

AL 340

# Information Visualization

February 6, 2014

Bobby L. Smiley

KNOWLEDGE, is either

Natural and Scientifical,  
which is either

OR,

Rational; consisting in the Perception  
of the intrinsick Characters or Ha-  
bitudes of sensible Objects—either

Their Powers and Properties—called PHYSICKS, and NATURAL PHILOSOPHY<sup>6</sup>.  
Abstracts thereof—called METAPHYSICS<sup>7</sup> ONTOLOGY.

which subdivides into PNEUMATOLOGY.

Quantities thereof, called MATHEMATICS—ARITHMETIC<sup>8</sup> whence ANALYTICS<sup>9</sup>.  
which divides, according to the Subject of the Quantity, into ALGEBRA<sup>10</sup>.  
GEOMETRY<sup>11</sup> — whence TRIGONOMETRY.  
STATICS<sup>12</sup>. CONICS.  
SPHERICS.

Relations thereof to our Happiness—called RELIGION, ETHICS<sup>13</sup>, or NATURAL POLITICS<sup>14</sup>.  
or the Doctrine of OFFICES, RELIGION—whence LAW<sup>15</sup>.  
which subdivides into THEOLOGY<sup>16</sup>, or REVELATION.

OR,

Internal; employ'd in discovering their Agreement and Disagreement; or their Relations in respect of Truth—call'd LOGICS<sup>17</sup>.

Further Powers and Properties of Bodies—ALCHEMY.  
called CHYMISTRY<sup>18</sup>—whence NATURAL MAGIC, &c.

OPTICS<sup>19</sup>, CATOPTRICS, PERSPECTIVE<sup>20</sup>.  
DIOPTRICS—whence PAINTING<sup>21</sup>.  
PHONICS—whence MUSICK<sup>22</sup>.  
HYDROSTATICS<sup>23</sup>, HYDRAULICS.  
PNEUMATICS<sup>24</sup>.

Quantities of Bodies—ARCHITECTURE<sup>26</sup>.  
call'd MIX'D MATHEMATICS; which according to the different Subjects resolves into SCULPTURE<sup>27</sup>.  
MECHANICS<sup>25</sup>—whence TRADES<sup>28</sup>, and MANUFACTURES.  
PYROTECHNIA<sup>29</sup>—whence The MILITARY Art<sup>30</sup>.  
ASTRONOMY<sup>32</sup>—whence FORTIFICATION<sup>31</sup>.  
GEOGRAPHY<sup>35</sup>, HYDROGRAPHY—whence CHRONOLOGY<sup>33</sup>.  
STRUCTURE and Oeconomy of Organical Bodies—called ANATOMY<sup>38</sup>. NAVIGATION<sup>36</sup>.  
DIALLING<sup>34</sup>.  
COMMERCE<sup>37</sup>.

Relations thereof to the Preservation and Improvement—either of Animals—called MEDICINE<sup>39</sup>.  
Vegetables—called AGRICULTURE<sup>41</sup>.  
Brutes—called FARRYING<sup>43</sup>, MANAGE—whence HUNTING.  
GARDENING<sup>42</sup>.  
FALCONRY.  
FISHING, &c.

Artificial and Technical,  
(consisting in the Application of Natural Notices to further Purposes)  
which is either

OR,

Real, employ'd in discovering and applying the—

call'd MIX'D MATHEMATICS; which according to the different Subjects resolves into

Structure and Oeconomy

of Organical Bodies

—called ANATOMY<sup>38</sup>.

External,  
which is either—

OR,

Relations thereof to the Preservation and Improvement—either of

Words, or Articulate Signs of Ideas—called GRAMMAR<sup>44</sup>.

Figures—called RHETORIC<sup>45</sup>—whence The making of Armories, called

HERALDRY<sup>46</sup>.

Fables—called POETRY<sup>47</sup>.

Symbolical, em-

ploy'd in framing

# Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812 ~ 1813.

Dessinée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour six mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie; le noir ceux qui en sortent. — Les renseignements qui ont servi à desser la carte ont été puisés dans les ouvrages de M. M. Chier, de Léger, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow et se rejoignaient vers Orsha en Witelok, avaient toujours marché avec l'armée.

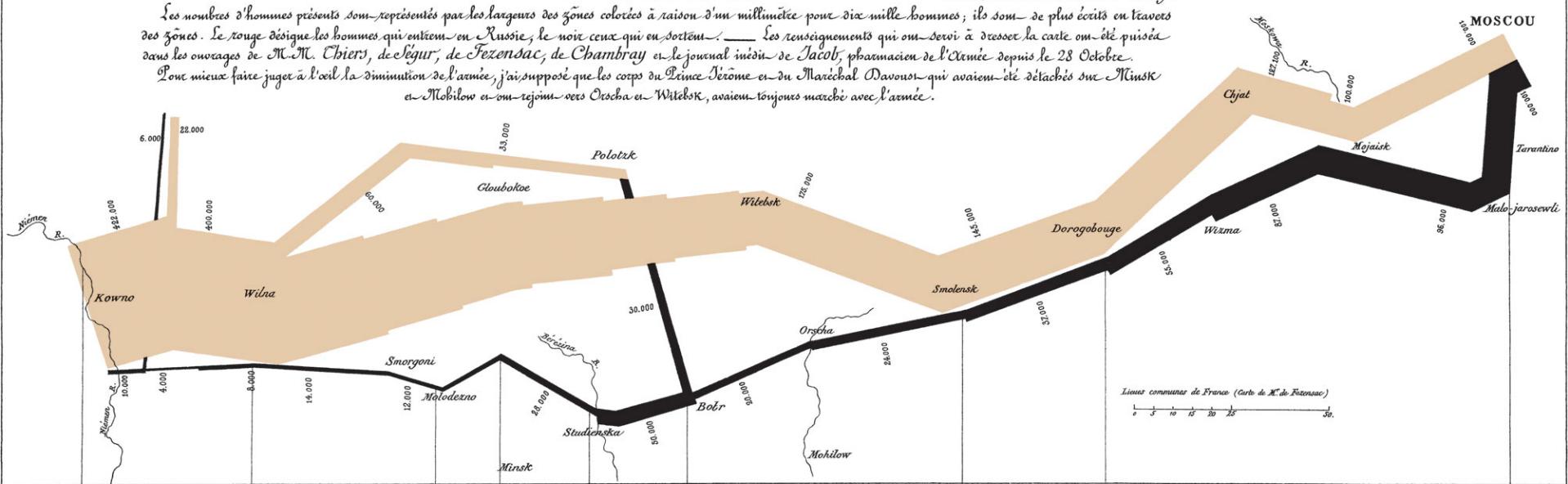


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Cosaques passent au galop  
le Niemen, gelé.

— 26° le 7 X.<sup>bre</sup>  
— 30° le 6 X.<sup>bre</sup>

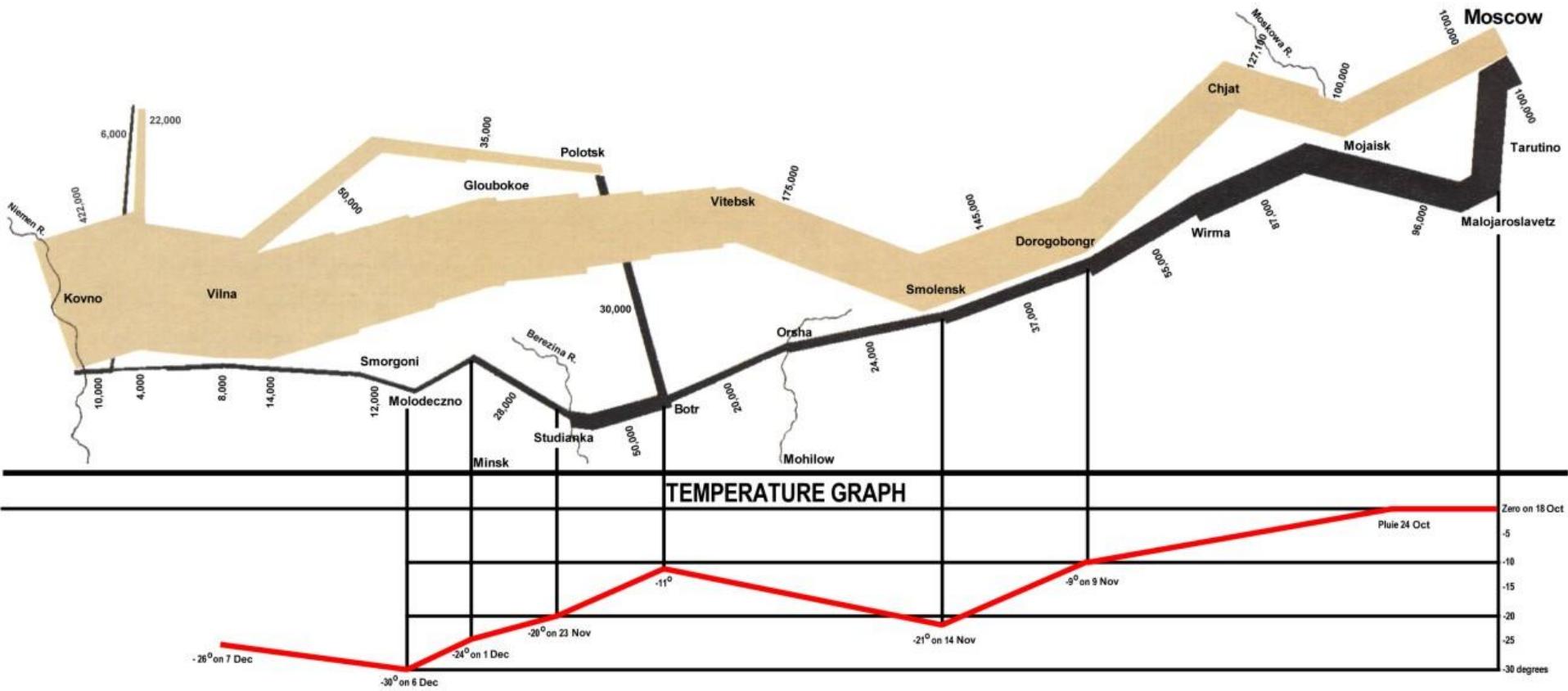
— 24° le 1<sup>er</sup> X.<sup>bre</sup>  
— 20° le 28 9.<sup>bre</sup>

— 11°

— 21° le 14 9.<sup>bre</sup>

— 9° le 9 9.<sup>bre</sup>

Zéro le 18<sup>bre</sup>.  
Pluie 24 8.  
10  
15  
20  
25  
30 degrés



# Class outline

1. What?
2. Wherfore?
3. Whence?
4. What again?
5. How?

# Class outline

1. What? (Definitions)
2. Wherfore?
3. Whence?
4. What again?
5. How?

# Definitions

“use of **abstract**, non-representational **pictures to show numbers**”  
Tufte, *The Visual Display of Quantitative Information* (1983)

“the use of computer-supported, **interactive**, **visual representations of abstract data** to **amplify cognition**” Card, Mackinlay, Shneidermann,  
*Readings in Information Visualization* (1999)

# Information visualization?

or

# Data visualization?

# Information visualization?

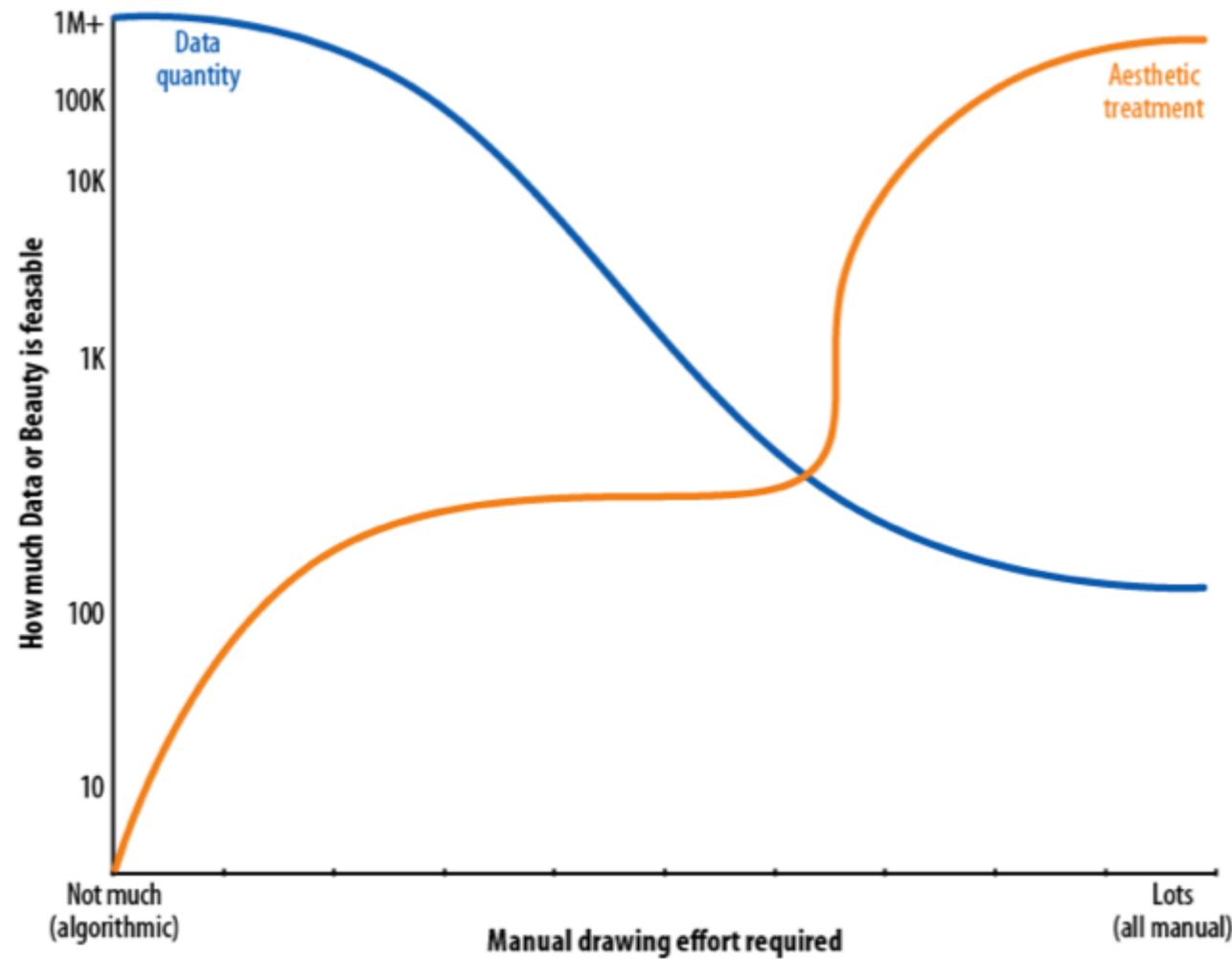
yes?

# Data visualization?

# Data/Information visualization?

But?

Infographics



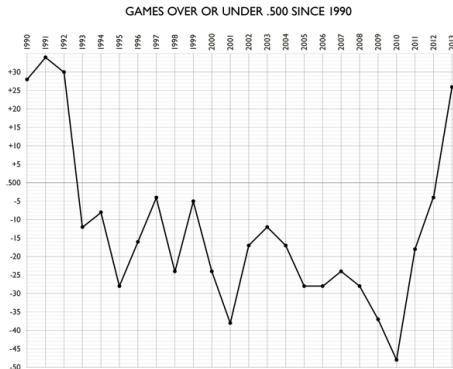
# Data/Information visualization?

Oh, there's the difference

Infographics

# PITTSBURGH PIRATES

## NOT LOSERS ANYMORE



In 1990, the Pirates won 95 games, finished first in the NL East, and had the best record in the National League. They lost the NLCS 4-2 to the Cincinnati Reds, the eventual World Series winners.

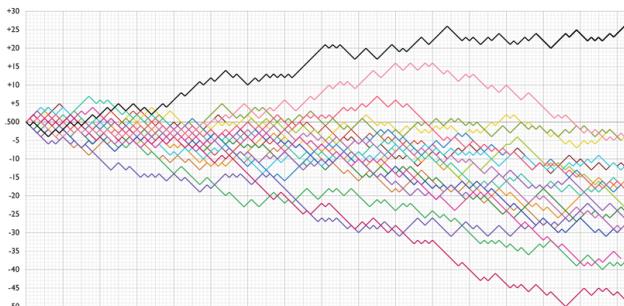
In 1991, the Pirates won 98 games, and had the best record in baseball. They lost the NLCS 4-3 to the Atlanta Braves.

In 1992, the Pirates won 96 games, won the NL East, and had the third best record in baseball. Again, they lost the NLCS 4-3 to the Atlanta Braves.

The Pirates then had 20 losing seasons.

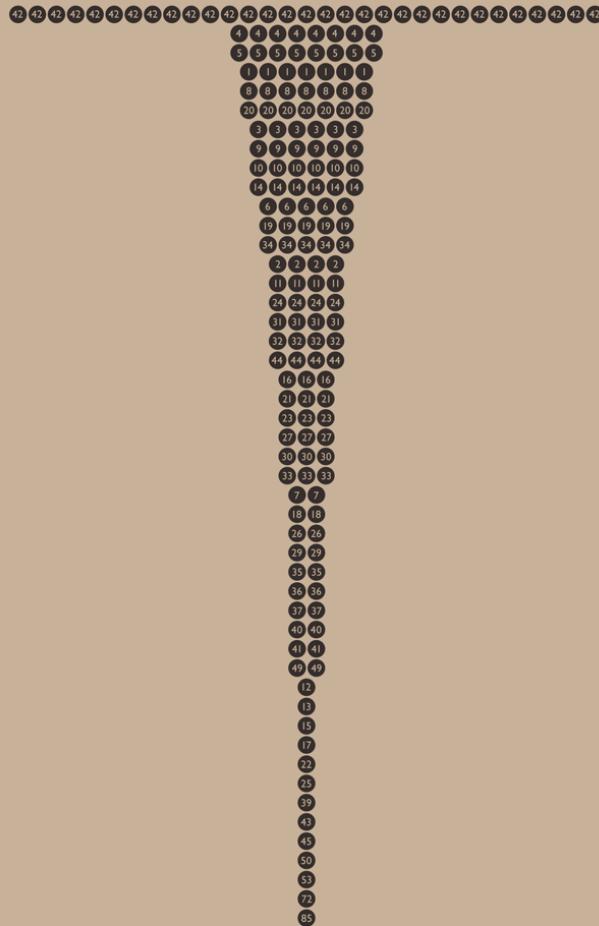
In 2013, the Pirates won 94 games, 26 games over .500. They won the Wild Card game and lost 3-2 in the NLDS to the Cardinals.

Here is a chart showing the number of games over or under .500 for every game of the last 21 seasons.

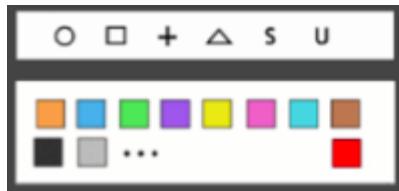


Here are the above seasons individually

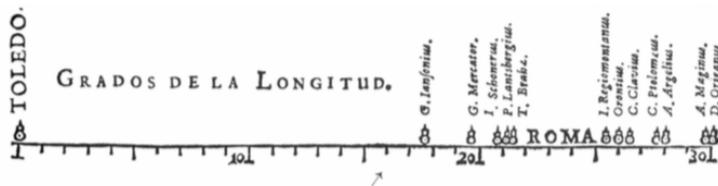
## RETIRED NUMBERS



# Data Types



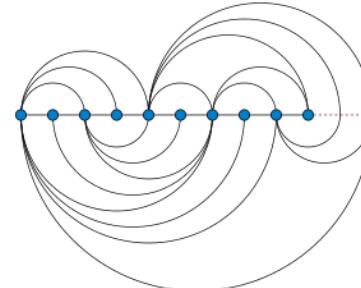
nominal



quantitative



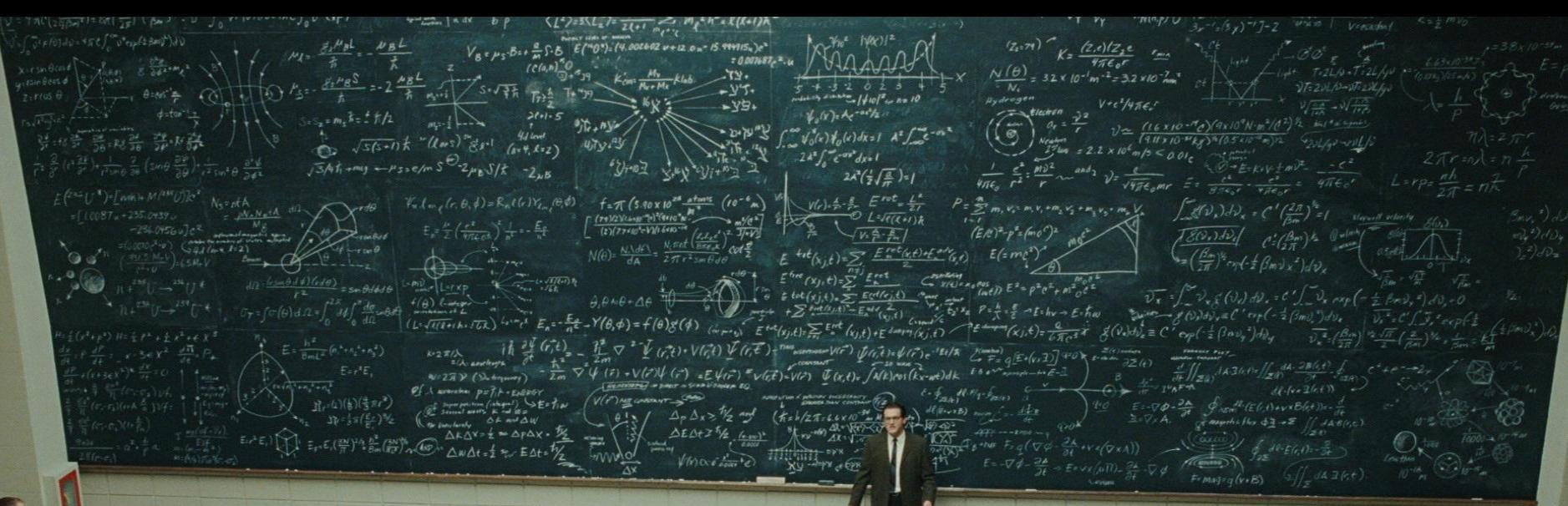
ordinal



relational

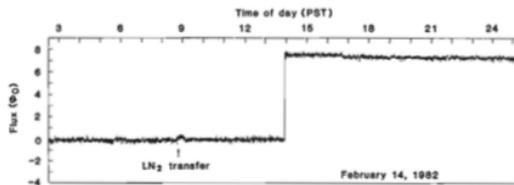
# Class outline

1. What?
2. Wherfore? (why visualize?)
3. Whence?
4. What again?
5. How?

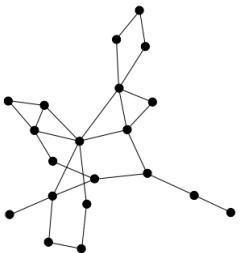


# wherfore

## Analytic



## Exploratory

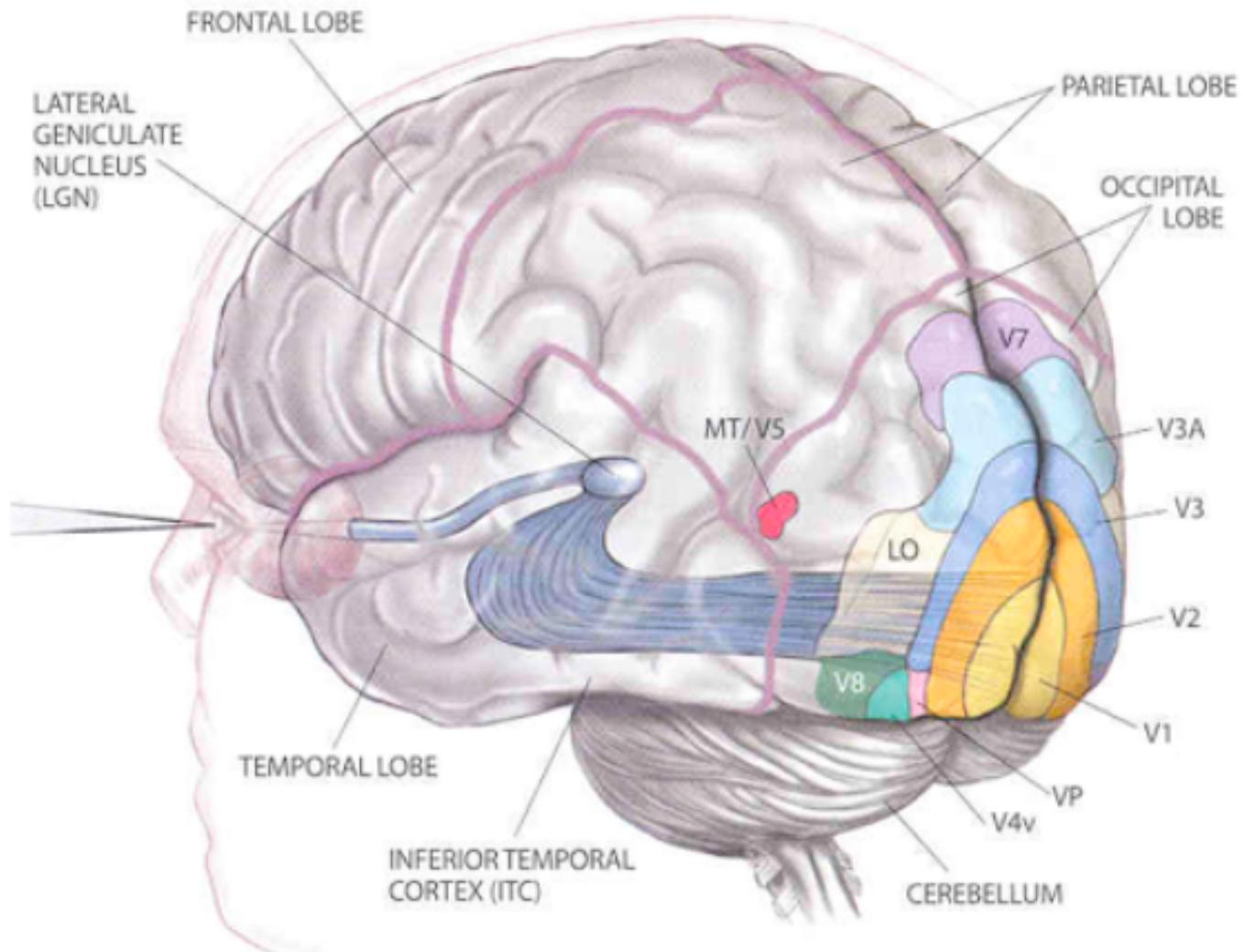


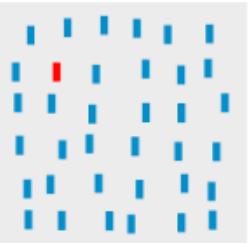
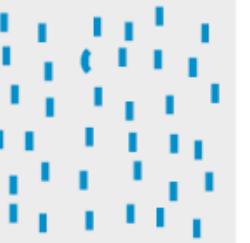
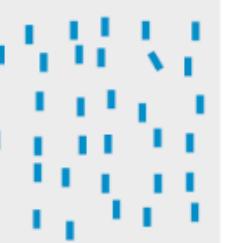
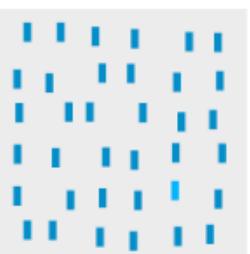
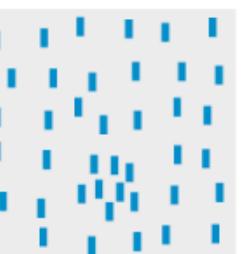
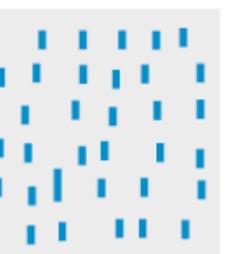
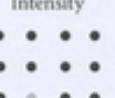
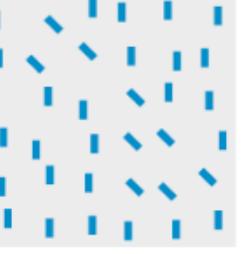
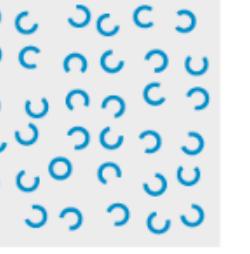
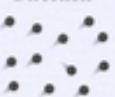
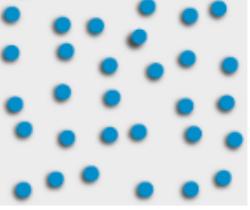
## Casual

“Casual Information Visualization,” Pousman, Stasko, Mateas, (1999)

# Class outline

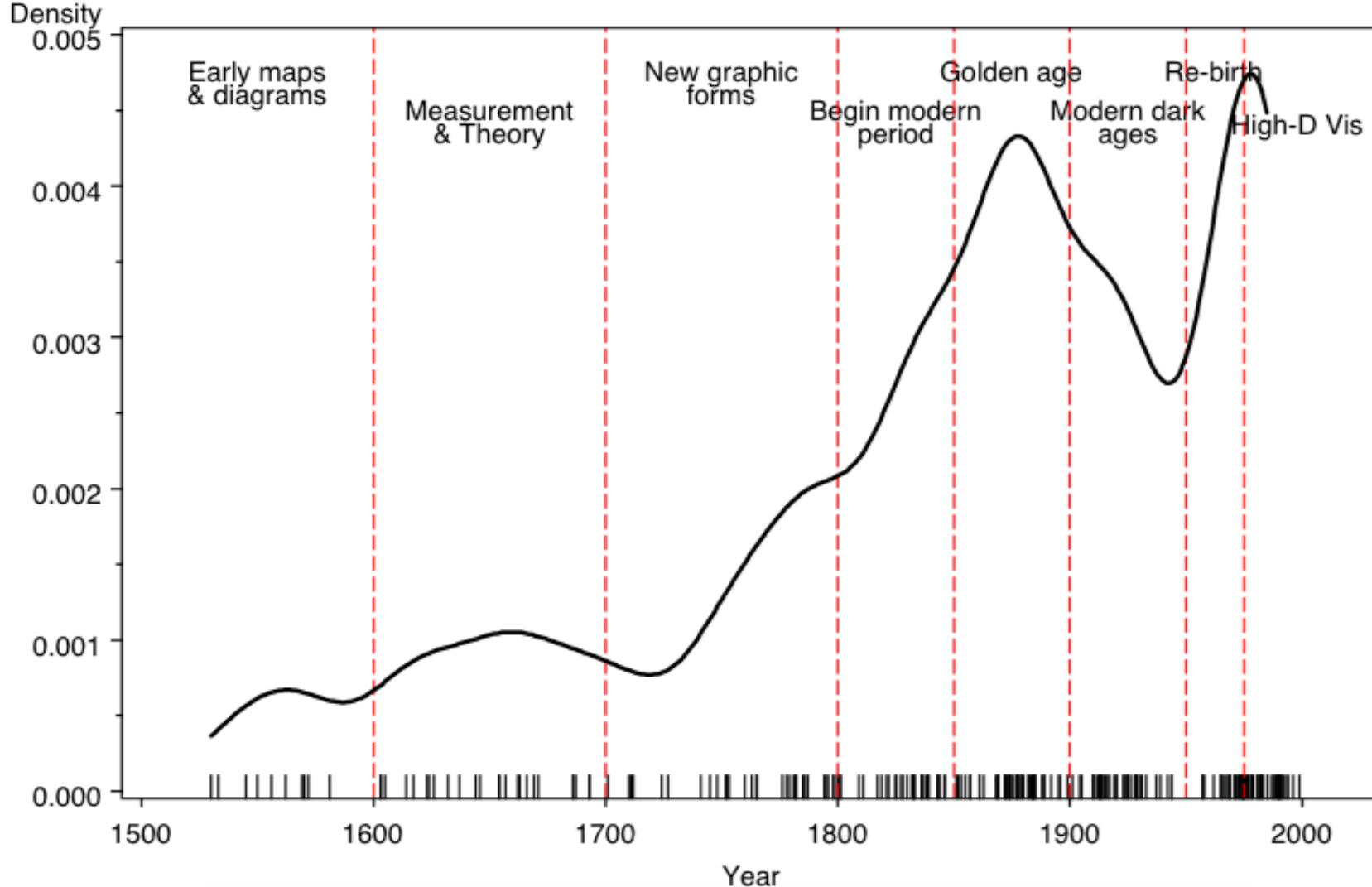
1. What?
2. Wherfore?
3. Whence? (Of Brains & Backstories)
4. What again?
5. How?

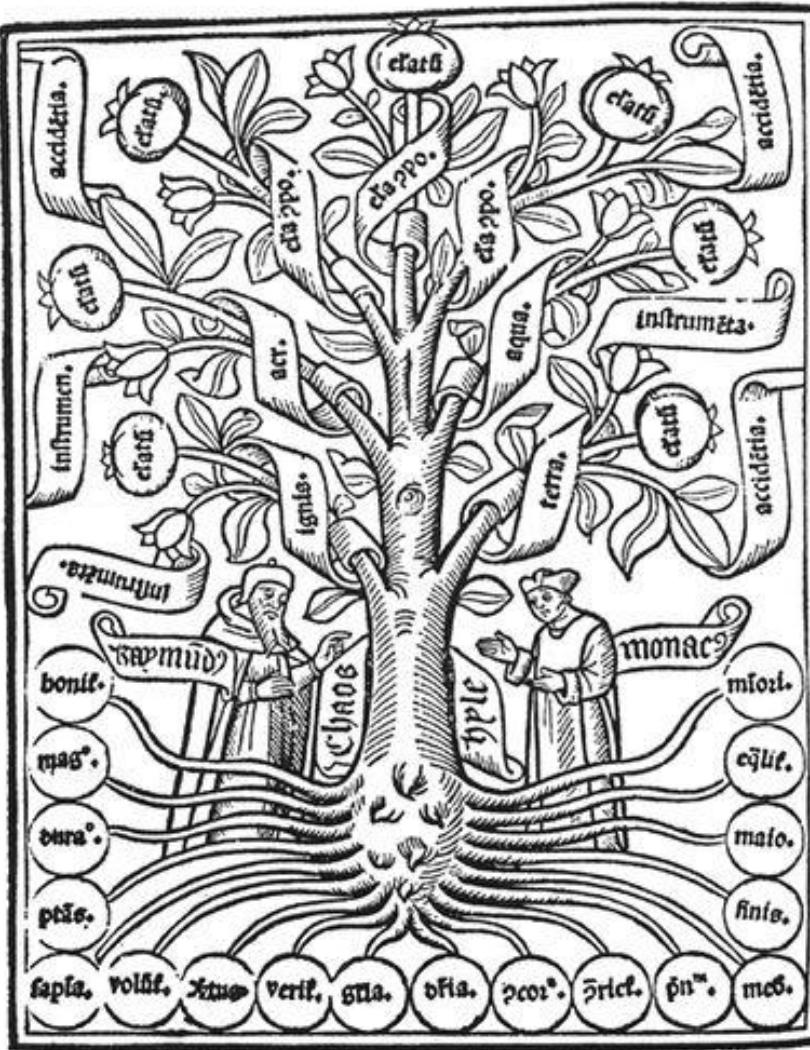
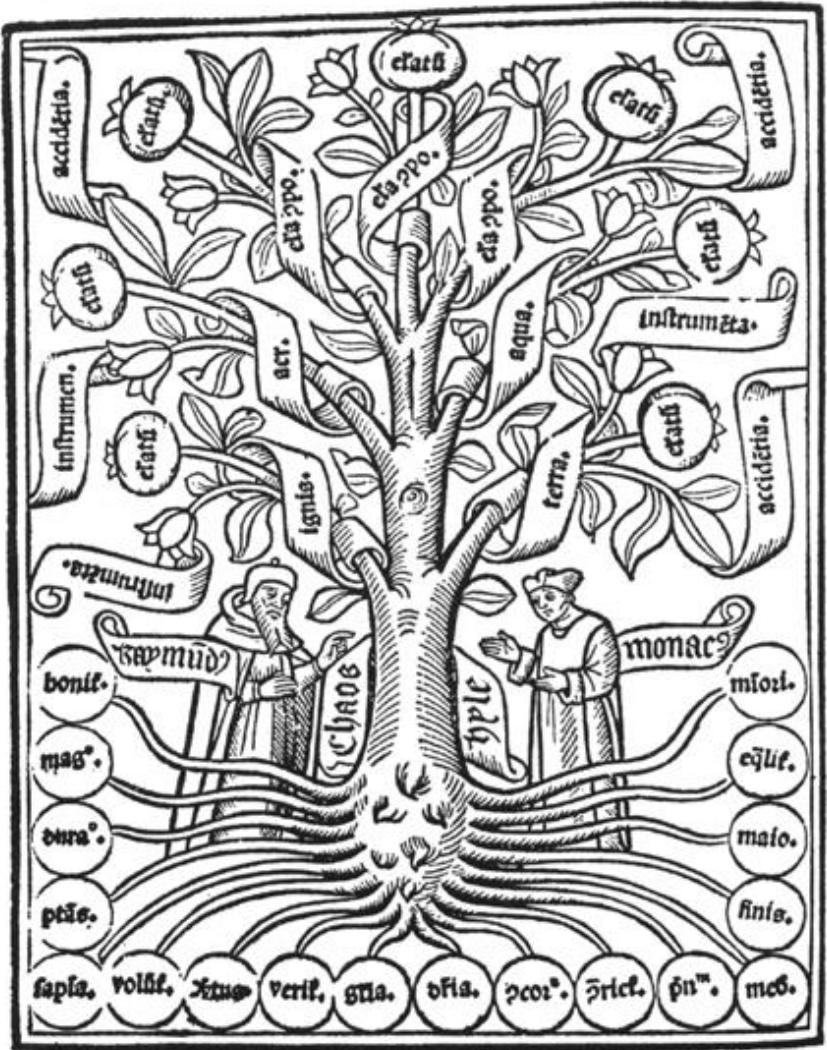


Group	Attribute			
Form	Length 	Width 	Orientation 	  
	Size 	Shape 	Curvature 	  
	Enclosure 	Blur 		
Color	Hue 	Intensity 		  
Spatial Position	2-D Position 	Spatial Grouping 		  
Motion	Direction 			  

# a short history

# Back in the 2nd century C.E. ...





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

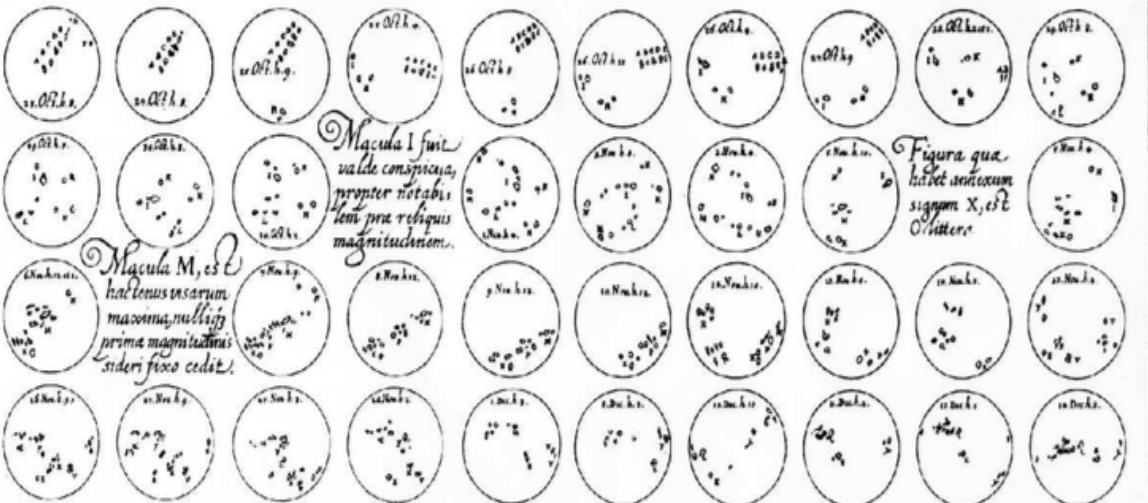
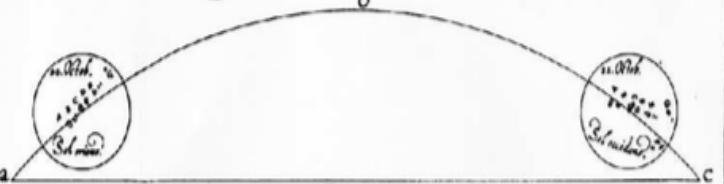
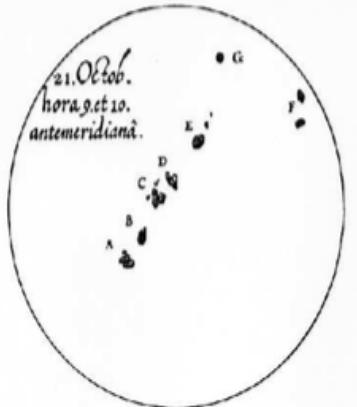
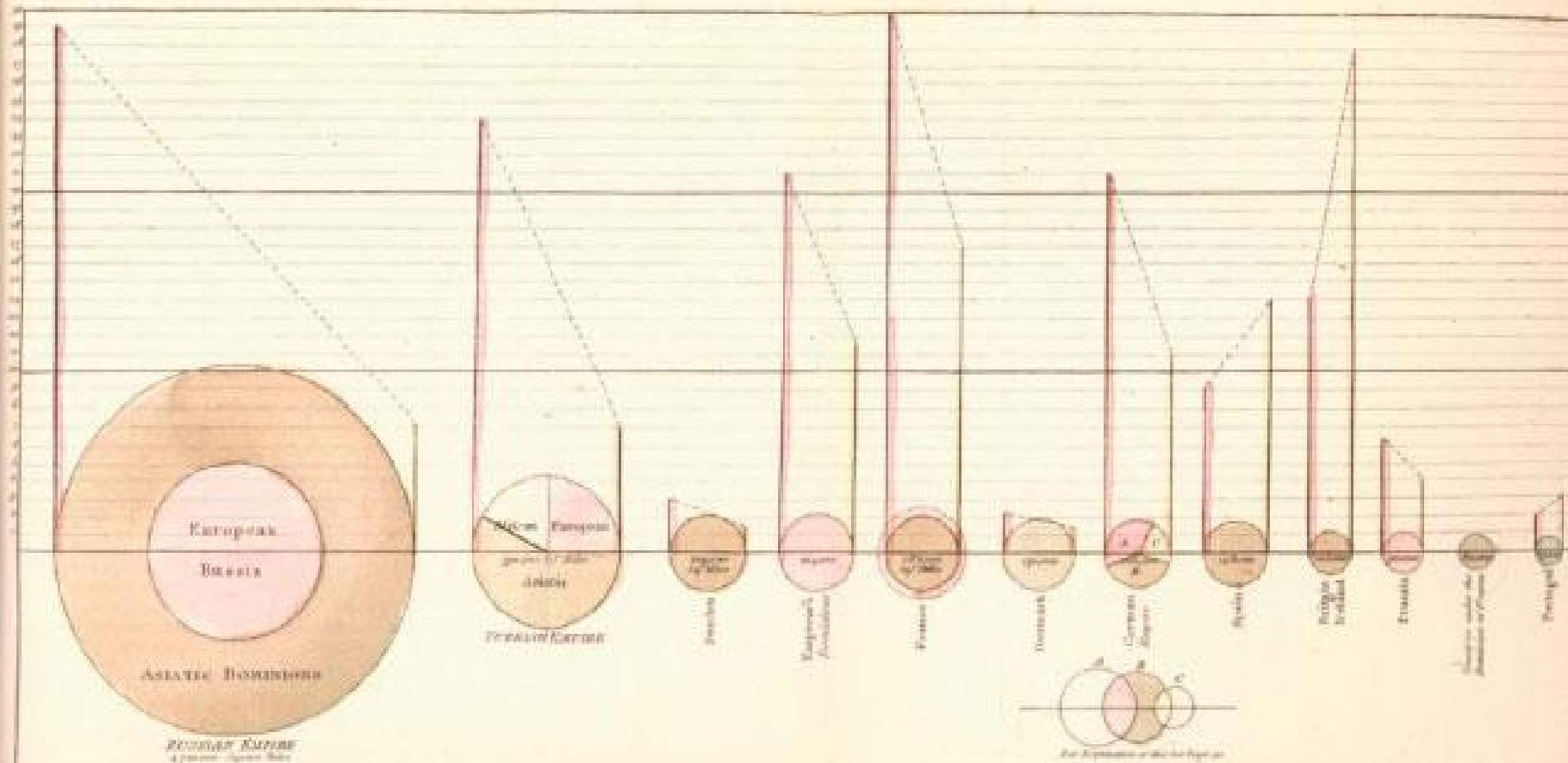
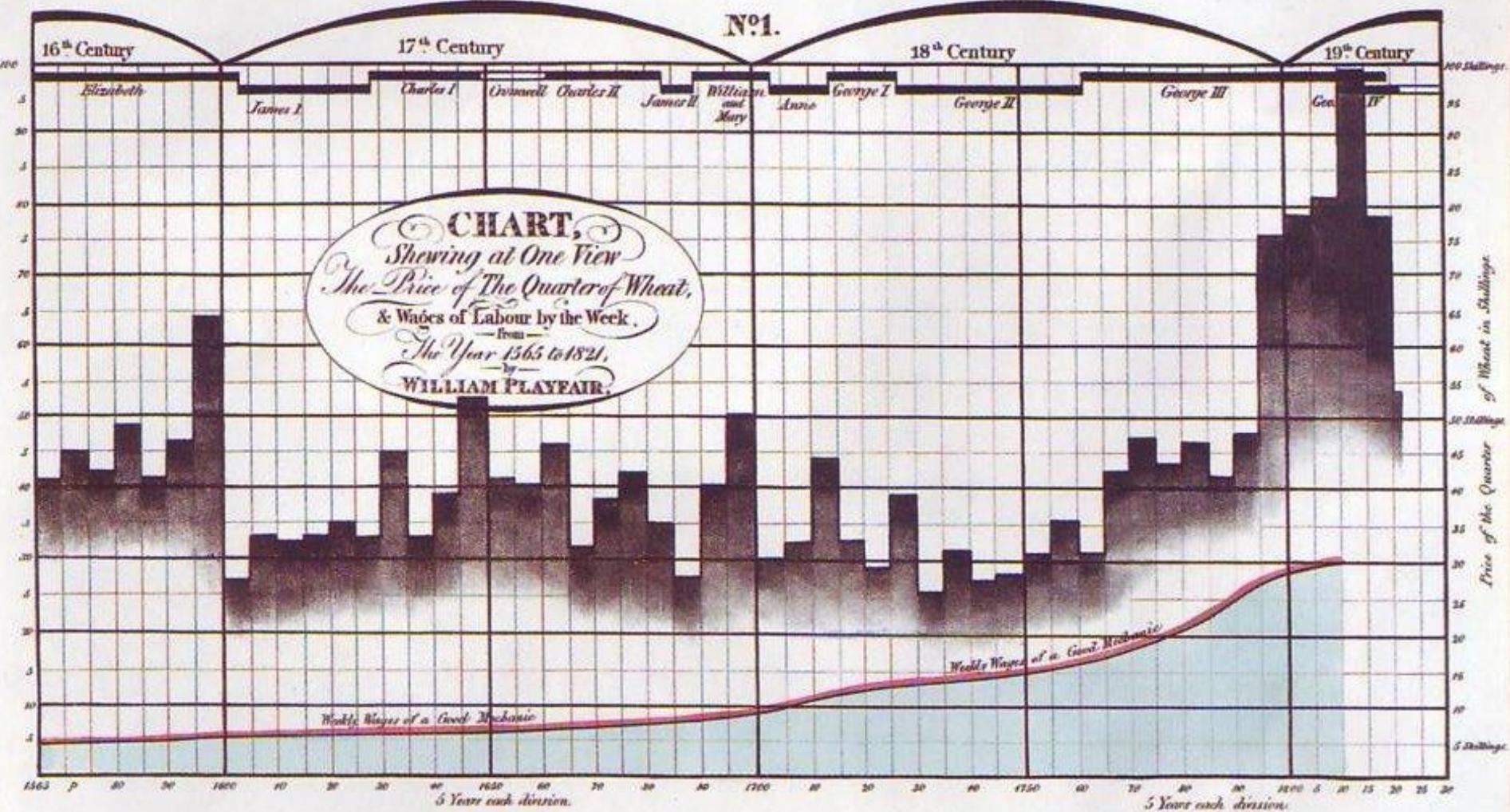
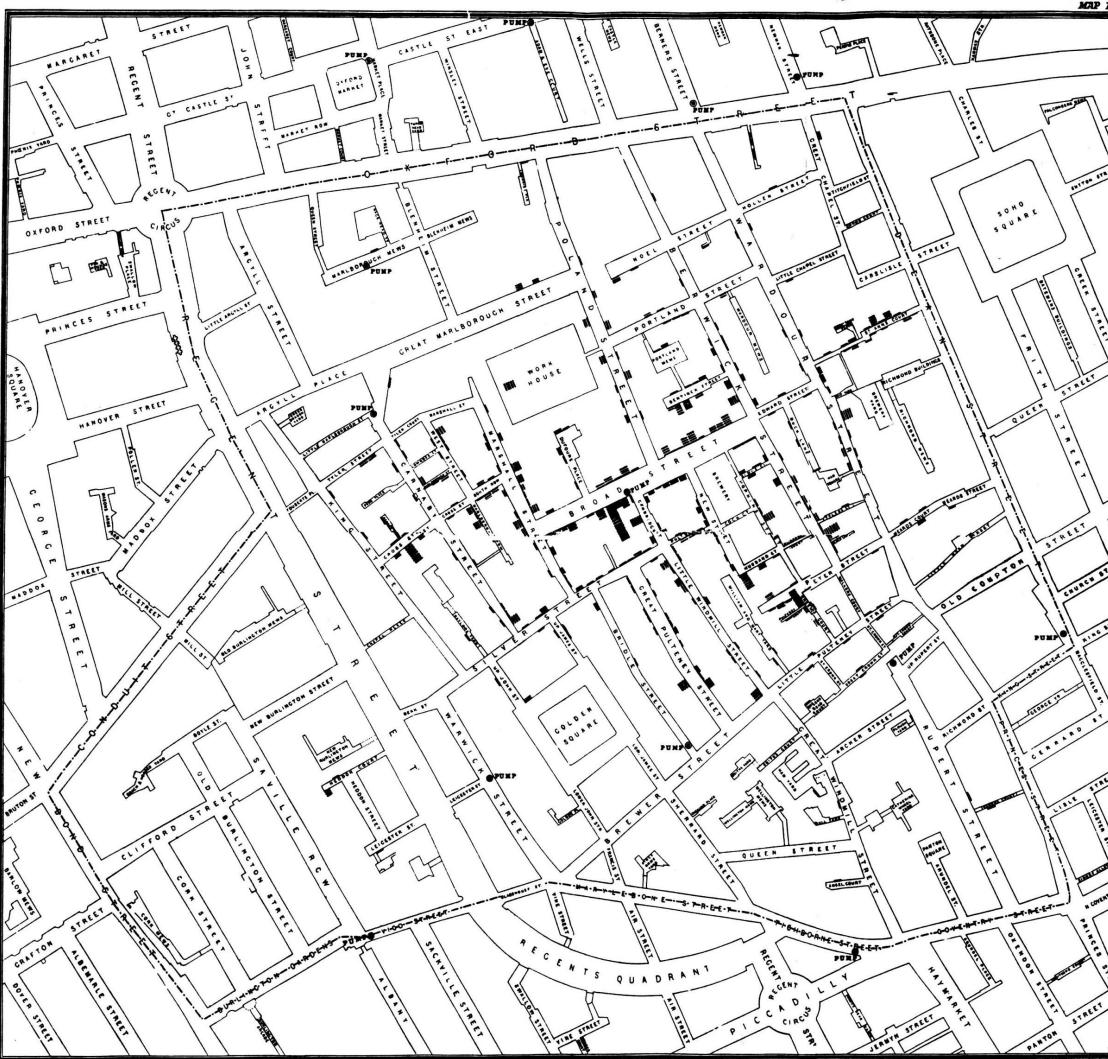


CHART Representing the EXTENT, POPULATION & REVENUES, of the PRINCIPAL NATIONS in EUROPE, after the DIVISION of POLAND by TREATY of LUNEVILLE.



Nº1.

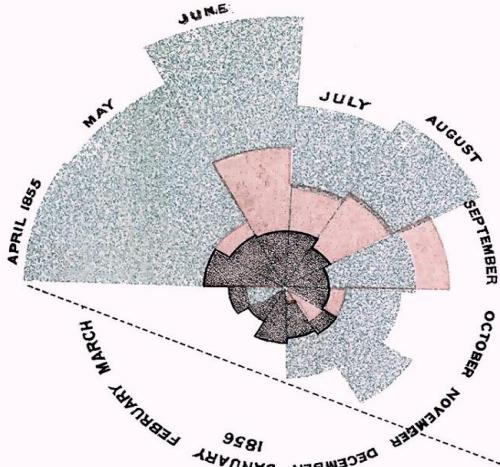




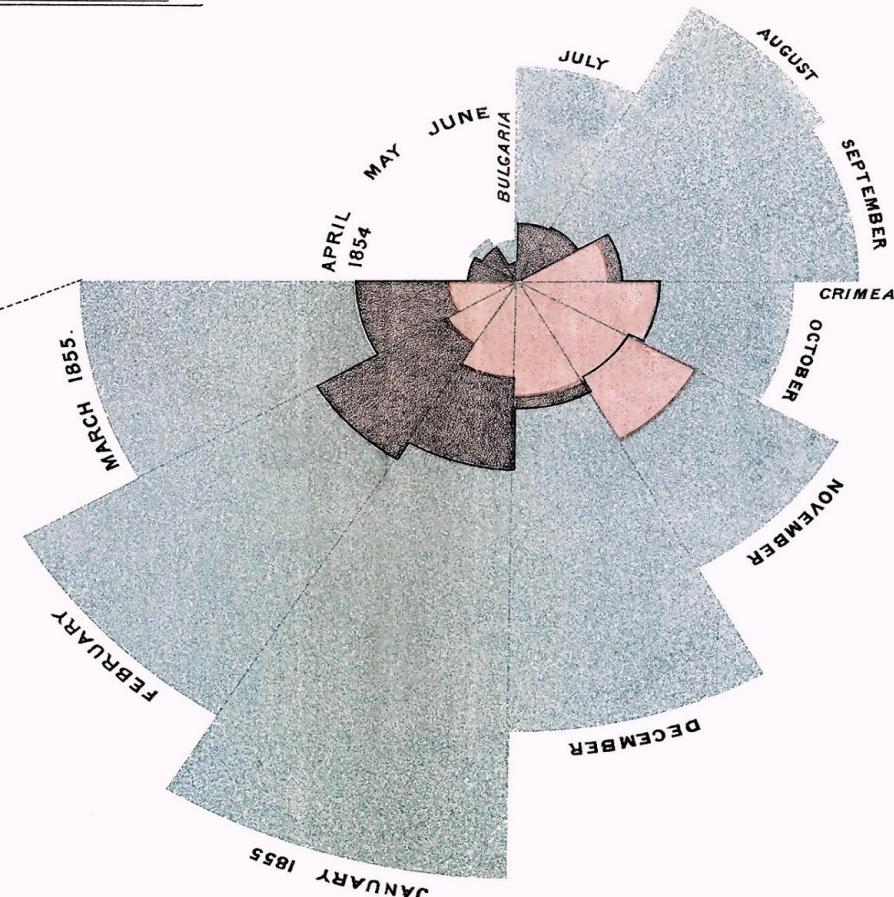


2.  
APRIL 1855 TO MARCH 1856.

DIAGRAM OF THE CAUSES OF MORTALITY  
IN THE ARMY IN THE EAST.



1.  
APRIL 1854 TO MARCH 1855.



The Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.

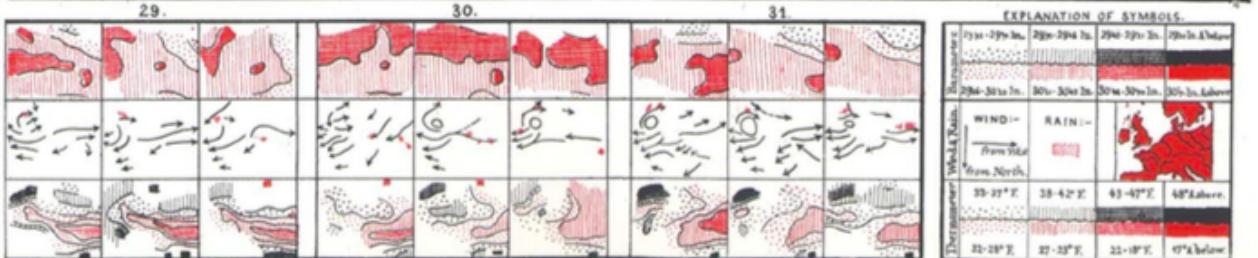
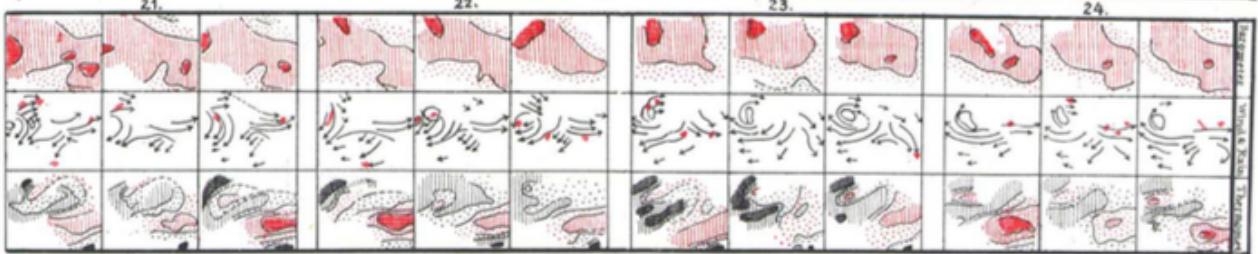
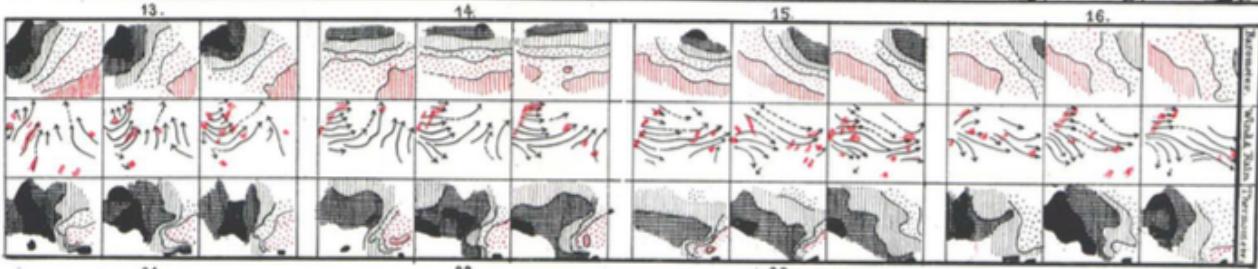
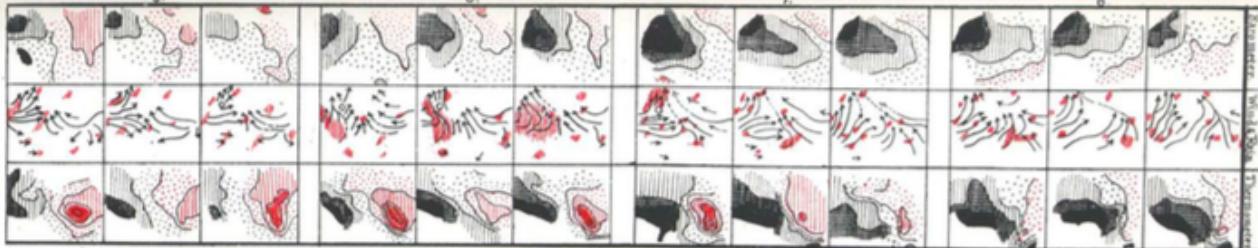
The blue wedges measured from the centre of the circle represent area for area the deaths from Preventible or Mitigable Zymotic diseases; the red wedges measured from the centre the deaths from wounds; & the black wedges measured from the centre the deaths from all other causes.

The black line across the red triangle in Nov<sup>r</sup> 1854 marks the boundary of the deaths from all other causes during the month.

In October 1854, & April 1855, the black area coincides with the red; in January & February 1855, the blue coincides with the black.

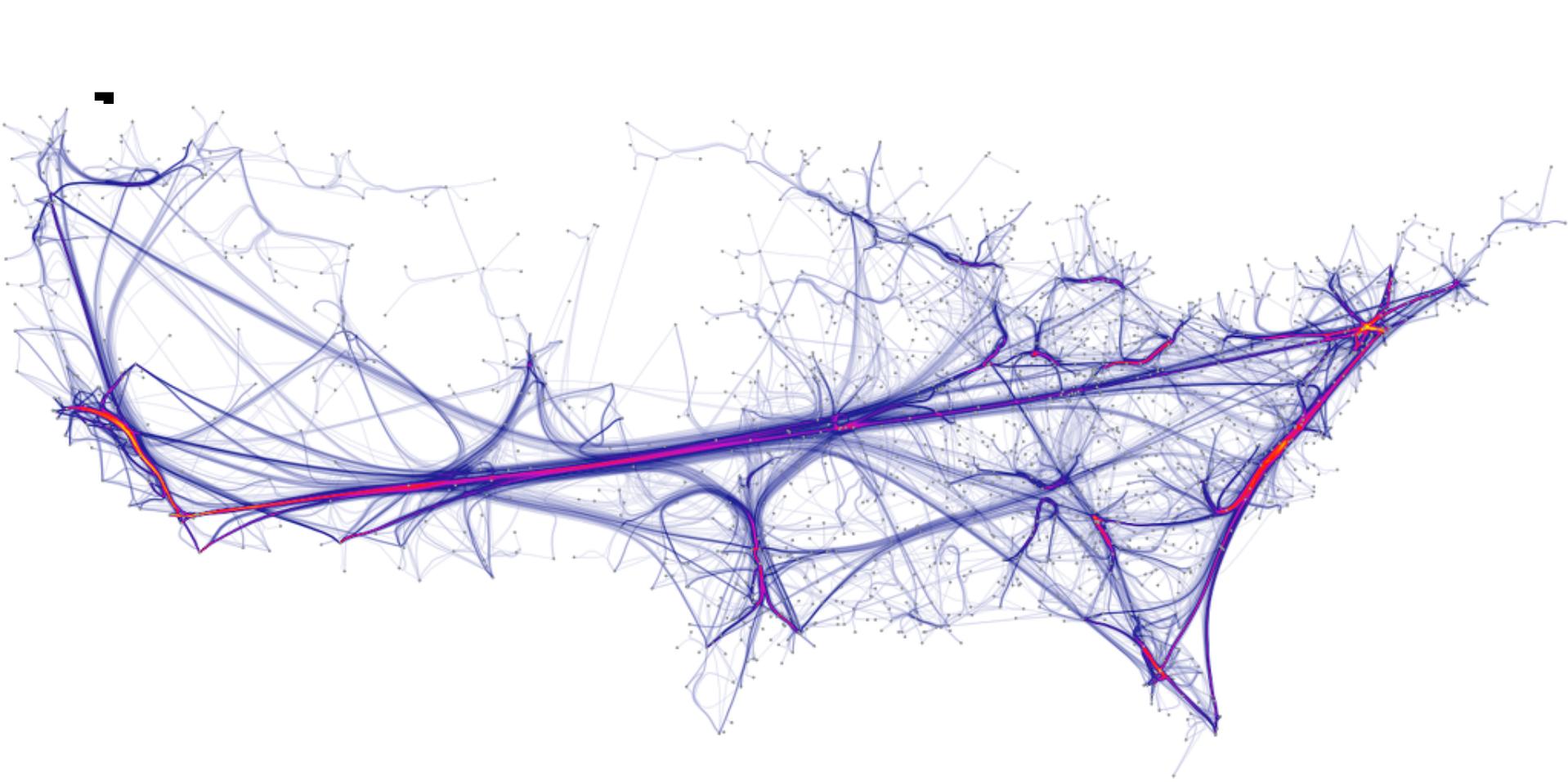
The entire areas may be compared by following the blue, the red & the black lines enclosing them.

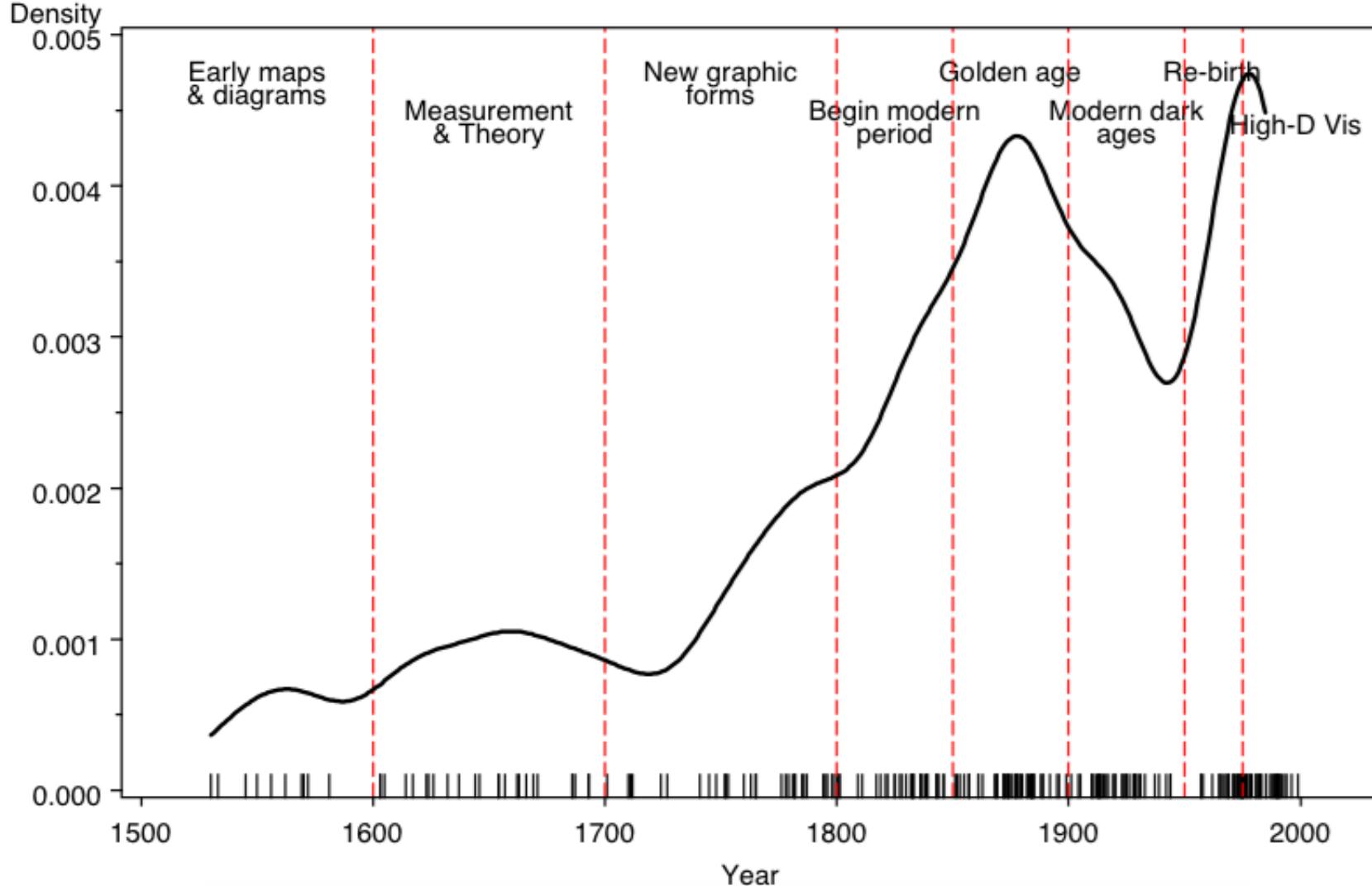
AFTERNOON AND EVENING ON EACH DAY DURING DECEMBER, 1861.



EXPLANATION OF SYMBOLS.

23°-29°, 29°-34°, 34°-39°, 39° above	29°-34°, 34°-39°, 39° above
Wind:-	Rain:-
From Land	Red dot
From North	Black dot
39-23° E.	23-42° E.
43-47° E.	48° E. Lat.
Thermometer, Whole Scale.	
23-28° F.	27-32° F.
32-36° F.	22-28° F.
47° & below	47° & below





# Class outline

1. What?
2. Wherfore?
3. Whence?
4. **What again? (Types)**
5. How?

# Types of visualizations

Time-Series

Statistical

Maps

Relational

# Types of visualizations

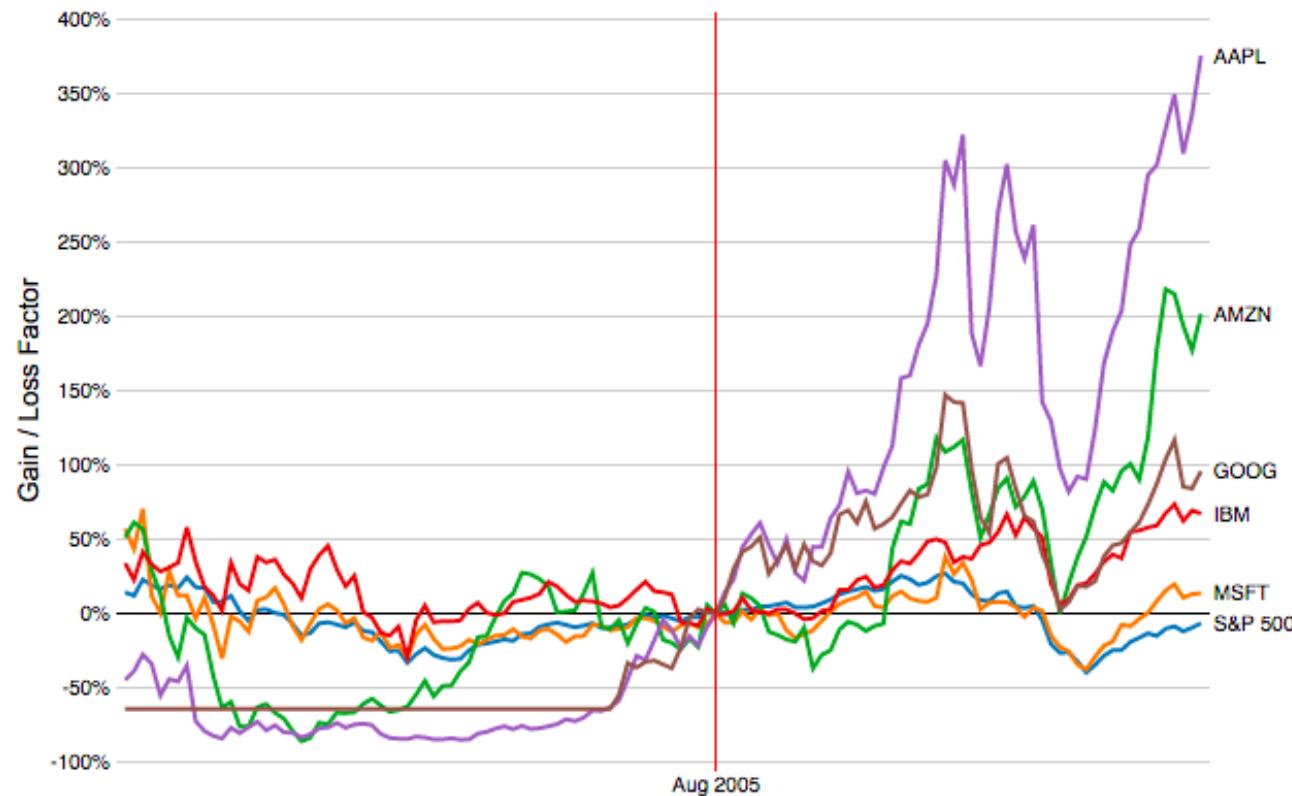
**Time-Series** (trends, co/variability, change rate, cycles, exceptions)

Statistical

Maps

Relational

## Index Chart of Selected Technology Stocks, 2000-2010





Agriculture



Business services



Construction



Education and Health



Finance



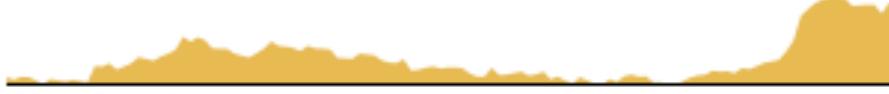
Government



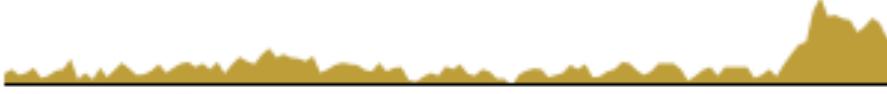
Information



Leisure and hospitality



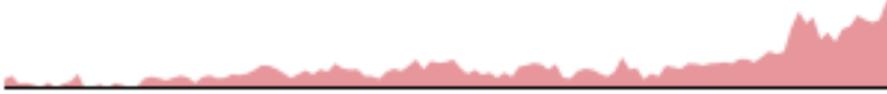
Manufacturing



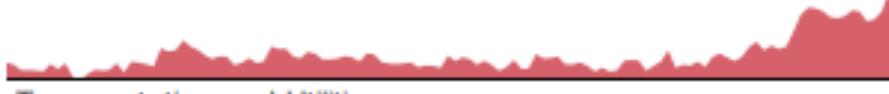
Mining and Extraction



Other



Self-employed



Transportation and Utilities



Wholesale and Retail Trade

# Types of visualizations

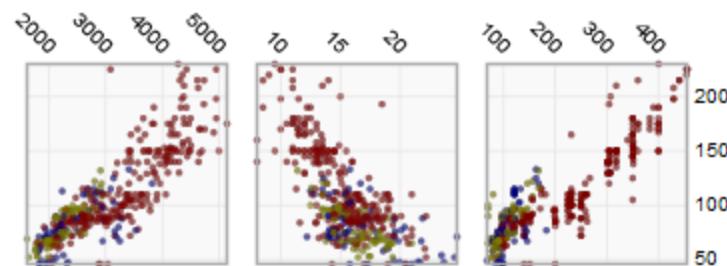
Time-Series

**Statistical** (central tendency, part-to-whole, deviation, uniformity)

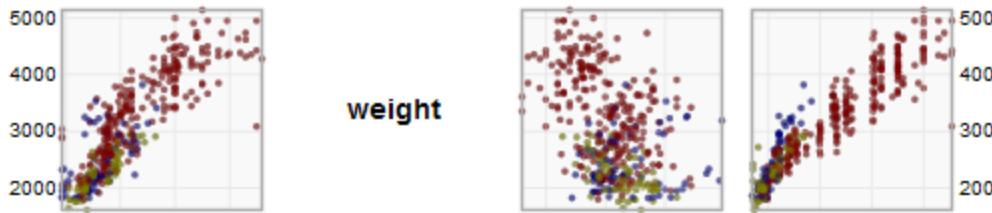
Maps

Relation

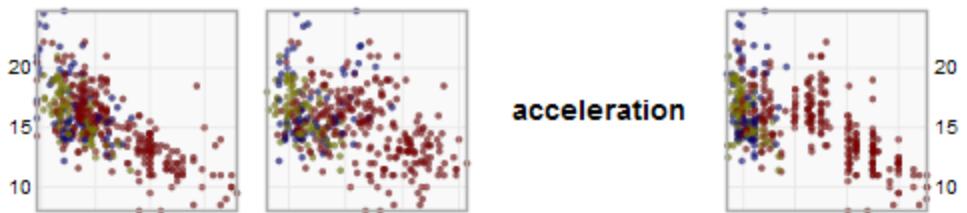
**horsepower**



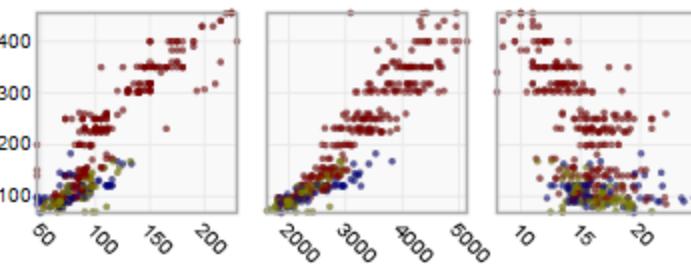
**weight**



**acceleration**



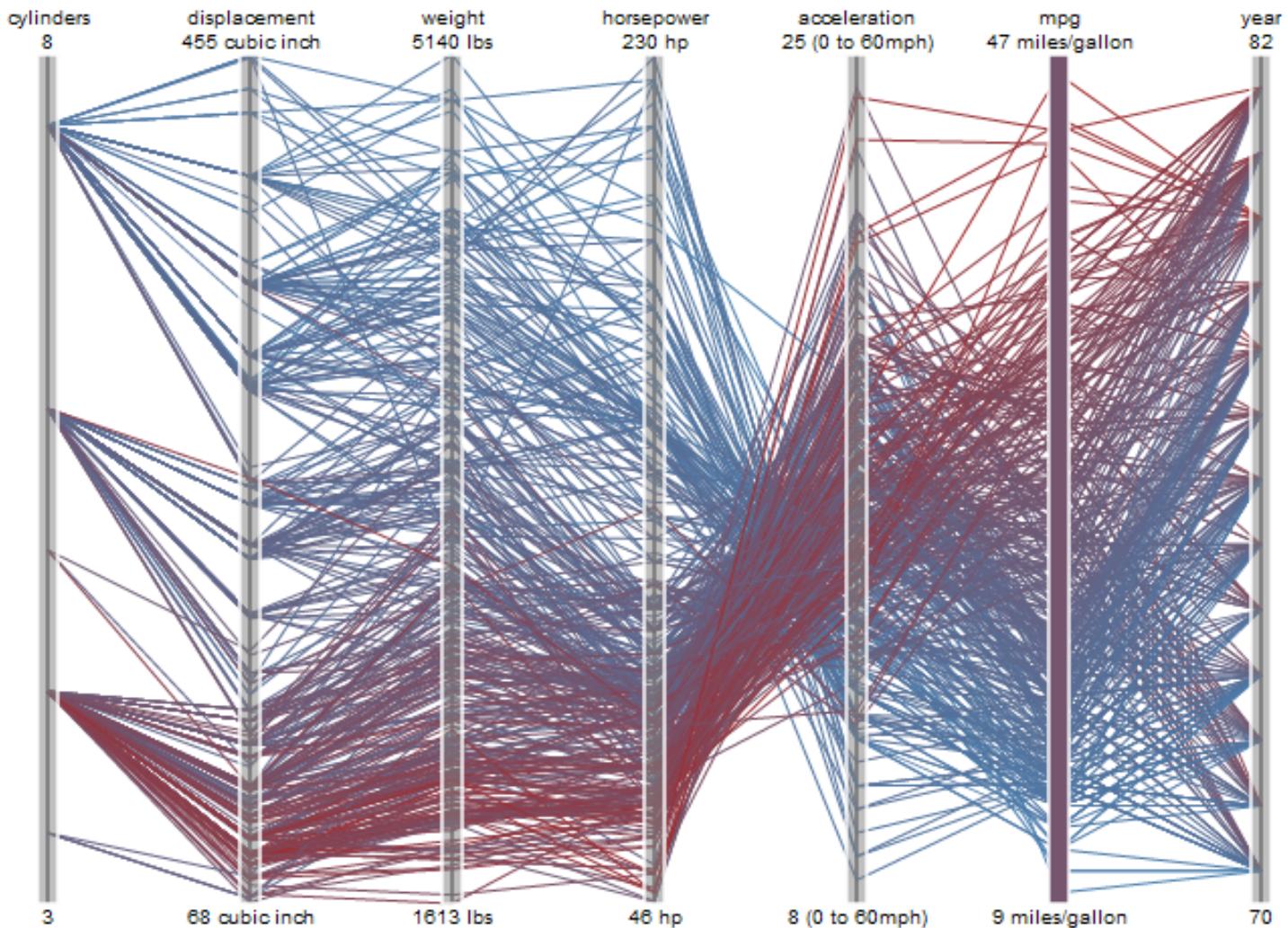
**displacement**



● United States

● European Union

● Japan



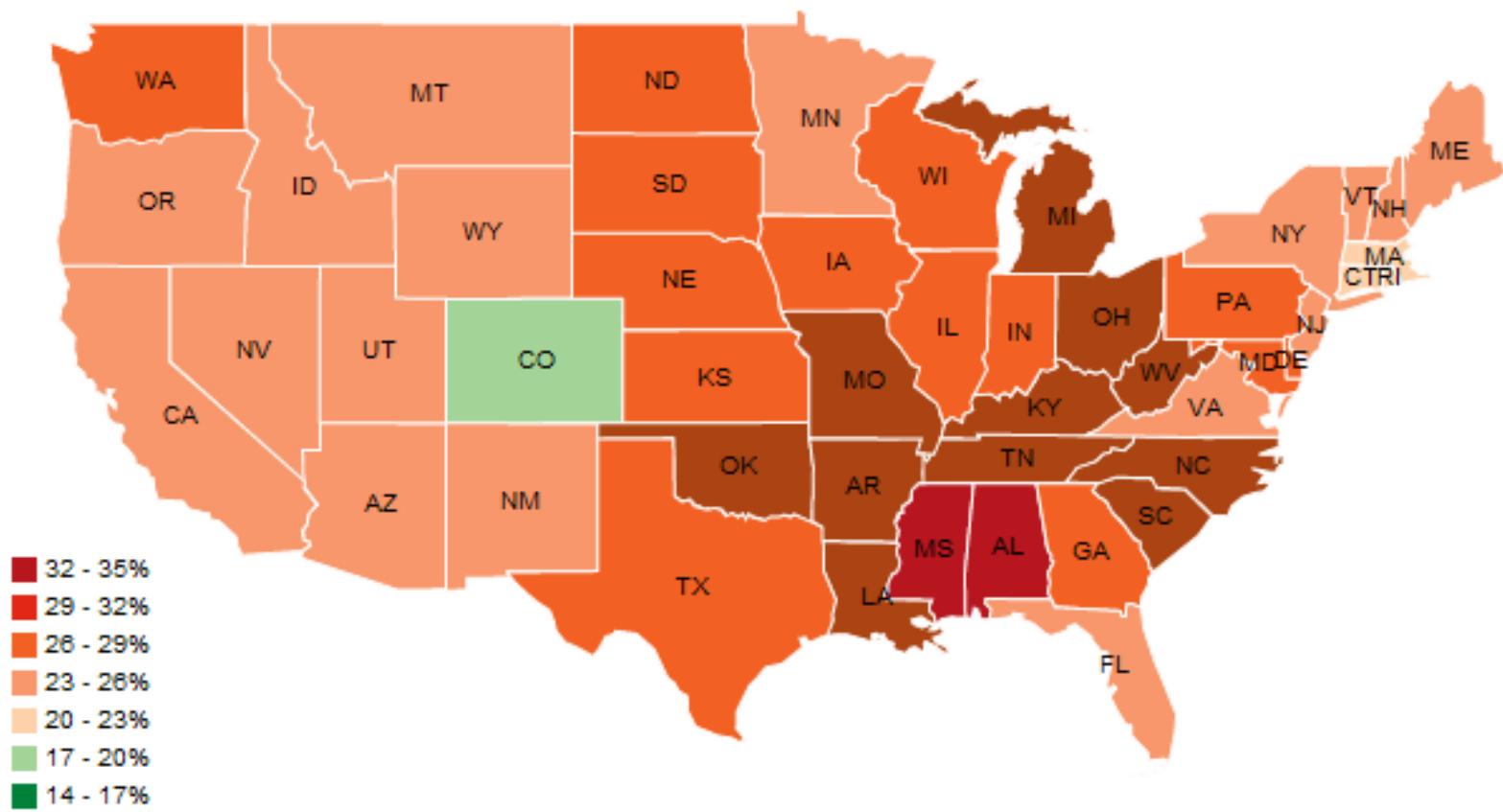
# Types of visualizations

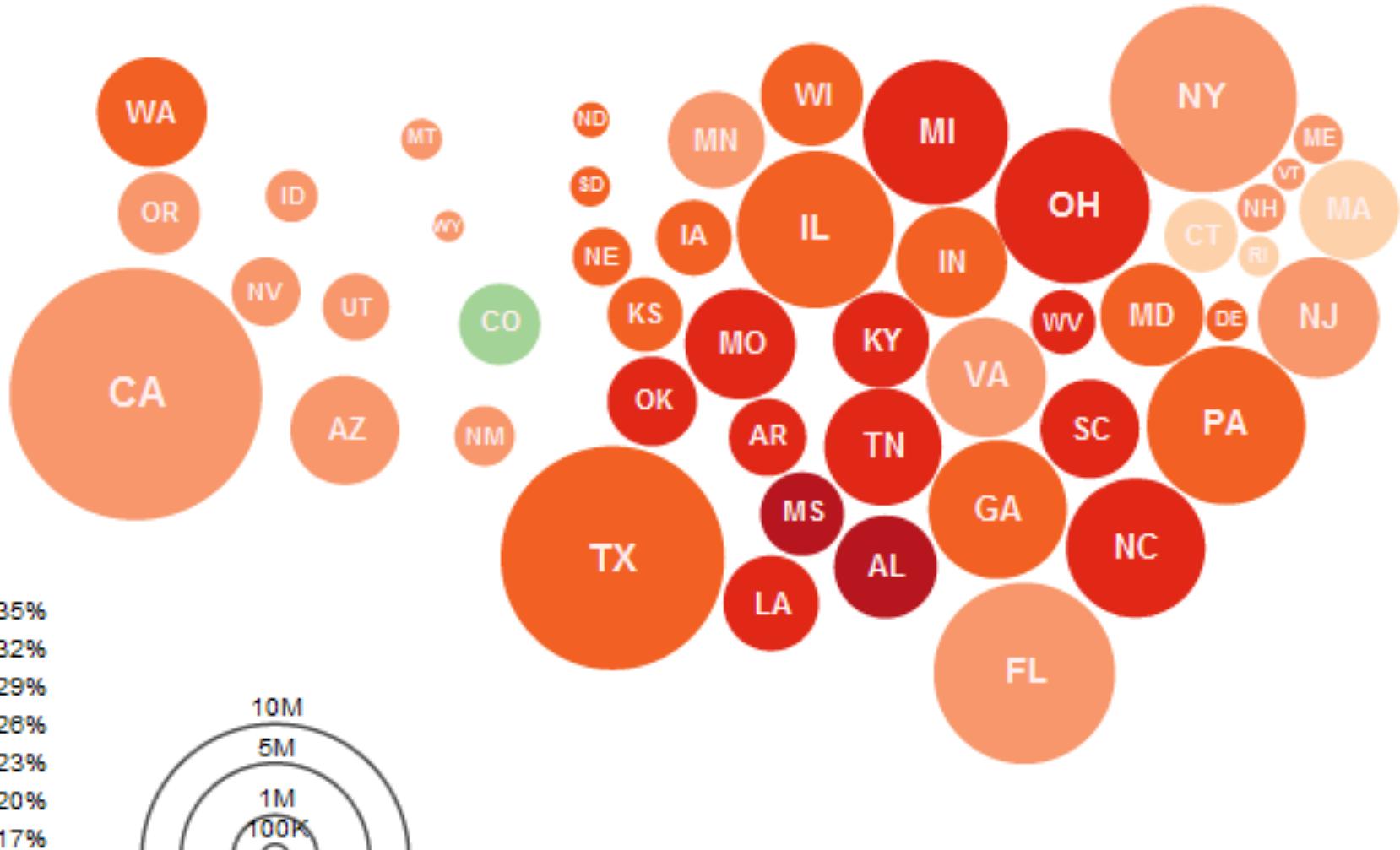
Time-Series

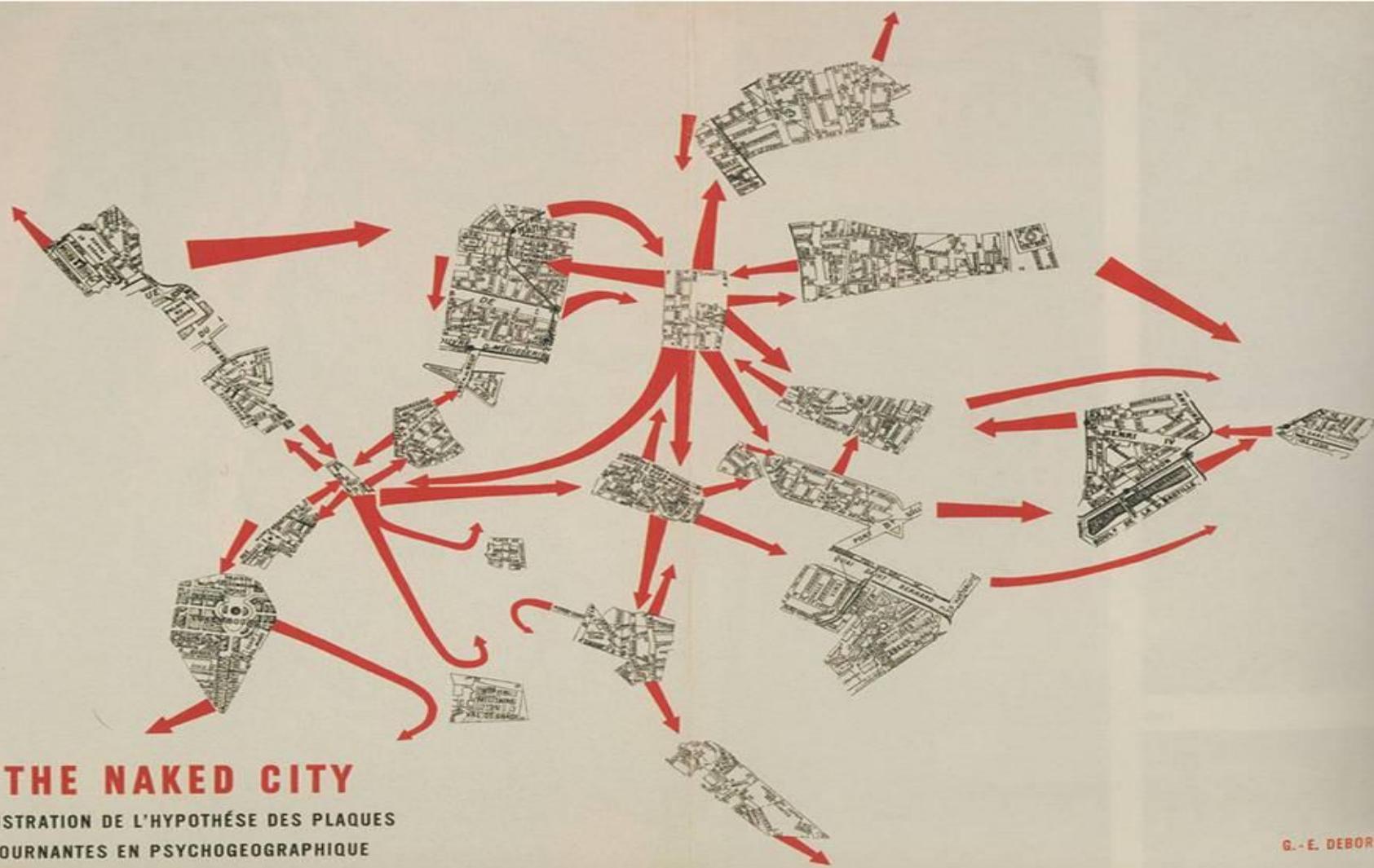
Statistical

**Maps** (relative/absolute scale, distance, size, trend)

Relational







## THE NAKED CITY

ILLUSTRATION DE L'HYPOTHÈSE DES PLAQUES  
TOURNANTES EN PSYCHOGEOGRAPHIQUE

G.-E. DEBORD

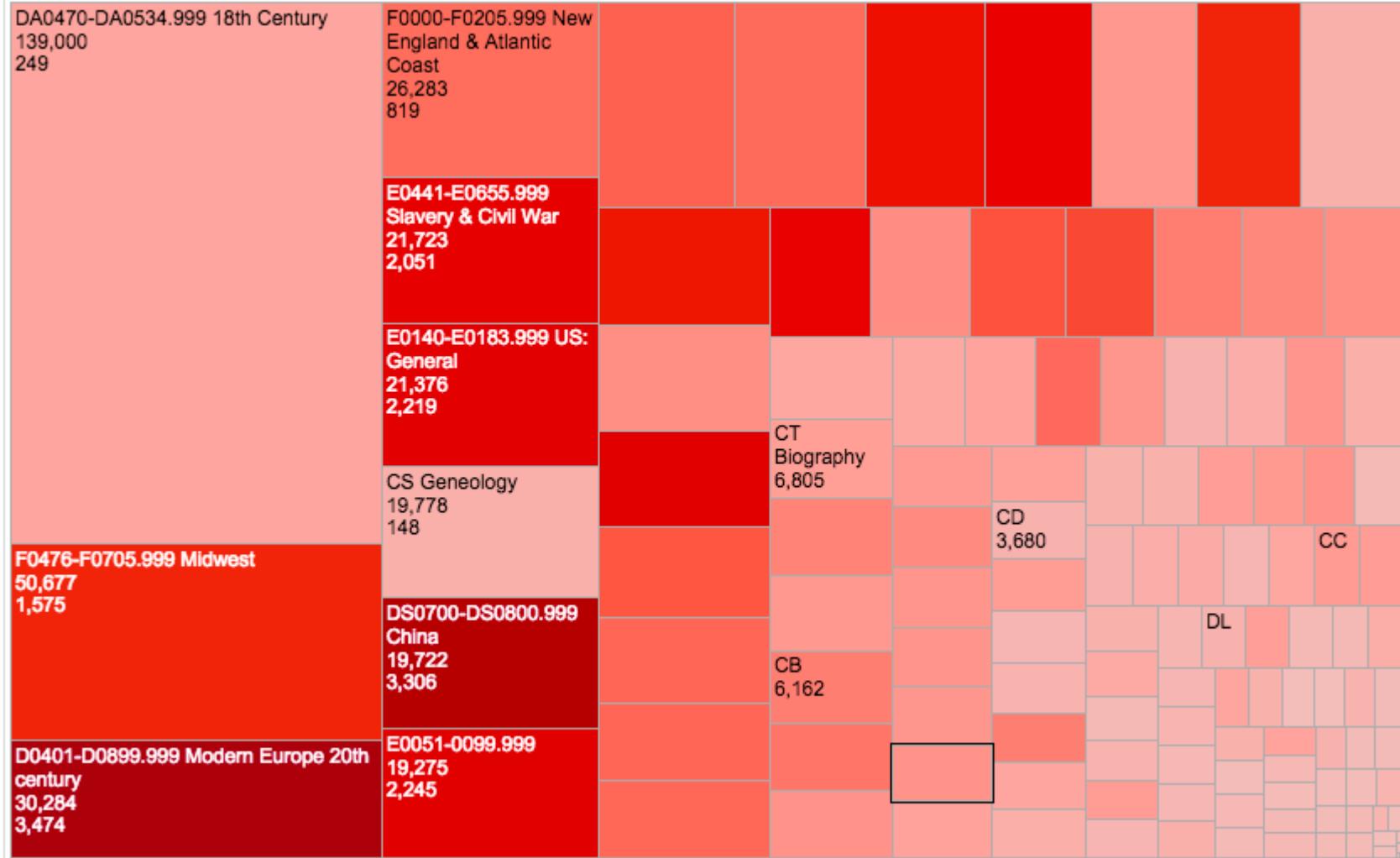
# Types of visualizations

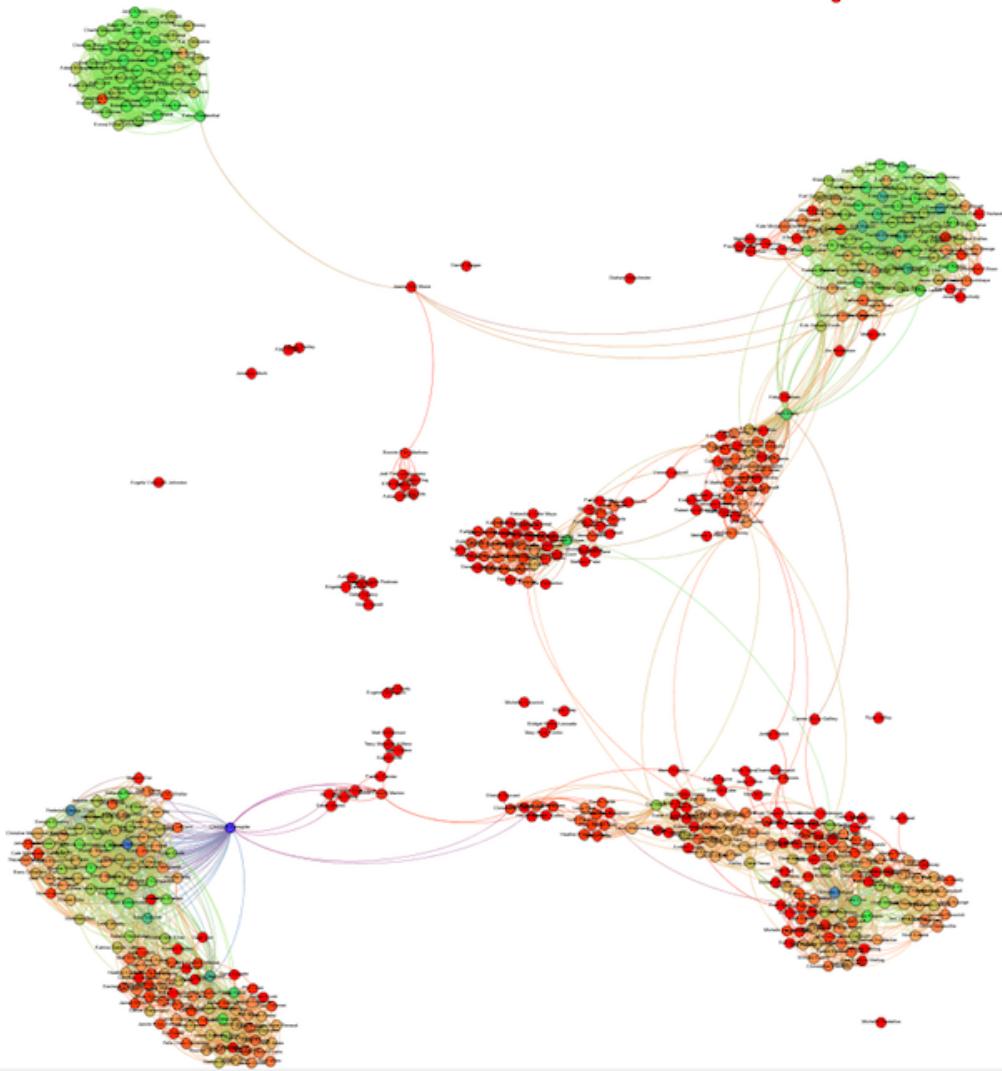
Time-Series

Statistical

Maps

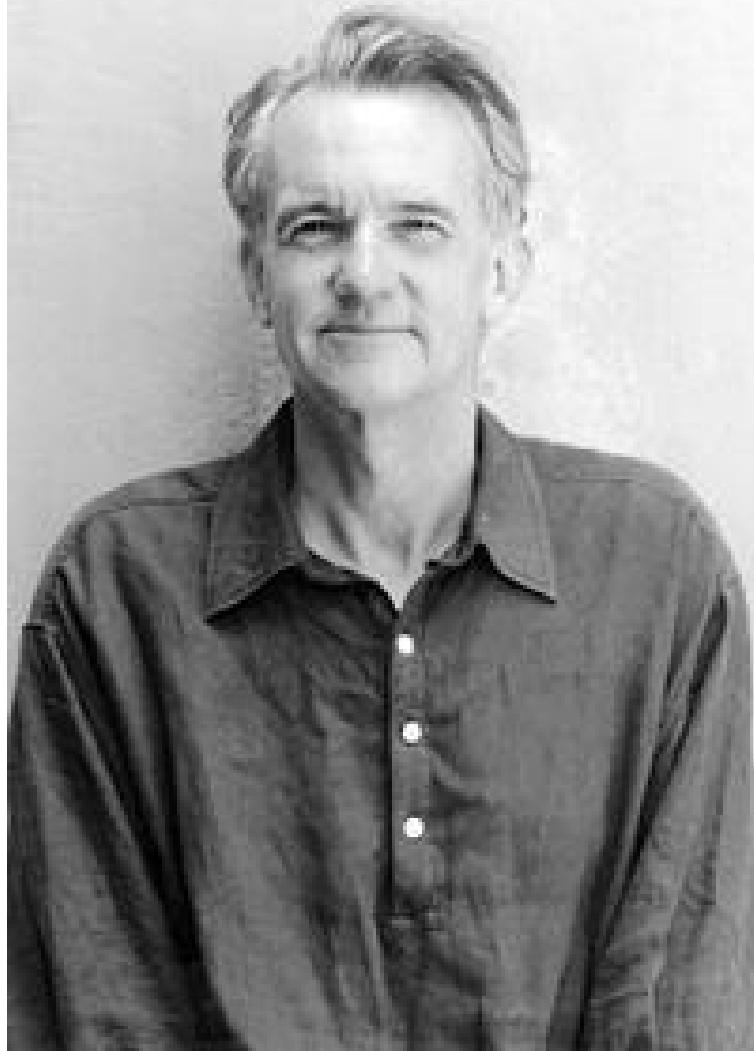
**Relational** (parts-to-whole, relatedness, trends, clustering)





# Class outline

1. What?
2. Wherefore?
3. Whence?
4. What again?
5. How? (Evaluating & Making)

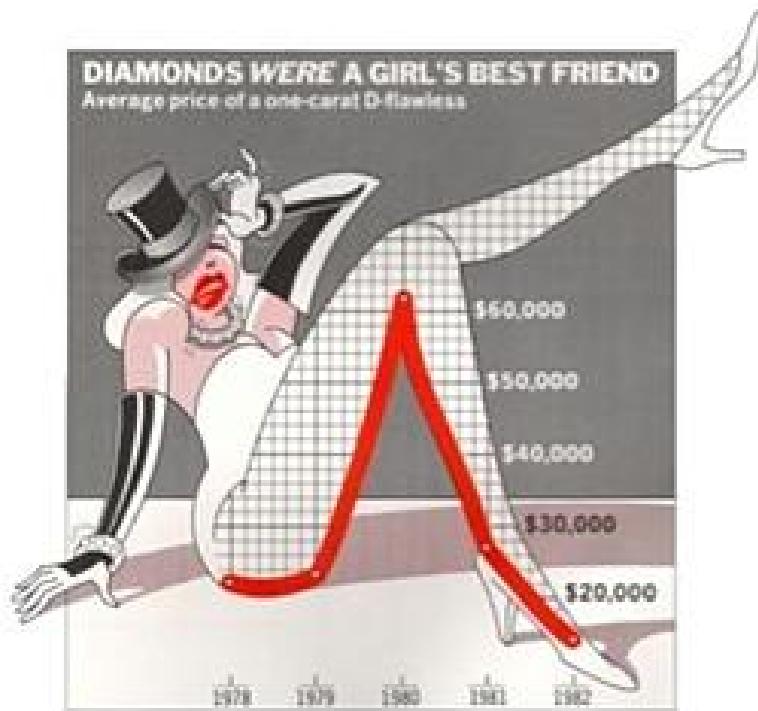


Data-ink ratio =  $\frac{\text{data-ink}}{\text{total ink used to print the graphic}}$

= proportion of a graphic's ink devoted to the non-redundant display of data-information

= 1.0 - proportion of a graphic that can be erased without loss of data-information.

# Chartjunk (according to Tufte)



# Tufte's Principles of Analytic Design

- Show Comparisons, contrasts, differences
- Show causality, mechanism, explanation, systematic structure
- Show multivariate data (more than 1 or 2 variables)
- Completely integrate words, numbers, images, diagrams
- Thoroughly describe the evidence (title, authors, data sources, scales of measurement, highlight relevant issues)
- Quality, relevance, and integrity of content

# Evaluating Visualizations

- NYT 2012 The Year in Graphics
- NYT 2014 The Year in Interactive Storytelling
- Flip Flop Fly Ball
- Visual Complexity