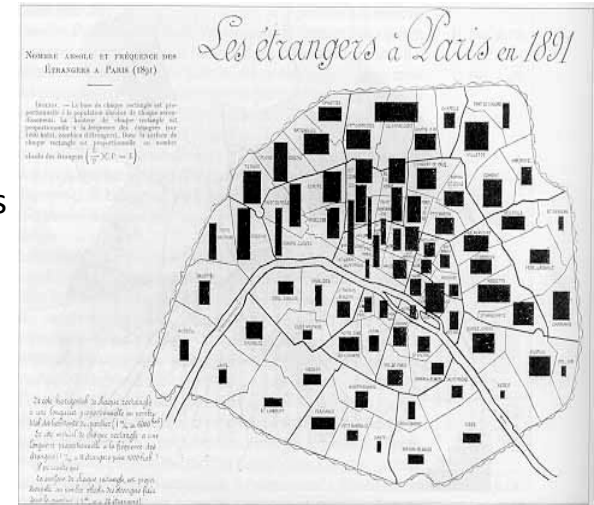


**1884:** Recursive multi-mosaic on a map- Emile Cheysson

**1879:** Stereogram (3D population pyramid)- Luigi Perozzo



**1896:** Area rectangles on a map to display two variables and their product- Jacques Bertillon





# Galton (1863): Discovery of weather

## METEOROGRAPHICA,

OR

### METHODS OF MAPPING THE WEATHER;

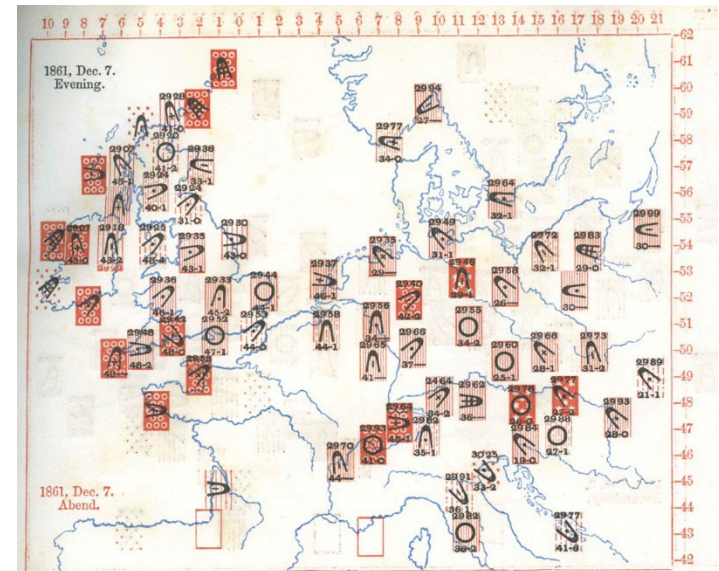
ILLUSTRATED BY UPWARDS OF 600 PRINTED AND LITHOGRAPHED DIAGRAMS

REFERRING TO

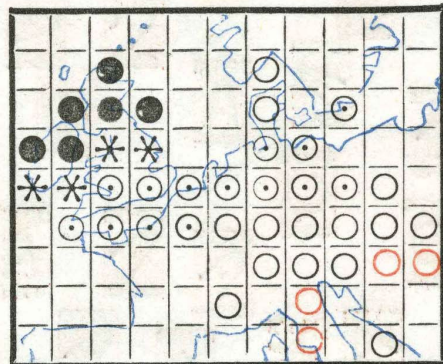
### THE WEATHER OF A LARGE PART OF EUROPE,

During the Month of December 1861.

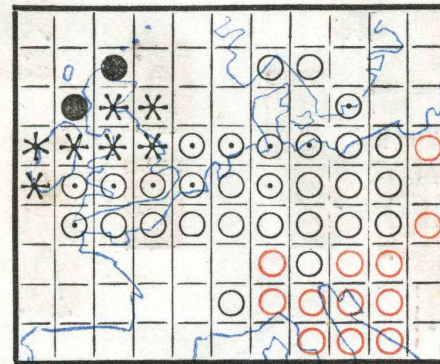
By FRANCIS GALTON, F.R.S.



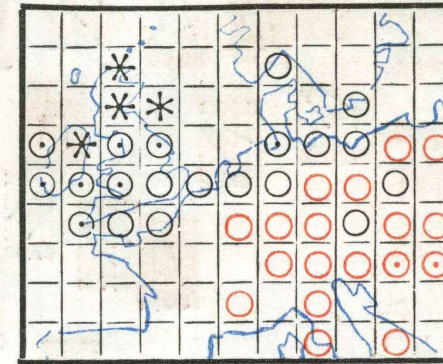
Dec. 8. Morning. **Morgen.**



Afternoon. **Nachmittag.**



Evening. **Abend.** Dec. 8.

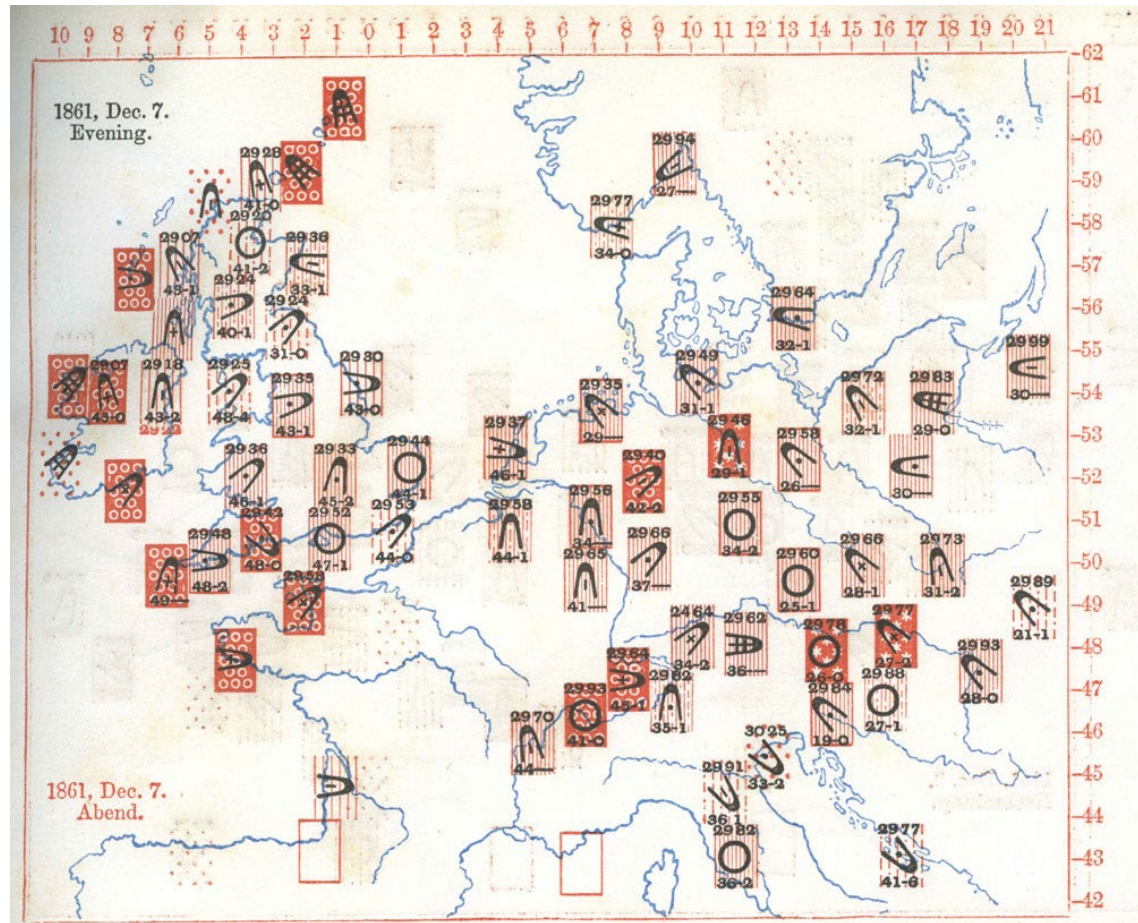




**Method:** All weather stations across Europe asked to record data 3x/day for all of Dec., 1861

**Data:** recordings of barometric pressure, wind dir/speed, rain, temp., cloud: 3x/day, 50 weather stations in Europe.

**Graphic analysis:** 3x31=93 maps, each with multivariate glyphs showing all variables



EXPLANATION OF THE SYMBOLS USED IN THE WEATHER CHARTS.

RAIN.				CLOUD.			
Rain.	Snow.	Entirely and heavily clouded.	Entirely clouded.	Mostly clouded.	Half clouded.	A few clouds.	Clear blue sky.
DIRECTION OF WIND.				FORCE OF WIND.			
S.	S.S.W.	S.W.	W.S.W.	W.	&c.	Gale.	Strong.
						Moderate.	Gentle.
						Almost calm.	Calm.

**Visual ideas:**

- Iconic symbols
- Multivariate glyphs (stamps!)



# The large picture → Insight

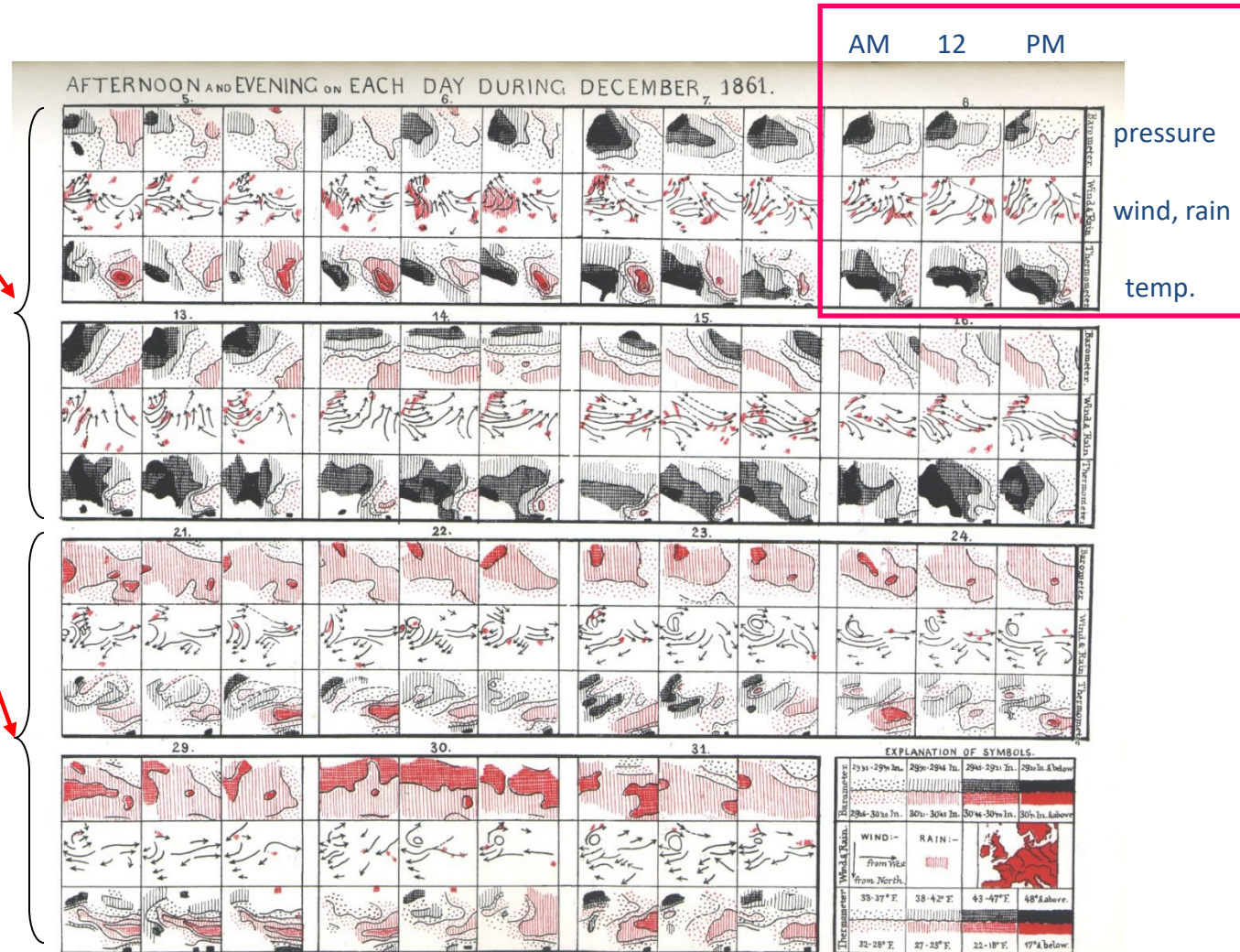
## Pattern:

Low pressure (black) in early Dec. → CCW wind

High pressure (red) in late Dec. → CW wind

**Graphic:** 3x3x31 grid, mapping {pressure, wind/rain, temperature} x {AM, 12, PM} x day {1:31}

(try this with your software!)



A series of weather maps from the *Meteorographica*.

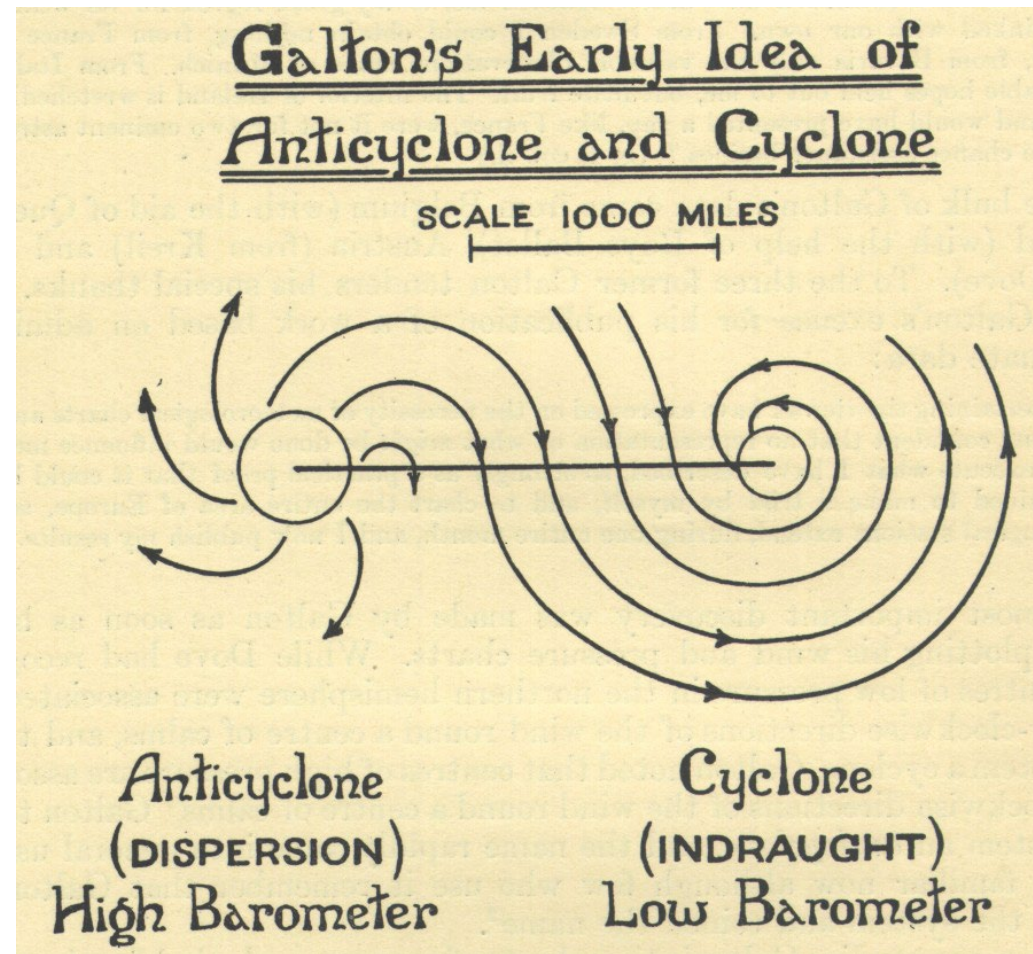
# Visual insight → Theory

**Visual insight** from 93 (3x31) high-D graphs:

- Changes in wind dir w/ pressure over time
- → Winds revolve inwardly (CCW) in low pressure areas– as in a cyclone;
- → revolve outwardly (CW) in high pressure areas– “anti-cyclone”

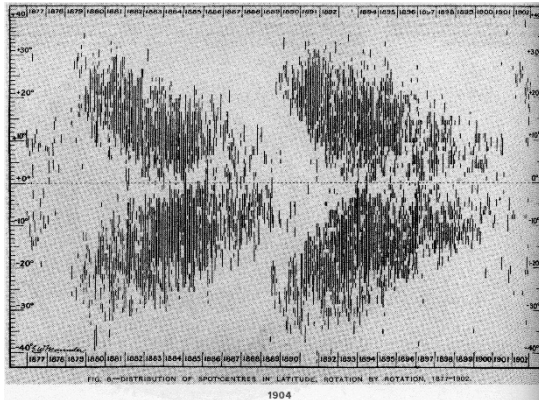
## Theory:

- Explained by Dove’s ‘Law of Gyration’
- Prediction: reversed pattern (CW/CCW) in southern hemisphere – confirmed!



# 1900-1950: Modern Dark Ages

**1904:** Maunder “butterfly diagram”  
– discovery of sunspot cycles



**1913:** WC Brinton, pictograms

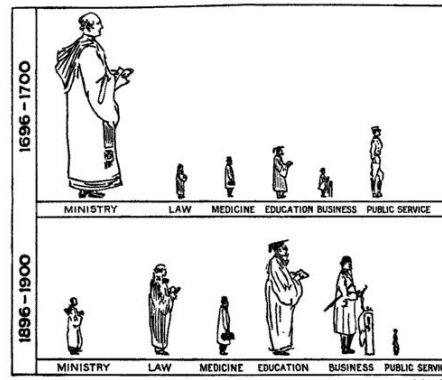
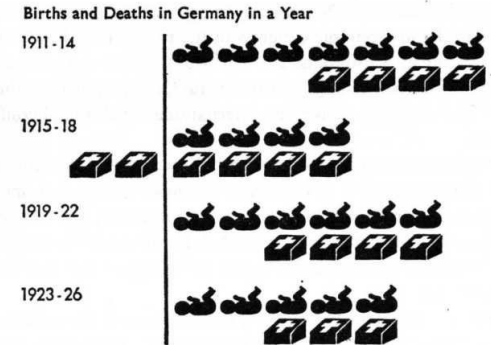


Fig. 39. Proportion of College Graduates in Different Professions in 1896-1900 and in 1913-1914

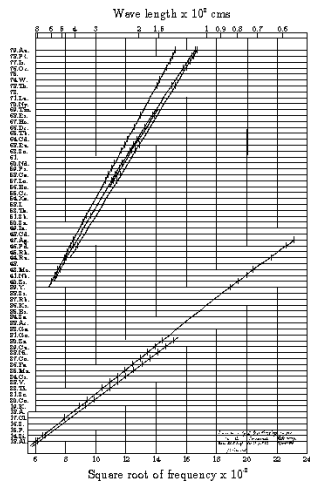
Charts of this kind with men represented in different sizes are usually so drawn that the data are represented by the height of the man. Such charts are misleading because the area of the pictured man increases more rapidly than his height. Considering the years 1896-1900, the pictured minister has about two and one-half times the height of the man representing public service. The minister looks over-important because he has an area of more than six times that of the man drawn to represent public service. This kind of graphic work has little real value.

**1924:** Otto Neurath, ISOTYPE method

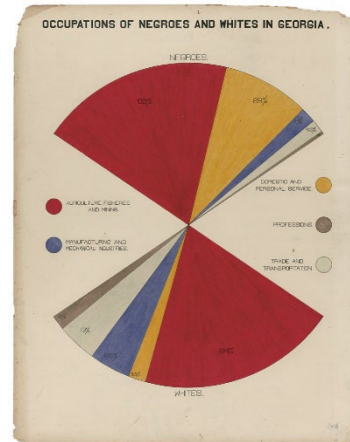


1 child for 250,000 births a year  
1 coffin for 250,000 deaths a year

**1913:** Moseley discovers atomic number,  
predicts new elements



**1900:** WEB DuBois, Paris Expo,  
“American Negro”



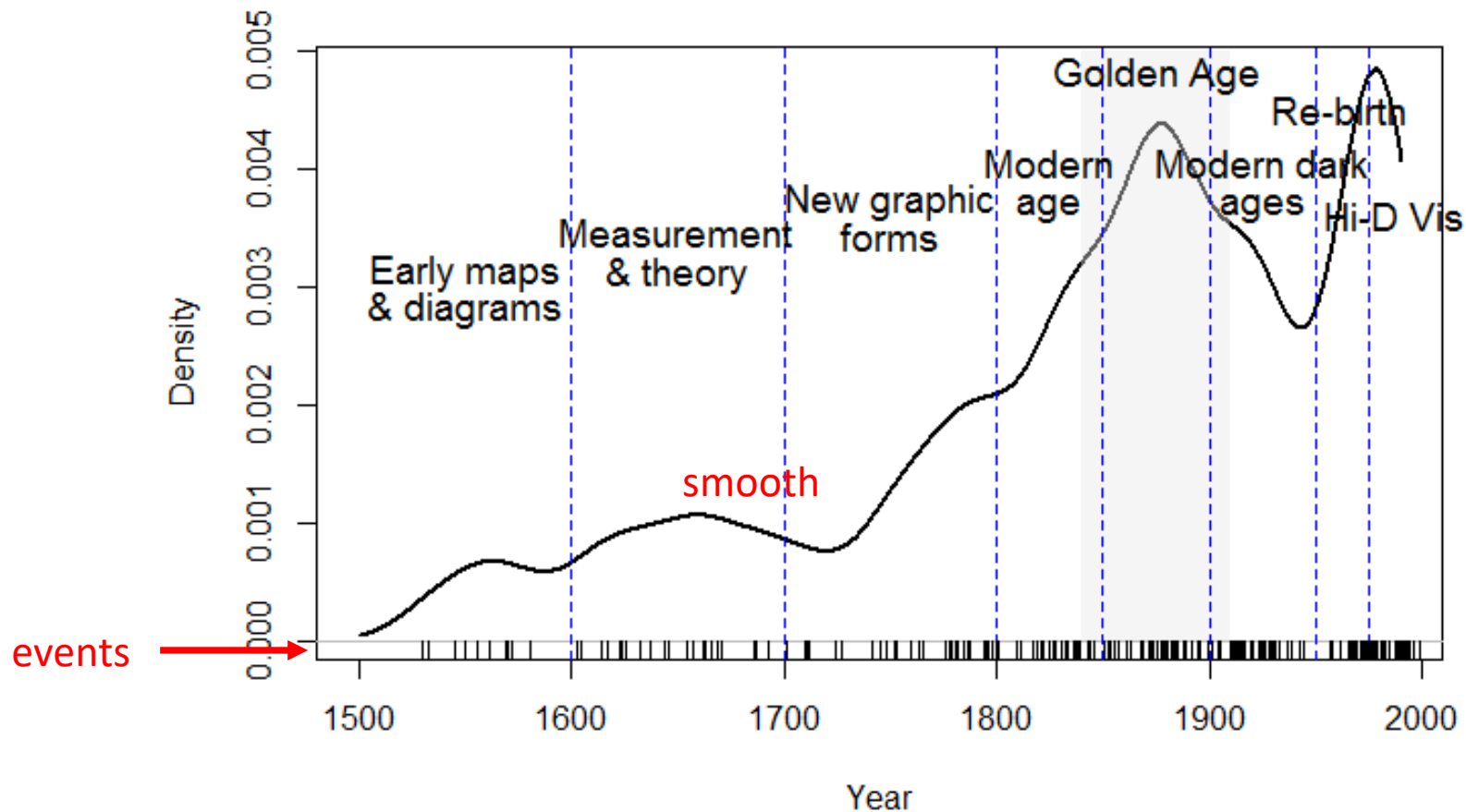
**1934:** Harry Beck, Usability map of  
London underground



# Statistical historiography: History as data

Historical information, suitably organized can be treated as **data**, and analyzed. This plot shows a smoothed frequency distribution of 248 milestones items over time, in relation to the named time periods.

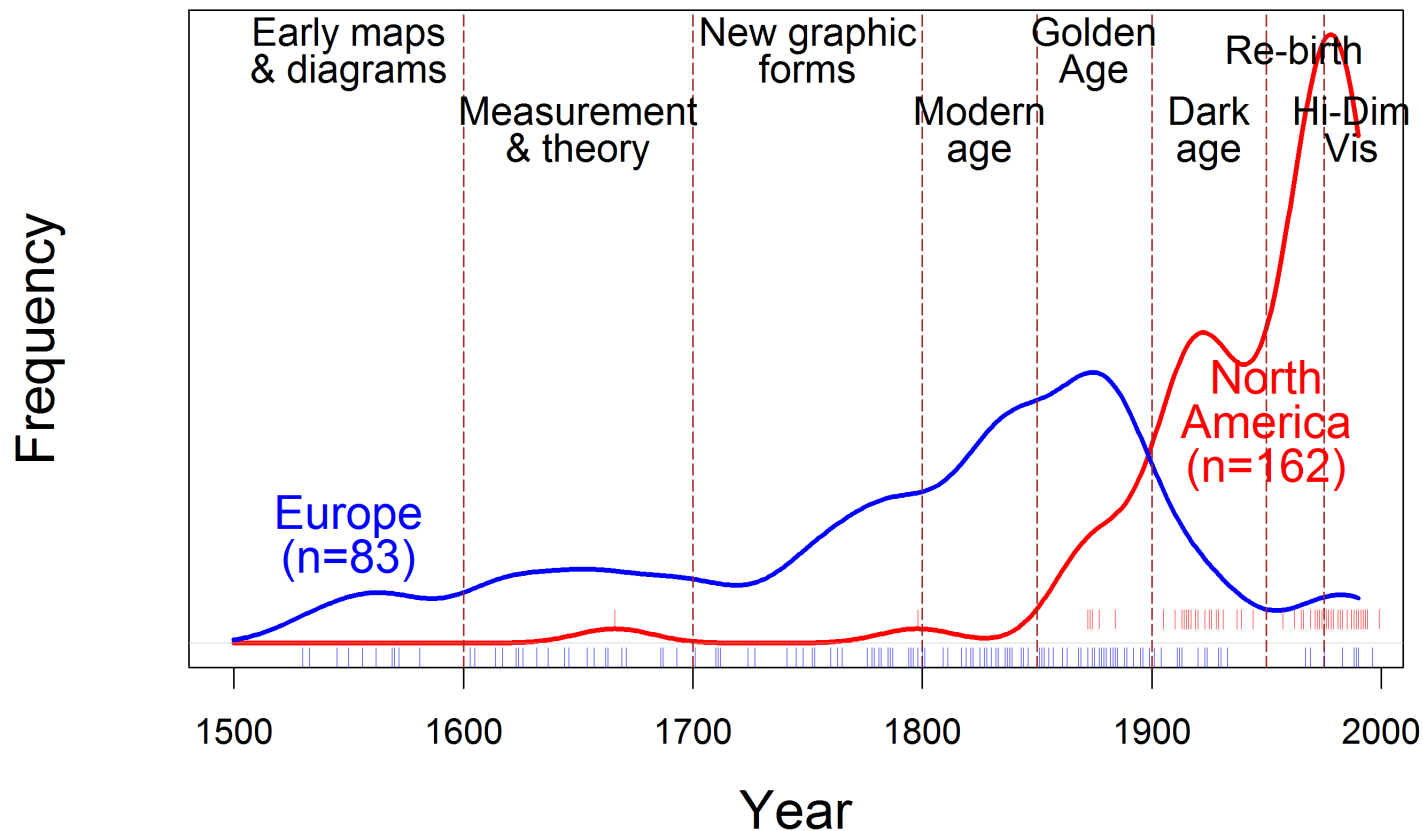
**Milestones: Time course of development**



# Statistical historiography

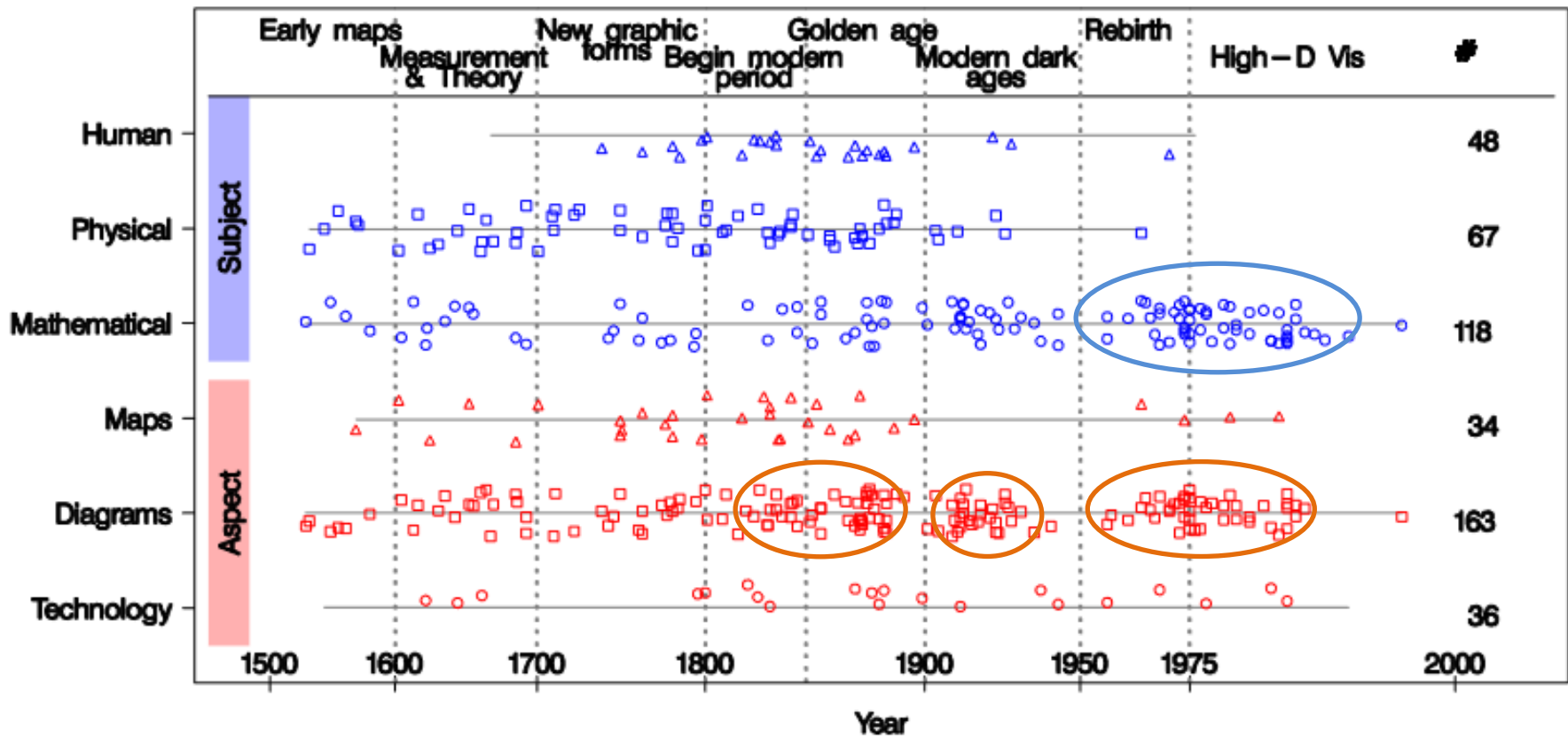
Additional features may be suggested when milestones items are classified by location, type (map, graph, technology...) or content (geography, human, ...)

## Where and when graphical milestones occurred



# Classify by content & type?

Thematic timeline of milestones in data visualization



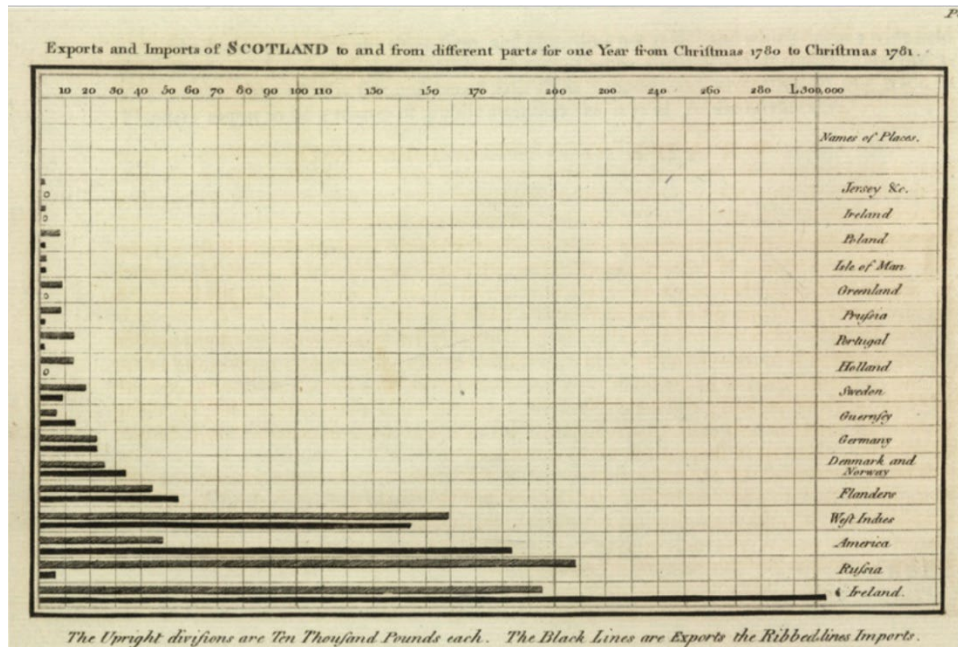
Friendly et al (2015), The Milestones Project: A Database for the History of Data Visualization, <https://www.datavis.ca/papers/MilestonesProject.pdf>



# Problems of statistical historiography

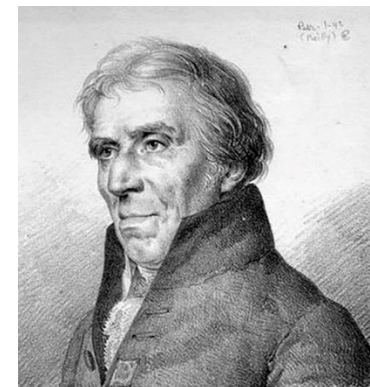
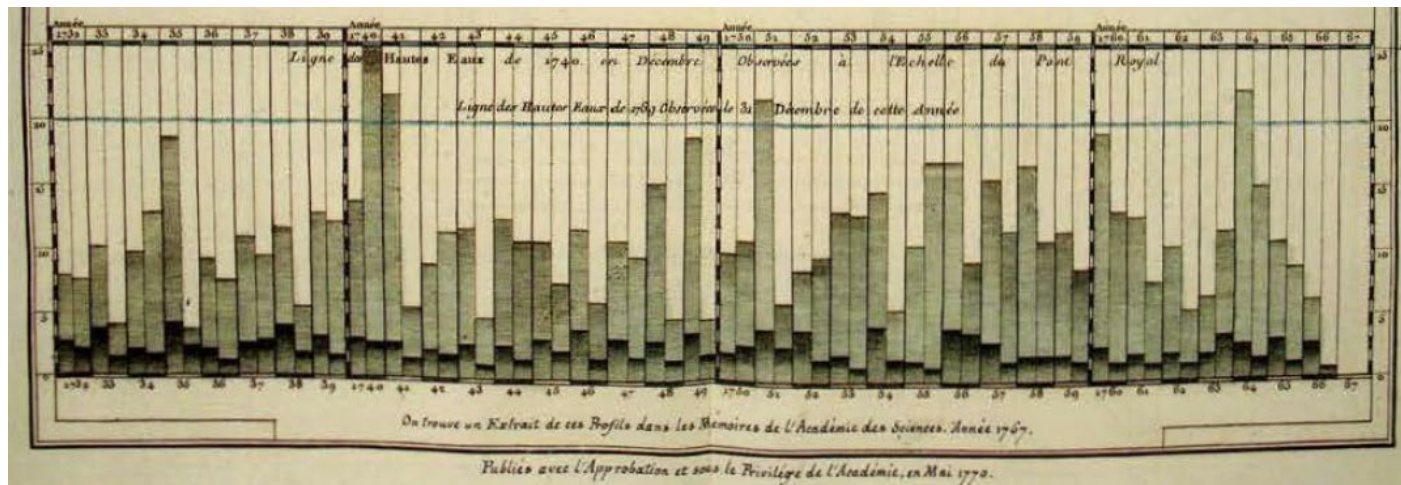
- What “counts” as a milestone?
  - Scope of time & space
    - Milestones Project largely Western, but many other things from the Asian & Arab worlds
    - Main focus on <2000. How should recent developments be counted?
  - Who gets credit?
    - Stigler’s Law of Eponymy: “No scientific discovery is named after its original discoverer.” – Fourier transform (Laplace), Cauchy distribution (Poisson), ...
    - “First chasing”: Innovations often developed earlier under a looser definition, or better later under a stricter one

# Who invented the bar chart?



**1786:** The first bar chart? Wm Playfair, *Commercial & Political Atlas*

**1752--1770:** Phillippe Buache, charts of high/low water on the Seine



# Understanding through reproduction

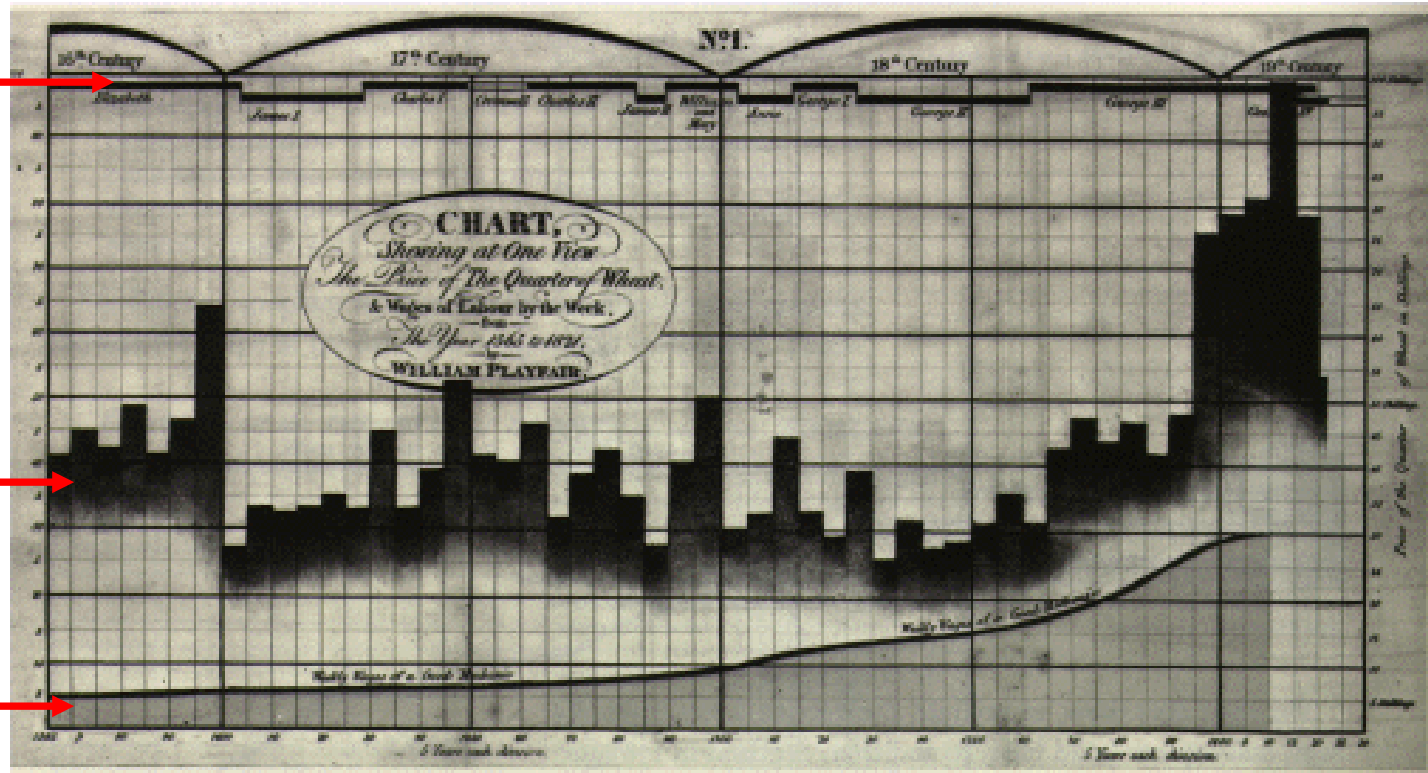
**RE-VISION** *n.* *ri-'vizz-en* (ca. 1611) 1. To see again, possibly from a new perspective; *syn:* review, reconsideration, reexamination, retrospection. 2. An act of revising; *syn:* rewrite, alteration, transformation.

- “Re-Visioning”: See again, possibly from a new perspective
  - Historical maps & graphs were created using available data, methods, technology & knowledge at the time
- We can often learn much of the intellectual & scientific questions by a re-analysis from a modern perspective
  - Sometimes, we find errors, gain new insights or appreciation
  - Sometimes, we come up short because software tools can’t compete with the artistic beauty of hand-drawn graphics

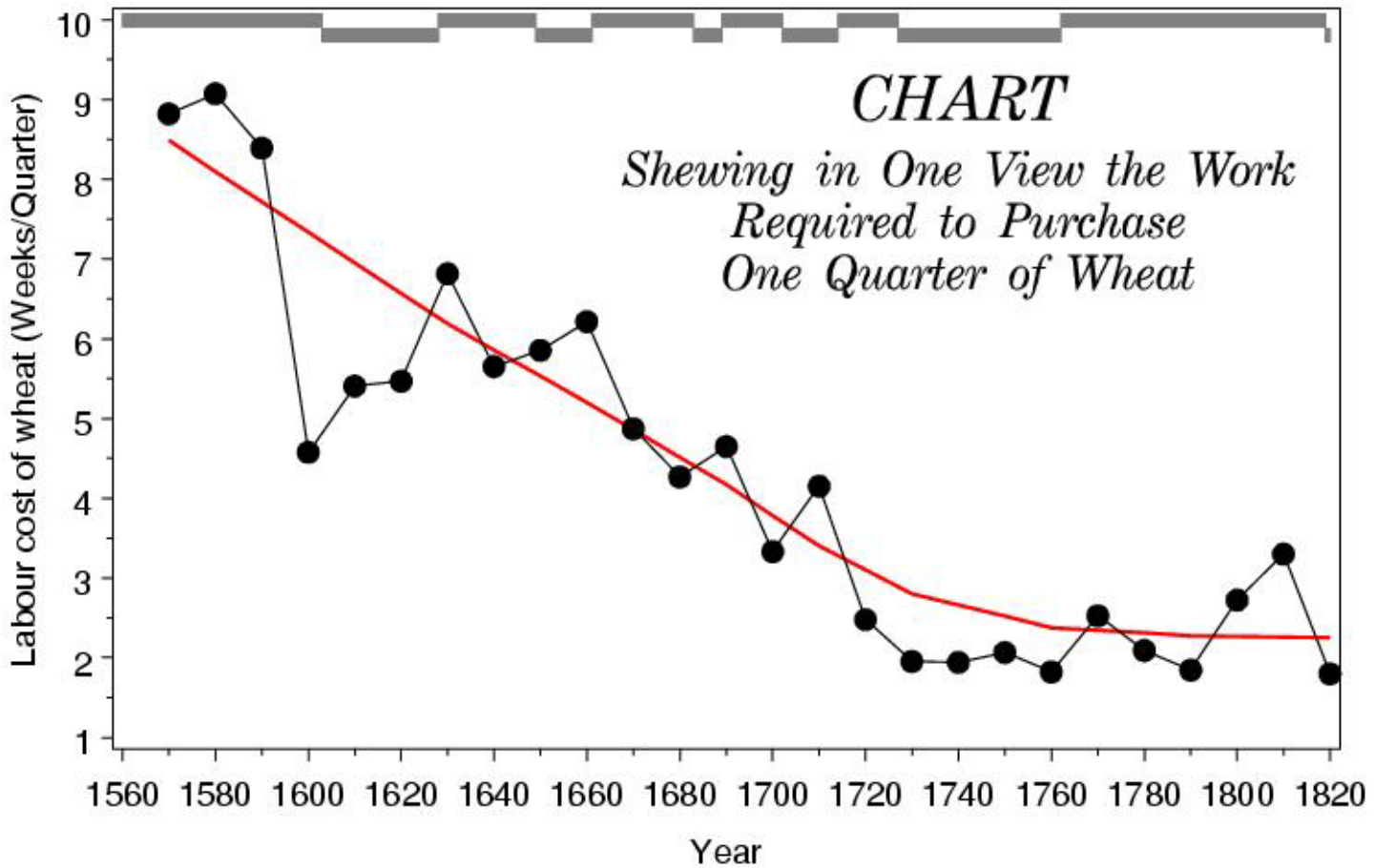
Friendly, M. (2002). Visions and re-visions of Charles Joseph Minard. *Journal of Educational and Behavioral Statistics*, **27**, 31–52. <https://doi.org/10.3102/10769986027001031>

# ExPlayfair: Wheat & wages

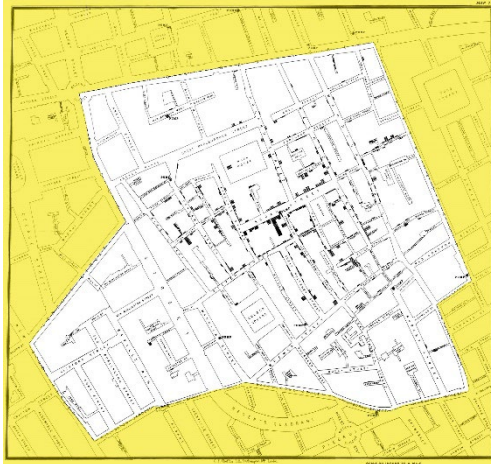
Playfair designed this graph to show that workers were best off in recent years, comparing prices to wages. **Is this what you see?**



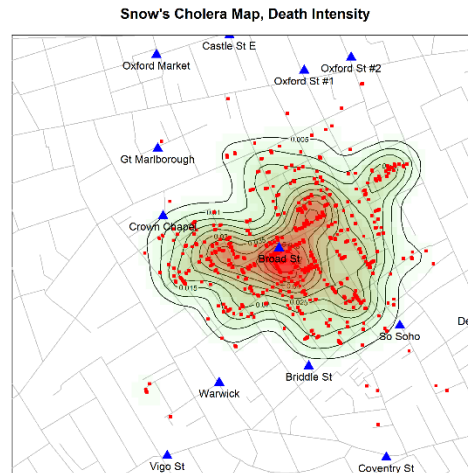
# Playfair re-visited



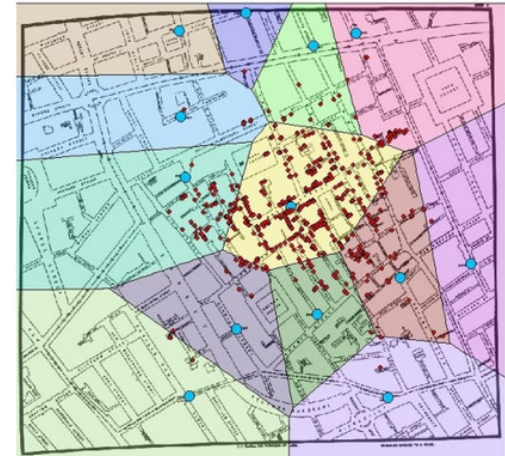
# Re-visioning John Snow



Original (highlighted)



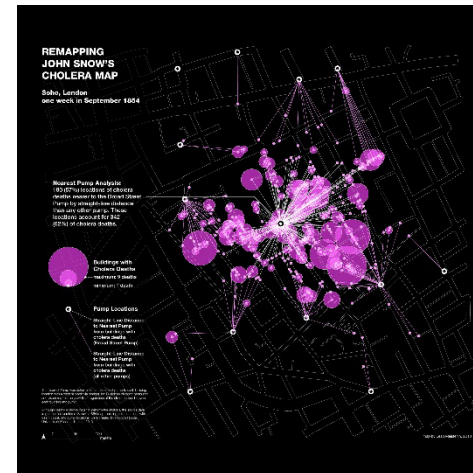
Density contours (MF)



Nearest pump polygons (Scott Hicks)



Interactive, 3D (Ken Fields)



From the air (Leah Meisterling)



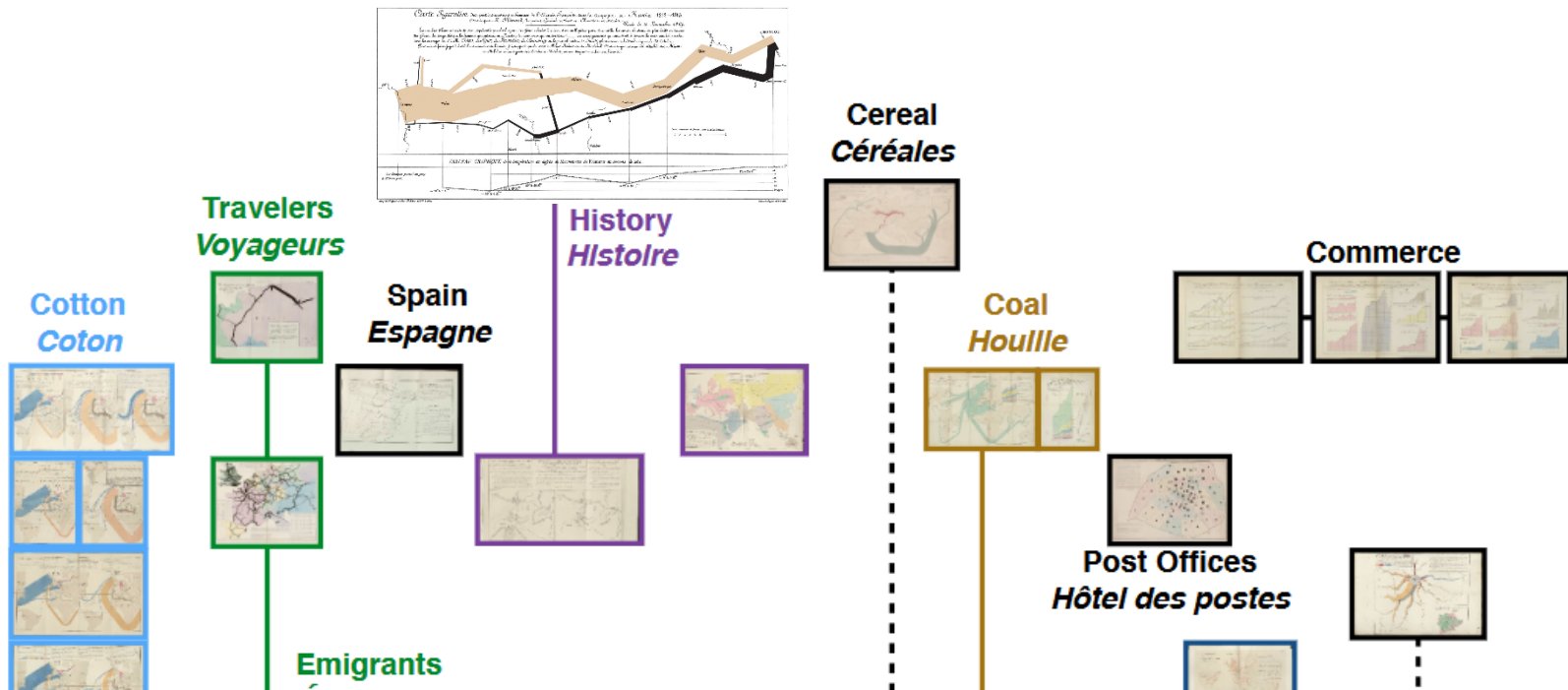
# Graphic Heroes

- Real historians may disdain the idea of “heroes,” but telling their stories:
  - Makes history come alive
  - Makes their work accessible to a modern audience
  - → Opportunities for discoveries of influences, similarities, ...
- Some Chevalier heroes:
  - Michael Florent van Langren: the first statistical graph
  - Charles Joseph Minard: “the best graphic ever produced”
  - William Playfair: the father of modern graphics
  - André-Michel Guerry: the birth of modern social science
  - Etienne-Jules Marey: the Graphic Method
  - Florence Nightingale: data & graphs for social change
  - Emma Willard: visualizing history

# Visual Catalog of the Work of Charles Joseph Minard

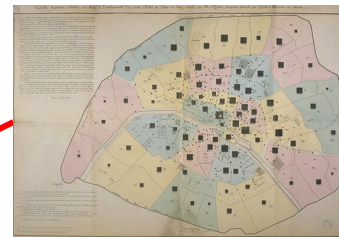
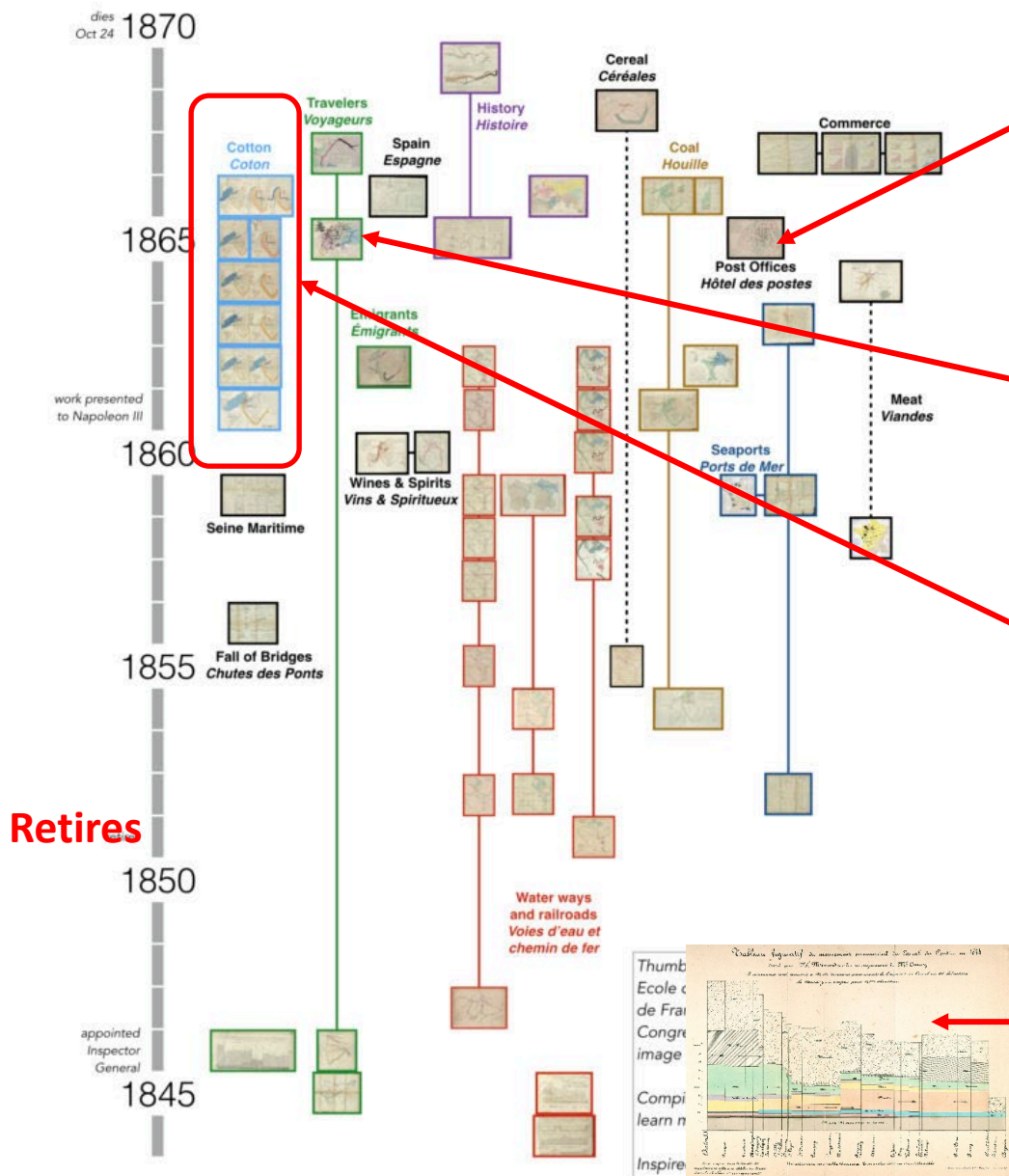
dies  
Oct 24 1870

1865

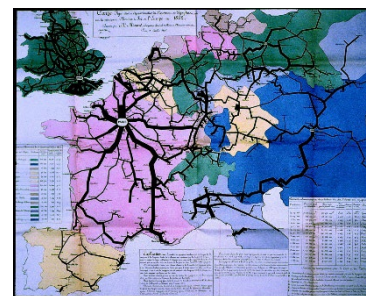




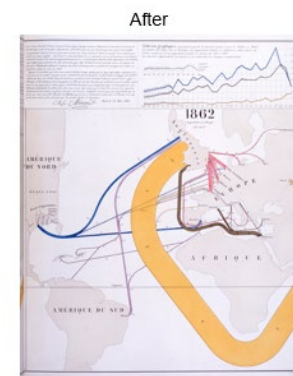
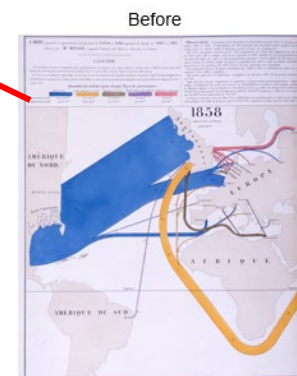
# Visual Catalog of the Work of Charles Joseph Minard



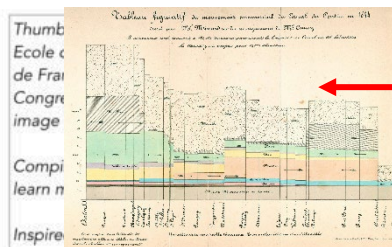
Visual explanation



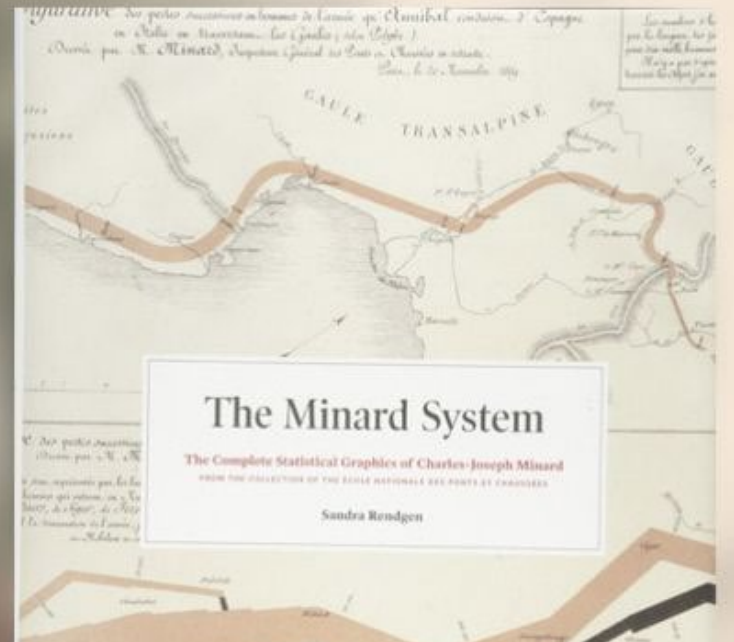
Flow maps as visual tools

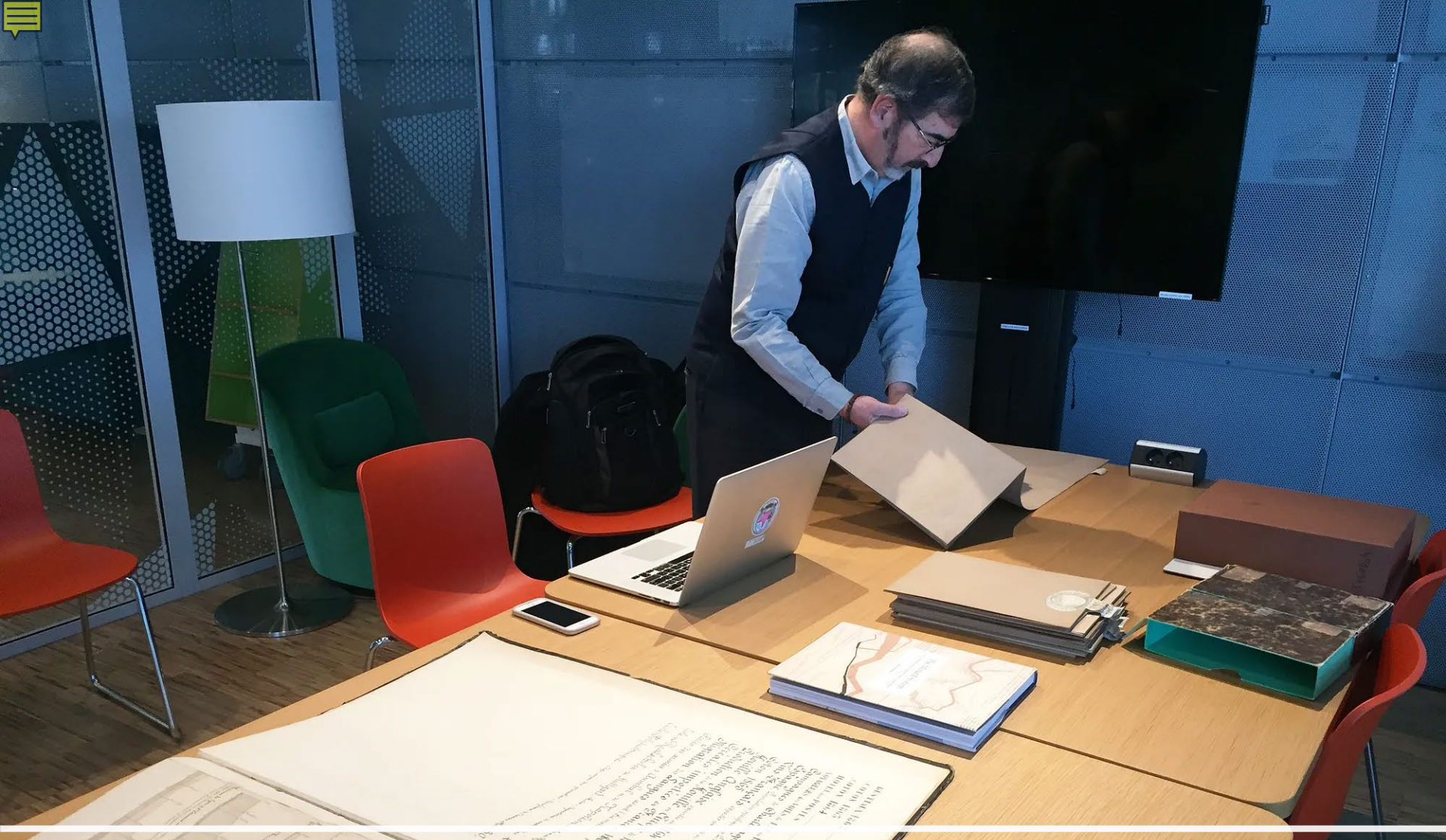


How to charge for passengers & goods on Canal du Centre?

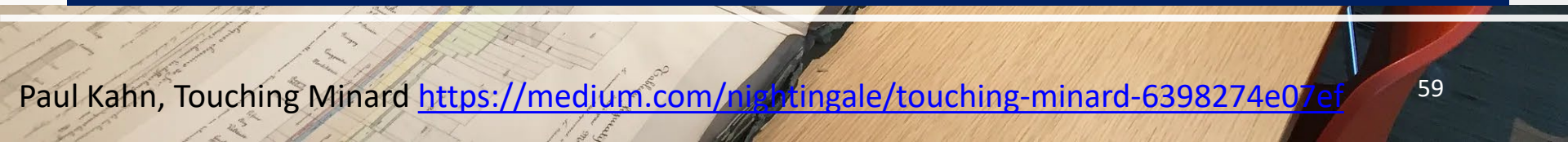


# The Complete Minard



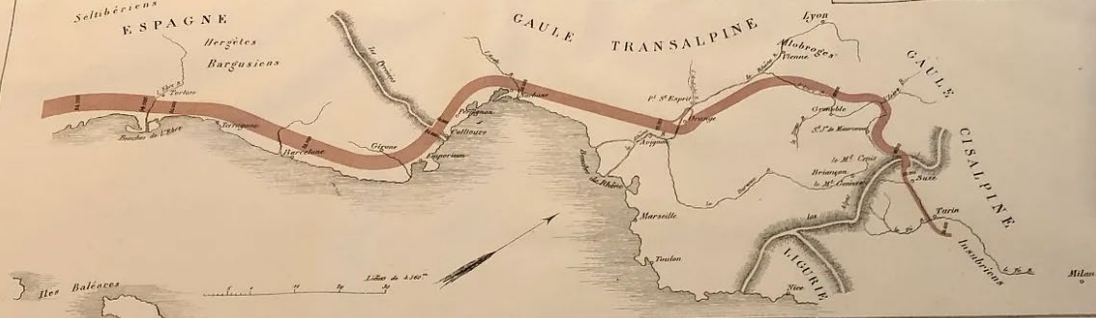


# Touching Minard



*Carte Figurative des pertes successives en hommes de l'armée qu'Annibal conduisit d'Espagne en Italie ou traversant les Gaules (selon Polybe).*

Dessiné par M. Ménière, Chef de bataillon des Ponts et Chaussées en retraite.  
Paris, le 20 Novembre 1869.

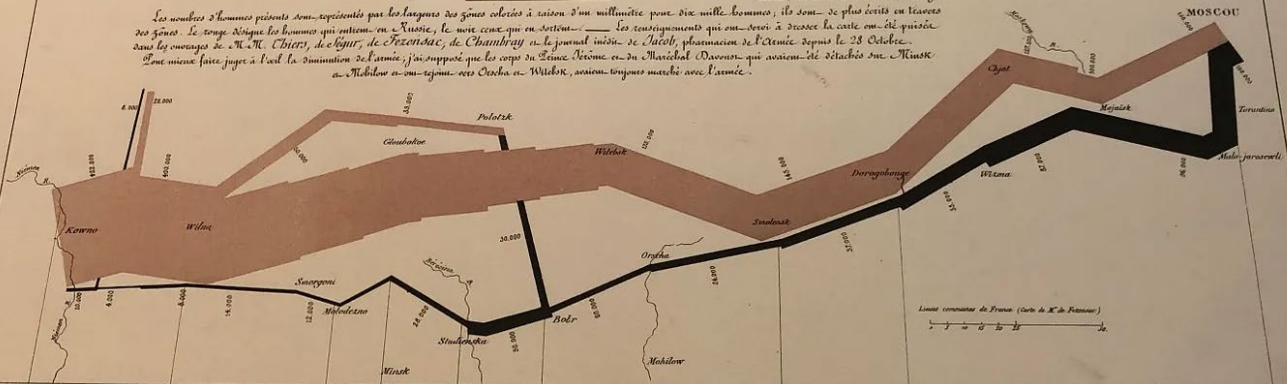


*Légende.*  
Les nombres d'hommes restés à Annibal sont représentés par le largeur des zones colorées à raison d'un millimètre pour dix mille hommes de plus ou de moins en moins des zones. Il n'y a pas 5 figures décimales sur la ligne, car Annibal ne traversa les Alpes, fut adopté, et se livra sans résistance la justice.

*Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.*

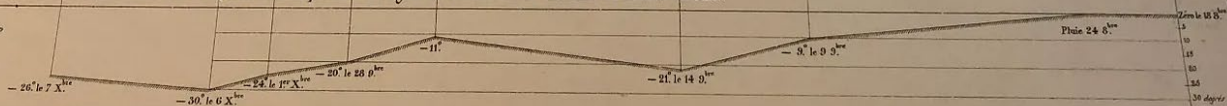
Dessiné par M. Ménière, Chef de bataillon des Ponts et Chaussées en retraite.  
Paris, le 20 Novembre 1869.

Les nombres d'hommes restés sont représentés par la largeur des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le tracé indique les hommes qui restèrent en Russie, le noir ceux qui en sortirent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Tout mieux faire juger à l'œil la diminution de l'armée; j'ai supposé que les corps du Prince Reine en du Maréchal Davout qui avaient été détachés sur Ruzick et Mielitz n'ont eurent ces Otrcha et Mielitz, avaient toujours marché avec l'armée.



*TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.*

Les Chinois passent au gélif le Niloum gelé.



Amoy par Register, le 3<sup>e</sup> Mars 17<sup>e</sup> 6<sup>me</sup> à Paris.

Imp. Leth. Register à Bruxelles.

80

# RJ's Trilogy



These three volumes from RJ Andrews' Visionary Press break new ground in telling the stories of some graphic heroes

Insights:

- Nightingale's "team", antecedents & early drafts of the famous radial diagram
- Marey: A rich context for understanding modern roots of graphic representation in maps, charts
- Willard: Visualizing history, maps, charts of chronography, education

# Raiders of the Lost Tombs: The Search for Some Heroes of the History of Data Visualization

Michael Friendly and Les Chevaliers des Albums de Statistique Graphique<sup>1</sup>



Michael Friendly

Published in Nightingale · 15 min read · Mar 23, 2020

**The well-knowns** – celebrated in their lifetimes, detailed biographies, public recognition of where they lived and were buried



John Snow



Nightingale



Galton



WEB Du Bois

Friendly & Les Chevaliers (2020), <https://bit.ly/3lvIcAo>

# Raiders of the Lost Tombs: The Search for Some Heroes of the History of Data Visualization

Michael Friendly and Les Chevaliers des Albums de Statistique Graphique<sup>1</sup>



Michael Friendly

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**Les inconnues** – heroes under-appreciated in their times, whose personal history and final resting places are unknown



MF van Langren



William Playfair



C. J Minard



A.-M. Guerry

# Finding Minard

- Very little of Minard's personal life is known
  - Family? Friends?
  - Where did he live?
  - Where was he buried?
- Antoine discovered an obscure notice of one of Minard's works listing "chez l'auteur, 38 ru du Bac"
- Connections with Playfair, Guerry?
  - Perhaps Minard entertained Playfair there?
  - A-M. Guerry found to have lived 123 Boul. St. Michel, 5eme





# Minard's Tomb

Discovery of Minard's tomb in Montparnasse Cemetery, Paris.

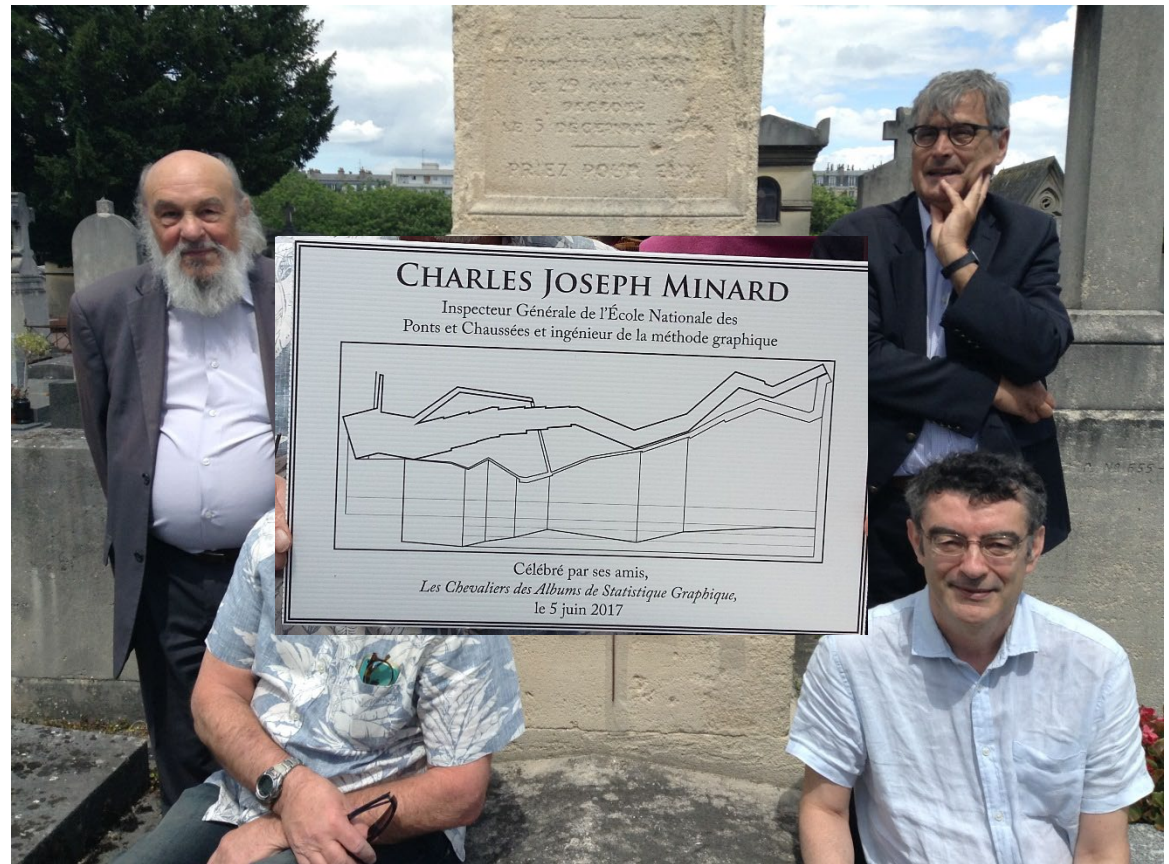
Celebrated June 5, 2017

Celebrate #MinardDay on his birthday, Mar. 27



Jean-Pierre Airey-Jouglard

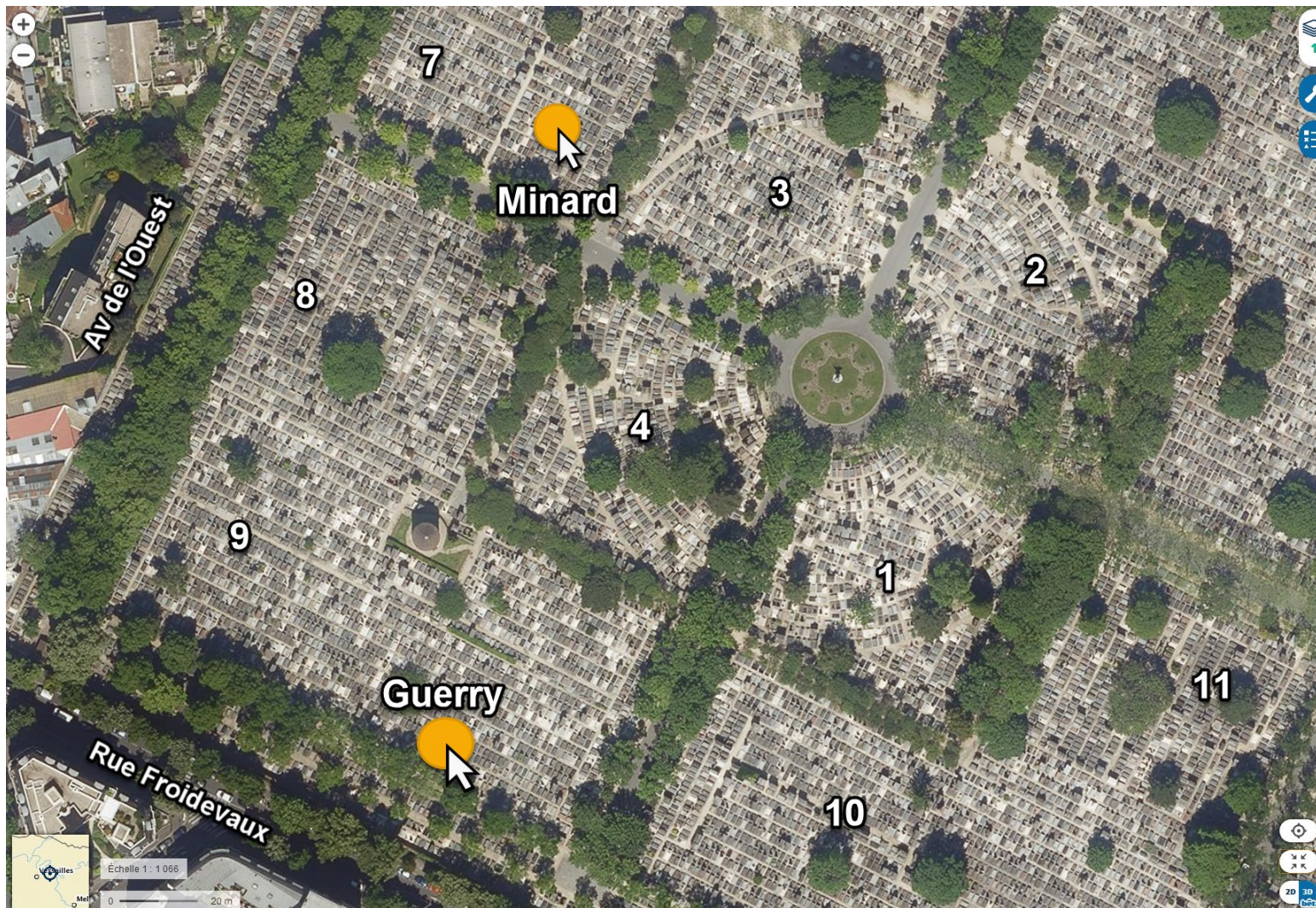
Antoine de Falguerroles



MF

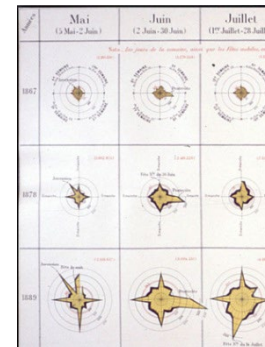
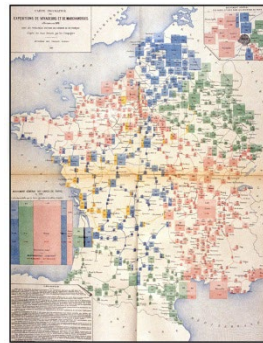
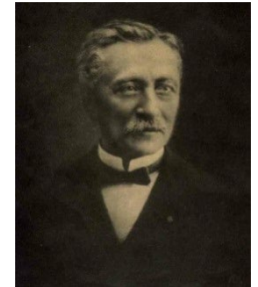
Gilles Palsky

# Minard & Guerry in Montparnasse



# Album de statistique graphique

- Published by the *Statistical Graphics Bureau*, Ministry of Public Works, Émile Cheysson, director
- 18 volumes: 1879-1899, 12—34 plates each, ~ 11"x15" pages
- Graphic forms:
  - Flow maps (simple, double, multi)
  - Pie maps, star, radial, polar time-series, proportional circles
  - Mosaic maps, anamorphic maps, planetary diagrams
  - Choropleth, bi-polar scales
  - Charts: line, bar, time-series
- **Pinnacle of the Golden Age:** exquisite sampler of all known graphic forms!



# ASG now online: David Rumsey

All volumes, <https://www.davidrumsey.com/luna/servlet/s/nl72bu>



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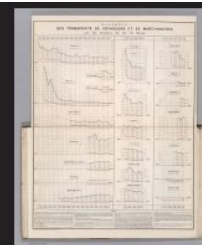
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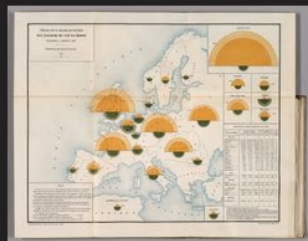
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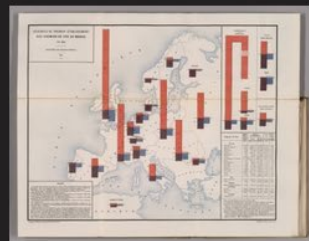
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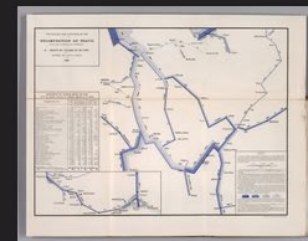
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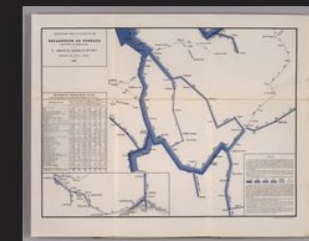
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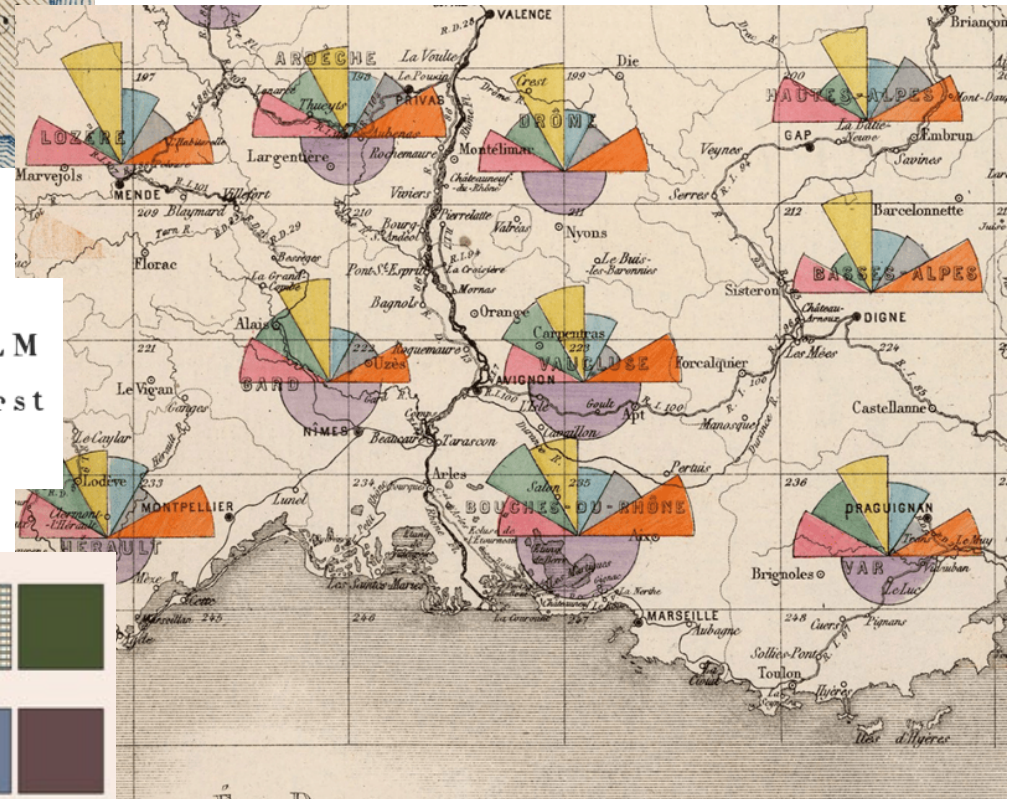
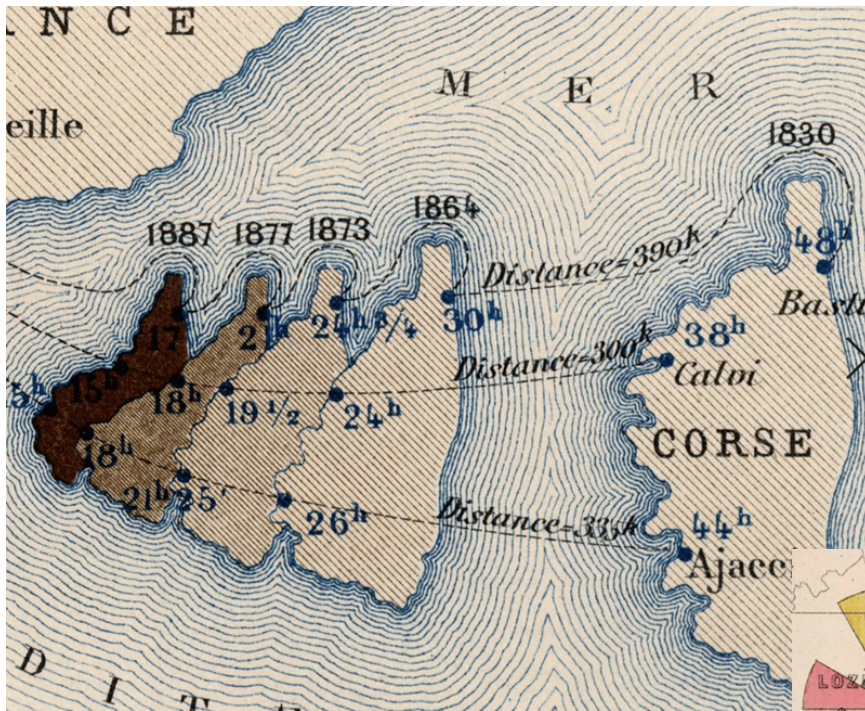
Ministere des Travaux P...  
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# Graphic details

“God is in the details” – Ludwig Mies van der Rohe

Map embeddings;  
hachures; fonts, color palettes, ...



Cheysson Regular

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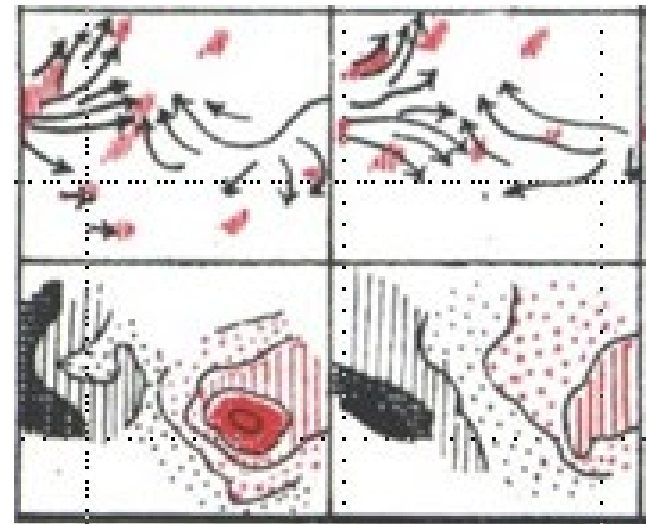
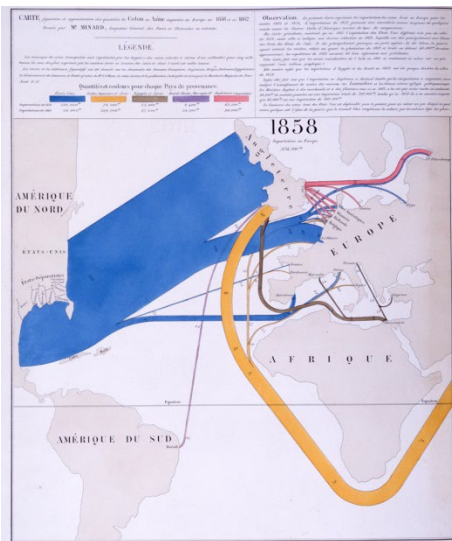
# Text-on-maps

- Maps as **data**?
- New tools for historical analysis?
- What more is needed?



# Golden Lessons

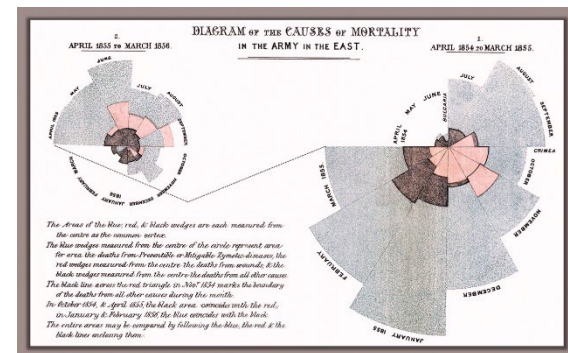
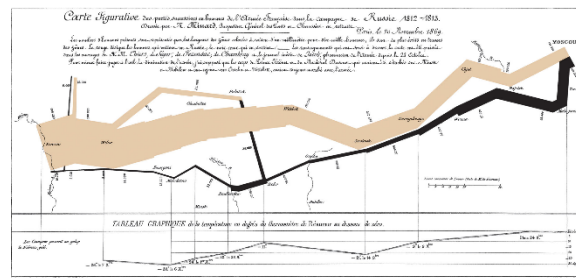
- What are the lessons for the future?
- **Phenomena**, not numbers or simply pretty pictures
  - Playfair, Guerry, Minard, Galton, etc. all developed new graphic forms to show **phenomena** of **deep interest**:
    - balance of trade, rates of crime, patterns in weather data, ...
- **1<sup>st</sup> lesson**: data visualization today should have a similar focus





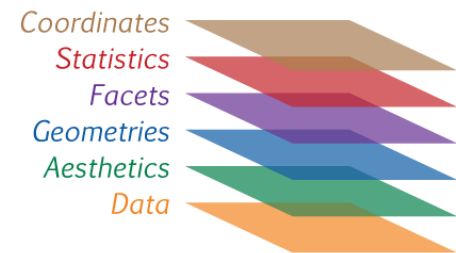
# Golden Lessons: Graphical Impact

- Impact: Early ideas
  - Playfair, Guerry: data should “speak to the eyes”
  - Minard, Lalanne: allow “calculation by the eyes”
  - Nightingale: graphs should speak to the **heart and mind**, influence public policy & practice
- Graphical impact (Tukey, 1990): Interocular traumatic test
  - **Interocularity**: the message hits you between the eyes
  - **Immediacy**: it hits you fast
  - **Inescapability**: it is hard to avoid the message
- **2<sup>nd</sup> lesson**: strive for visual impact in graphs and tables
  - God is in the details



# Golden Lessons: Expressive power

- Hand-made graphics were often beautiful but entailed much sweat and hard work.
- Today: software → ease of use vs. expressive power
- Theories of graphics → graphic “languages”
  - Bertin: *Semiology of graphics*
  - Wilkinson: *Grammar of Graphics*
    - Wickham: *ggplot2* R package, tidyverse
  - In all: the devil is in the details!
- **3<sup>rd</sup> lesson:** continue to reduce the distance between a graphic idea and appearance on screen or paper.



# Conclusions

*The only new thing... is the history you don't know* – Harry Truman

- Dataviz today still has new domains to conquer
- Must remember the deep roots:
  - Cartography
  - Statistical theory
  - Data collection
  - Visual thinking
  - Technology

All combined to give insightful views of data

Each area fed from, and nourished the others
- The Golden Age:
  - Qualitatively distinct, deserves recognition
  - Works of unparalleled beauty & scope
  - Statistical graphics had a ***purpose***: tell a story, inform decision
  - Provides lessons for today and tomorrow

# Thank you!

## Ask me anything

Further info:



<https://datavis.ca>



@datavisFriendly



(Photo mosaic of history of dataviz)