

Creative representation of invisible data

"Discover: to obtain knowledge or sight of what was not known."

What is Data?

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Data Visualization:

**visual representation of abstract information
that exploits our visual perception abilities
in order to amplify cognition**

Basic Visualization

	A	B	C
1	Query	Searches	Volume
3	pga	5244	11.08230719
4	pga.com	2583	6.610499028
5	freegolfinfo	64	4.147764096
6	golf tips	1884	3.046014258
7	golf	176386	1.62022035
8	pga tour	4142	1.360985094
9	michigan football	5105	0.777705768
10	golf swing	1596	0.777705768
11	pga golf	1406	0.712896954
12	pga championship	504	0.583279326
13	mgoblue	311	0.583279326
14	putting tips	133	0.518470512
15	golf shank	22	0.453661698
16	michigan wolverines	2587	0.453661698
17	golf lessons	463	0.453661698
18	us open	6077	0.388852884
19	online golf tips	8	0.388852884
20	university of michigan	4948	0.32404407
21	golf schools	1657	0.32404407
22	how to play golf	394	0.32404407
23	free video golf lessons	5	0.32404407
25	stratton	976	0.259235256
26	swing plane	15	0.259235256

It doesn't allow to identify patterns.

Why pattern?

Humans are intensely visual creatures.
Patterns can express meaning.











Visual patterns can be surprisingly.

It can reveal hidden informations.

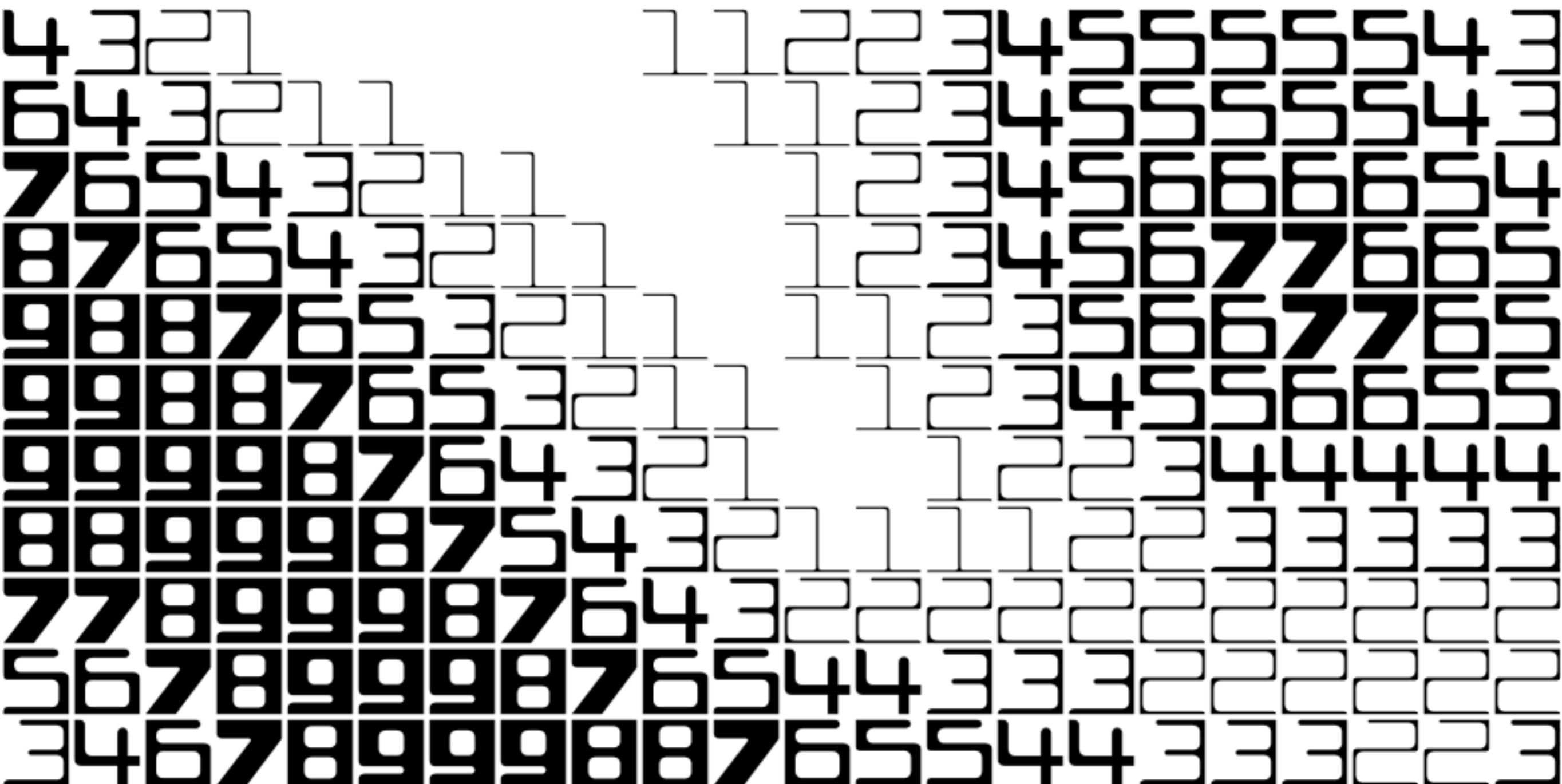
Radiations of a microwave oven



How to create patterns from raw data?

The act of mapping information to visual elements.

FatFont: a proportional correlation between the value and the ink



Purposes

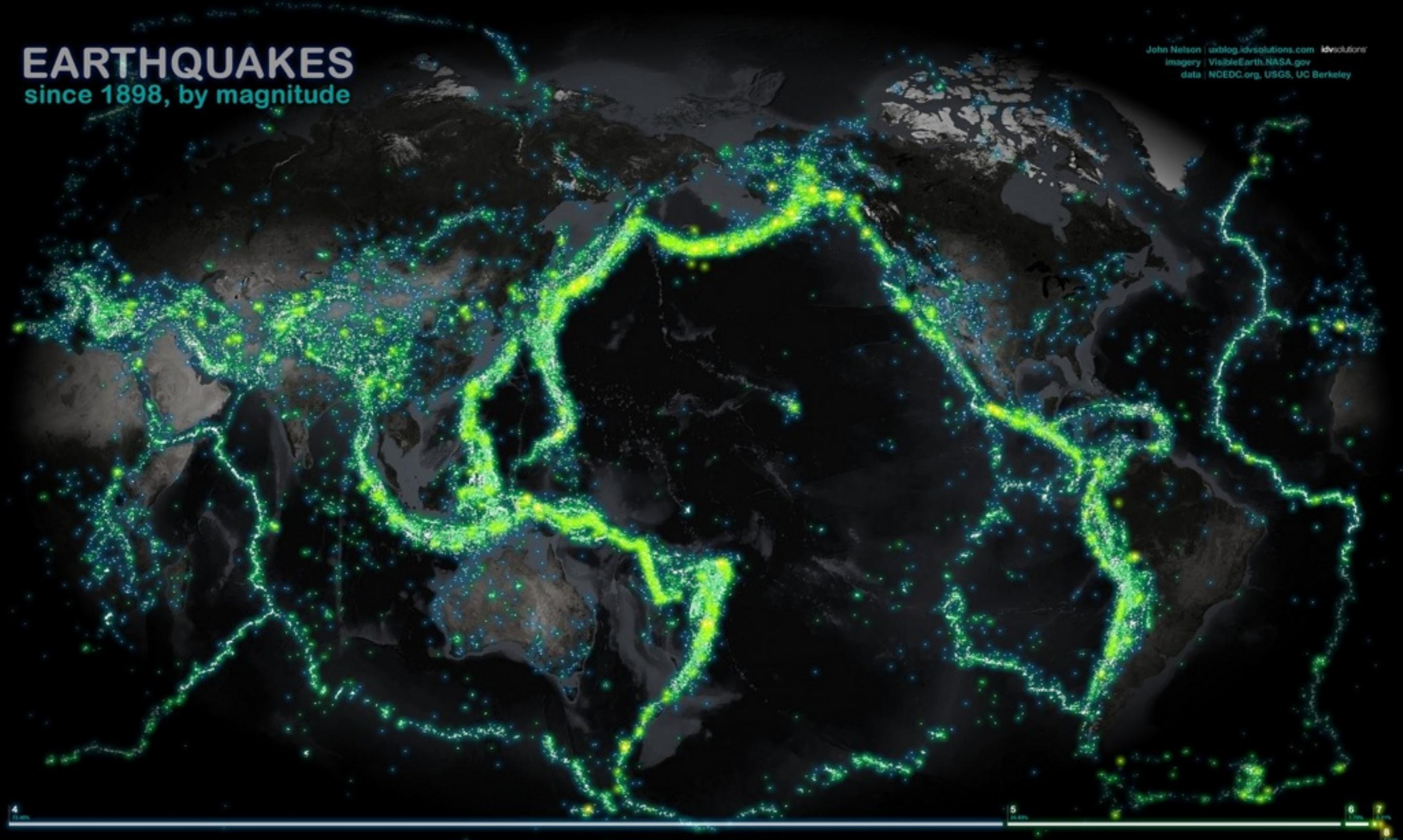
"The purpose of visualization is insight, not pictures"

Ben Shneiderman

EARTHQUAKES

since 1898, by magnitude

John Nelson | uxblog.idvsolutions.com | idvsolutions.com
Imagery | VisibleEarth.NASA.gov
data | NCEDC.org, USGS, UC Berkeley



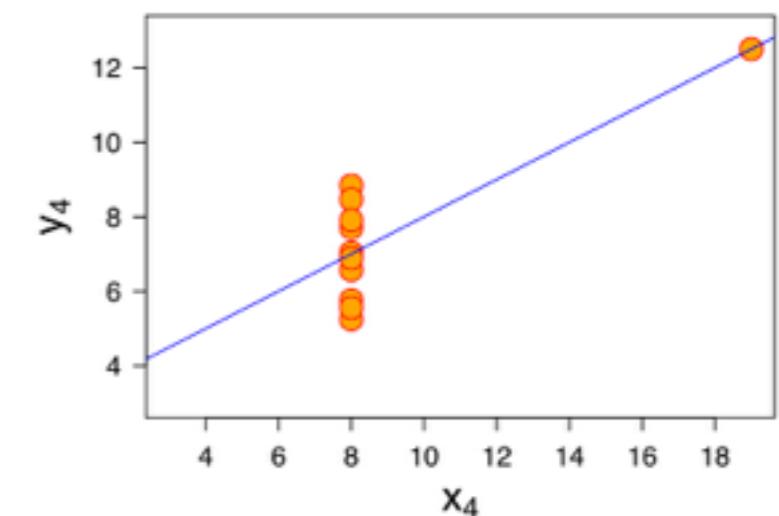
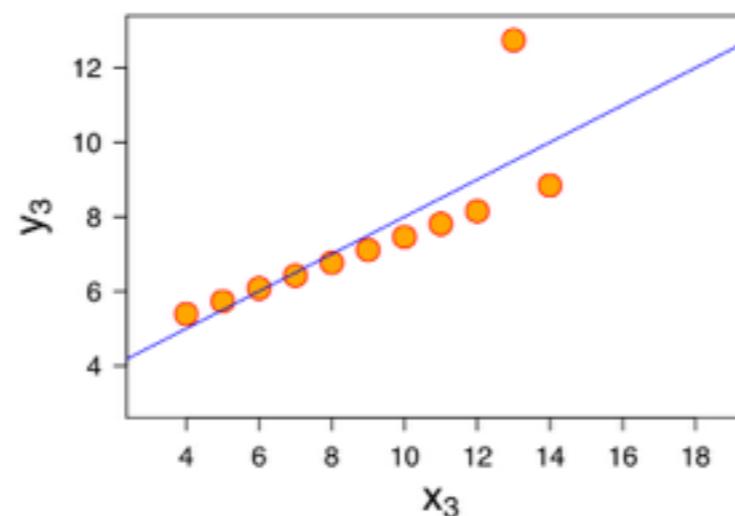
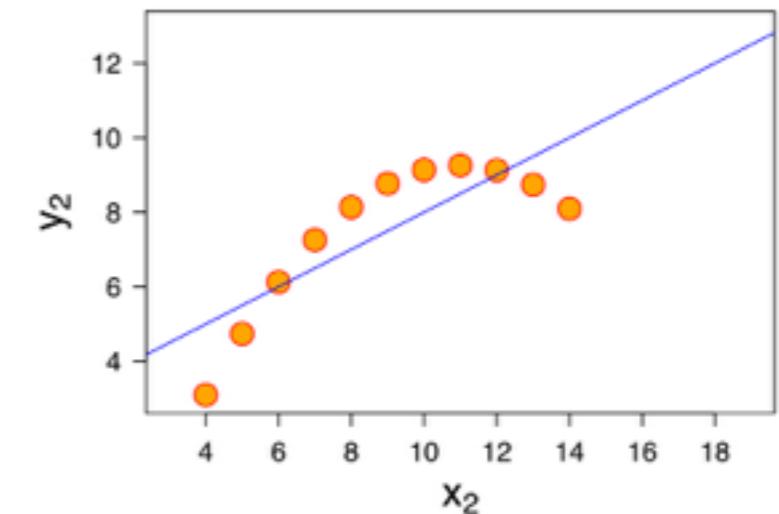
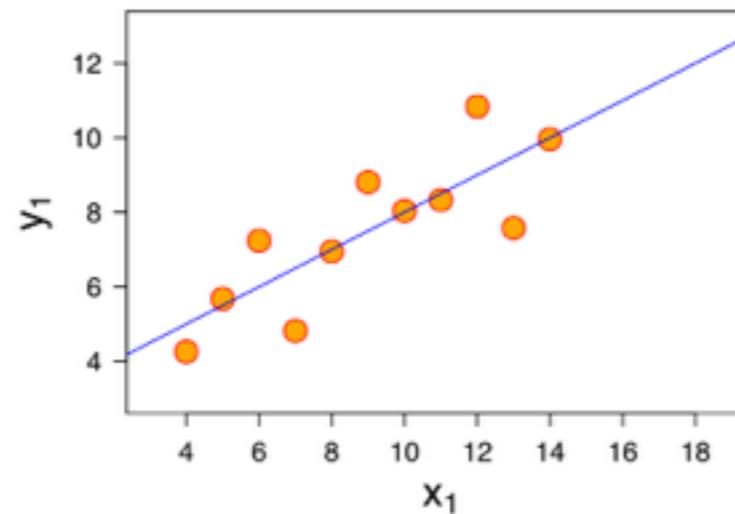
Visualization is a powerful tool to
discover, understand and present
hidden stories

Discover:

In 1973, Anscombe's quartet dataset.

Nearly identical simple statistical properties, yet appear very different when graphed.

Anscombe's quartet									
I		II		III		IV			
x	y	x	y	x	y	x	y		
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58		
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76		
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71		
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84		
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47		
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04		
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25		
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50		
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56		
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91		
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89		



Presentation:

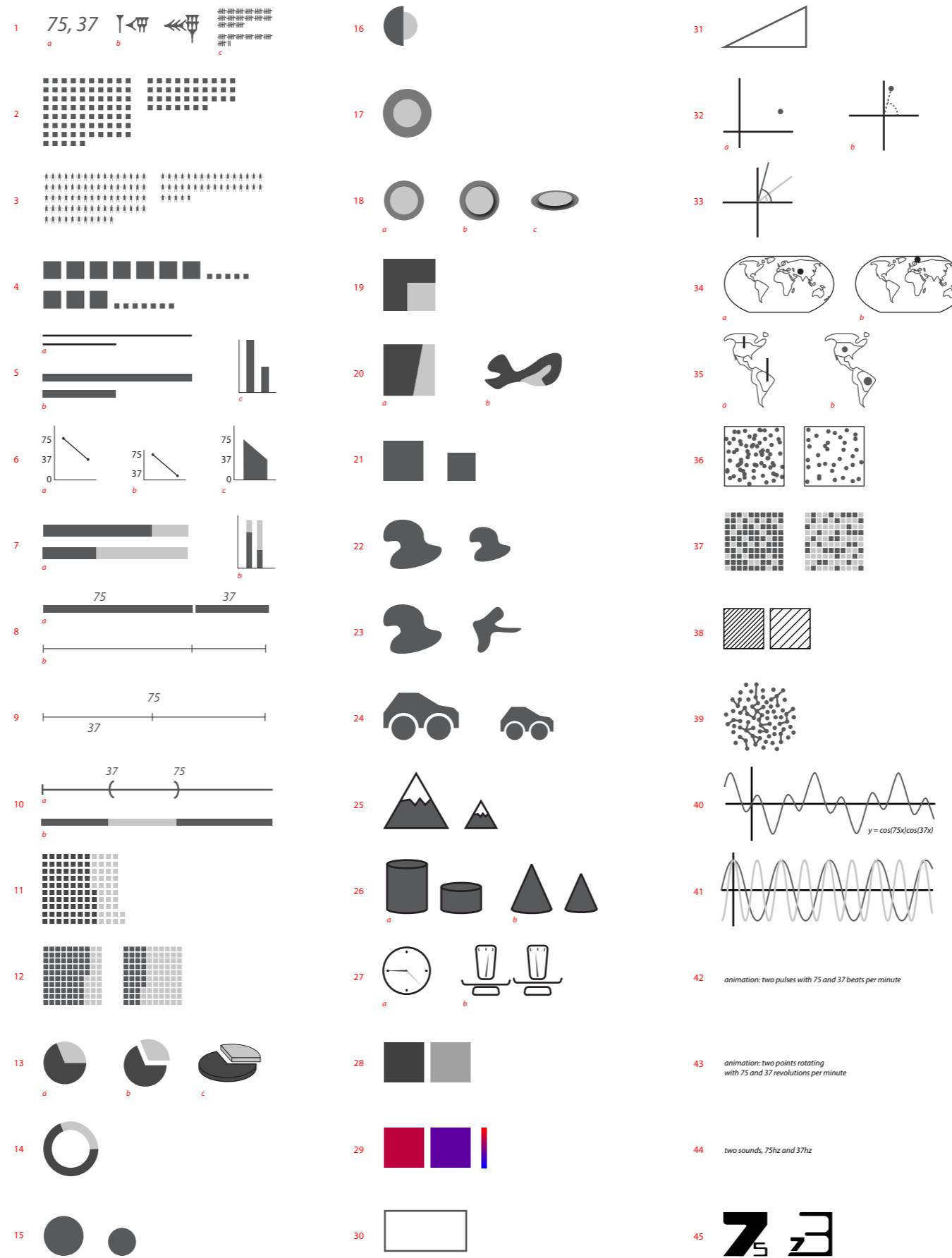
- 1. Communicate:**
clearly and effectively
- 2. Stimulate:**
engadge the viewer attention



We need a Language to

**explain the world, tell stories, point specific facts and objects,
elaborate ambiguous messages, defend arguments,
attack arguments and carry ideas and ideologies**

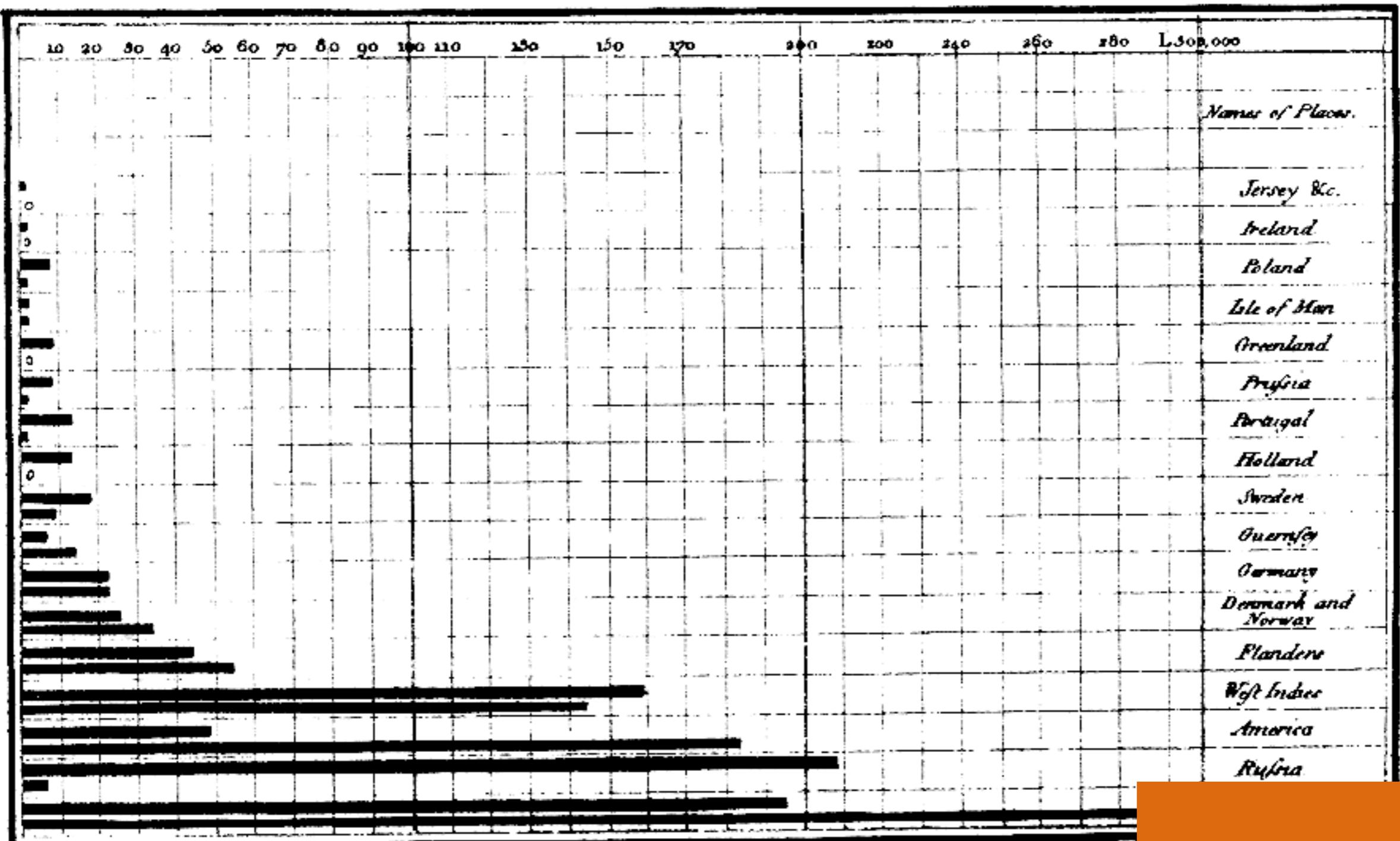
75, 37 multiple ways to communicate two quantities



Early days
(great examples)

William Playfair | Scotland's imports and exports (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 white lines are Imports.

First quantitative graphical form.

z

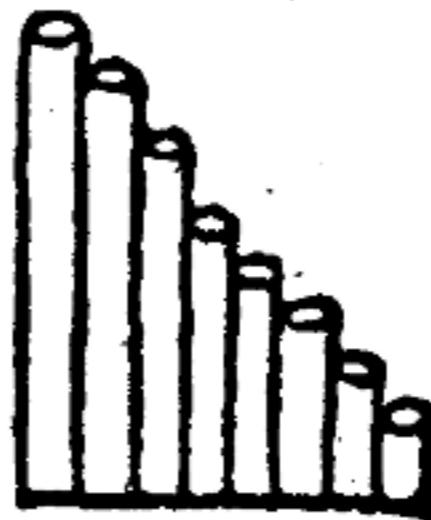
ratio reddit uniforme cap. et si ad h[ab]it
ie. **C** Lato: vni
if ex celus graduu[m]
iportos a lati a p/
it ex celus graduu[m]
eis iportos eq[ue]ta
nic diff[er]entia ut p; ex
um secunde duiliois
io seruat tunc nulla
e in latitudine tali et
diff[er]entia in diff[er]entis
afformiter diff[er]entis
idu[m] eque distantiu[m]
portionem sicut in se
tendum tamen est
futore ubi loquitur
se eque distantiu[m]



Diff[er]entia

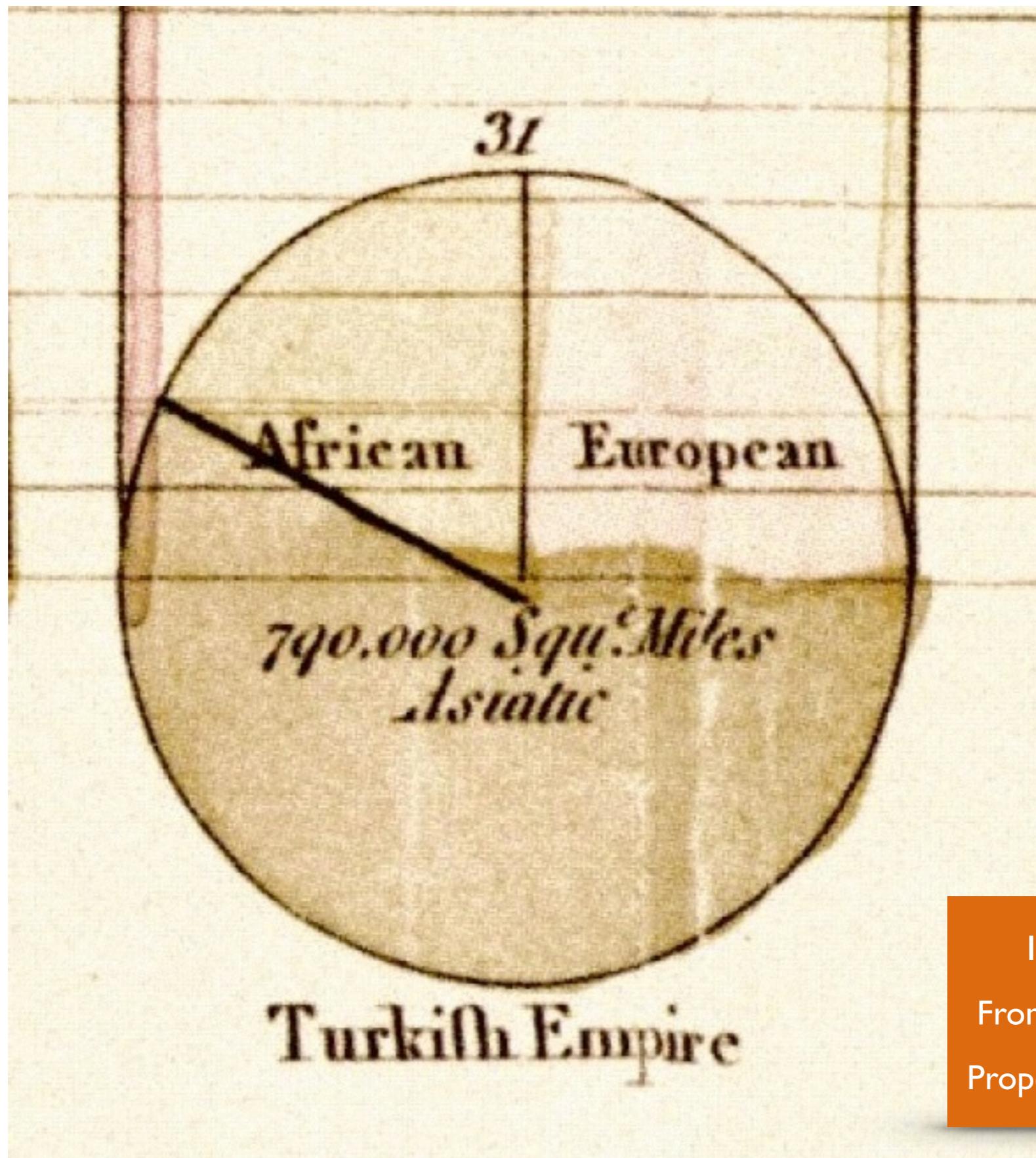


Diff[er]entia



Plot velocity over time

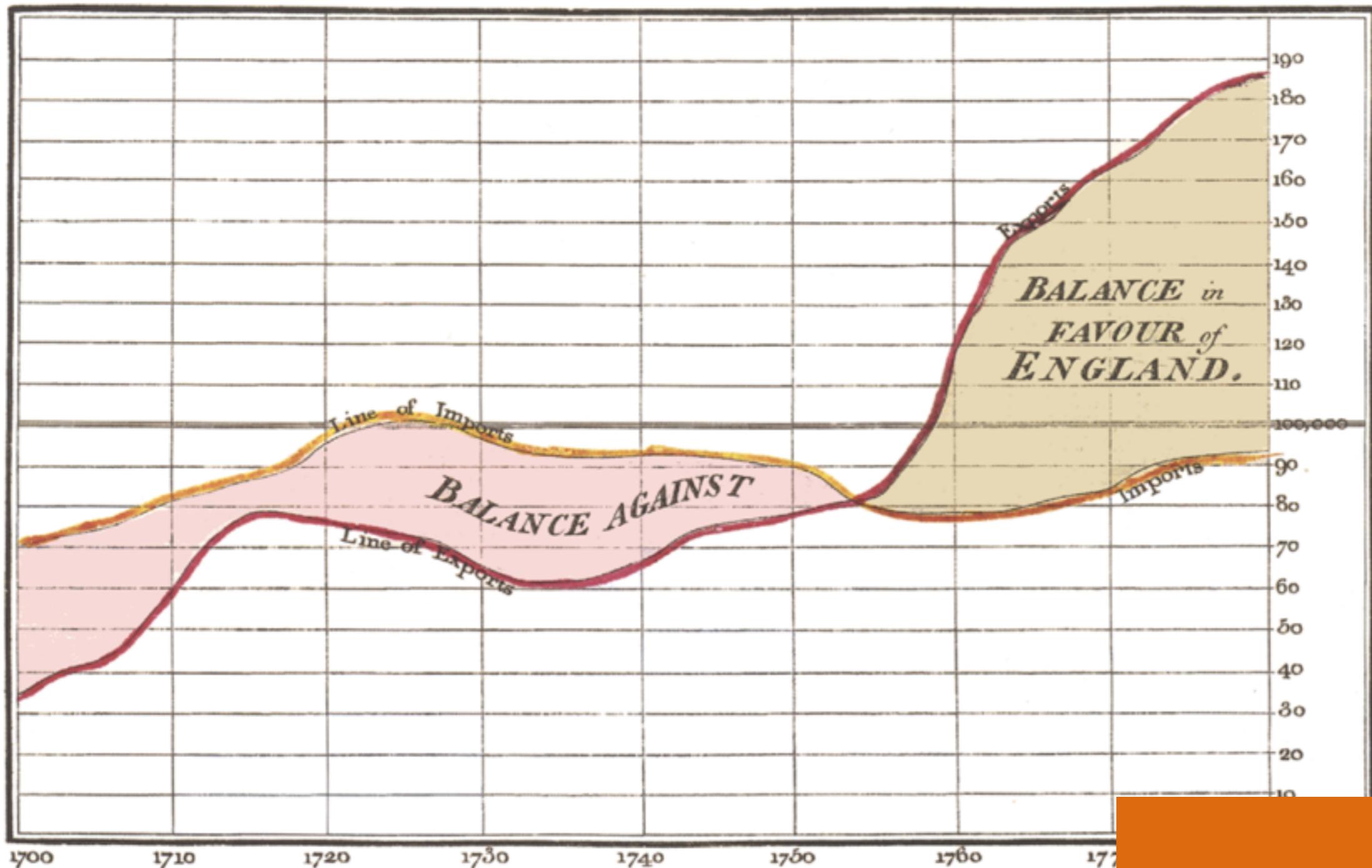
William Playfair | Turkish Empire (1789)



Inventor of Pie chart
From his Statistical Breviary
Proportion of Turkish Empire

William Playfair | Exports and Imports of Denmark and Norway (1786)

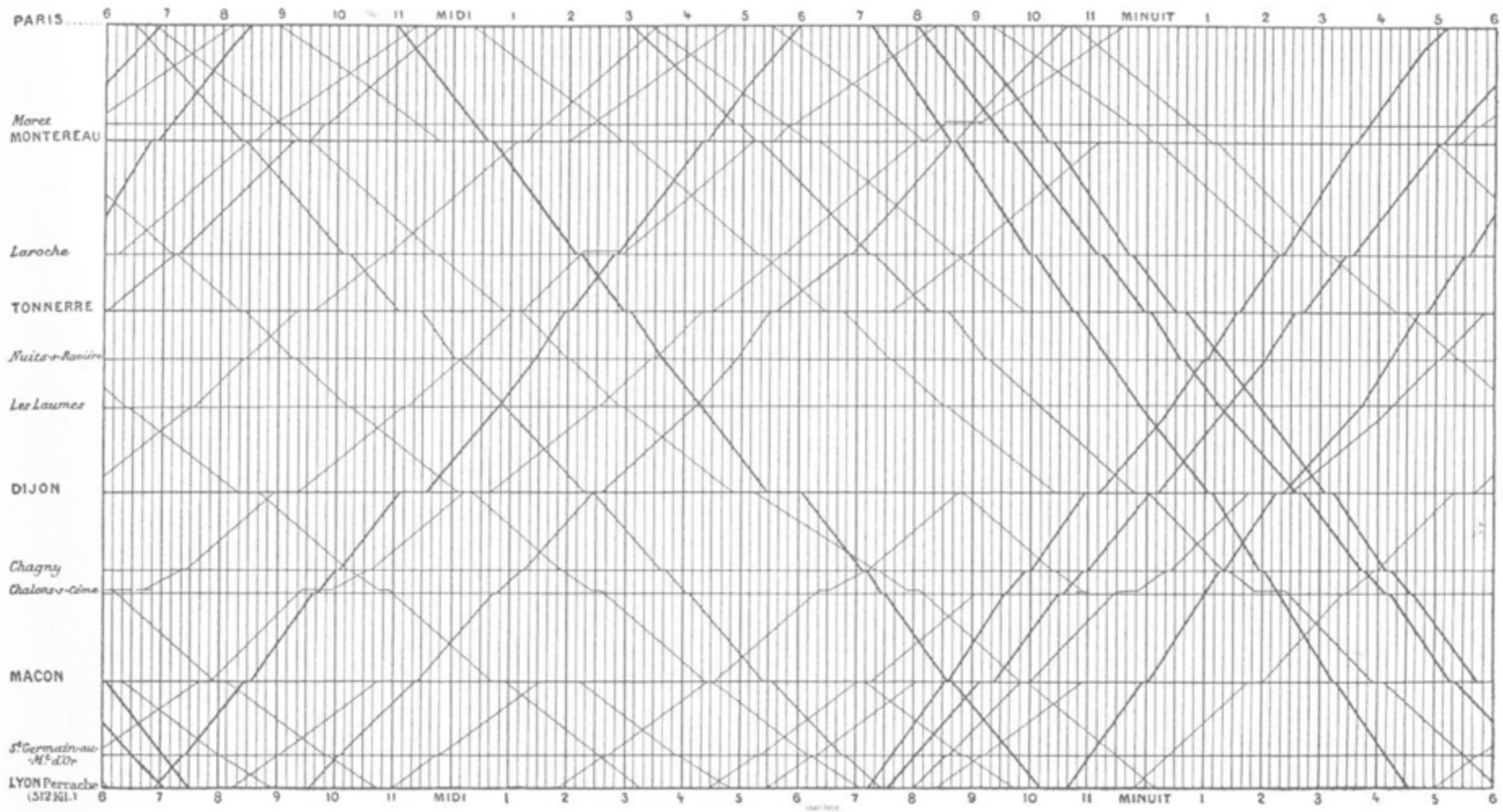
Exports and Imports to and from DENMARK & NORWAY from 1700 to 1780.



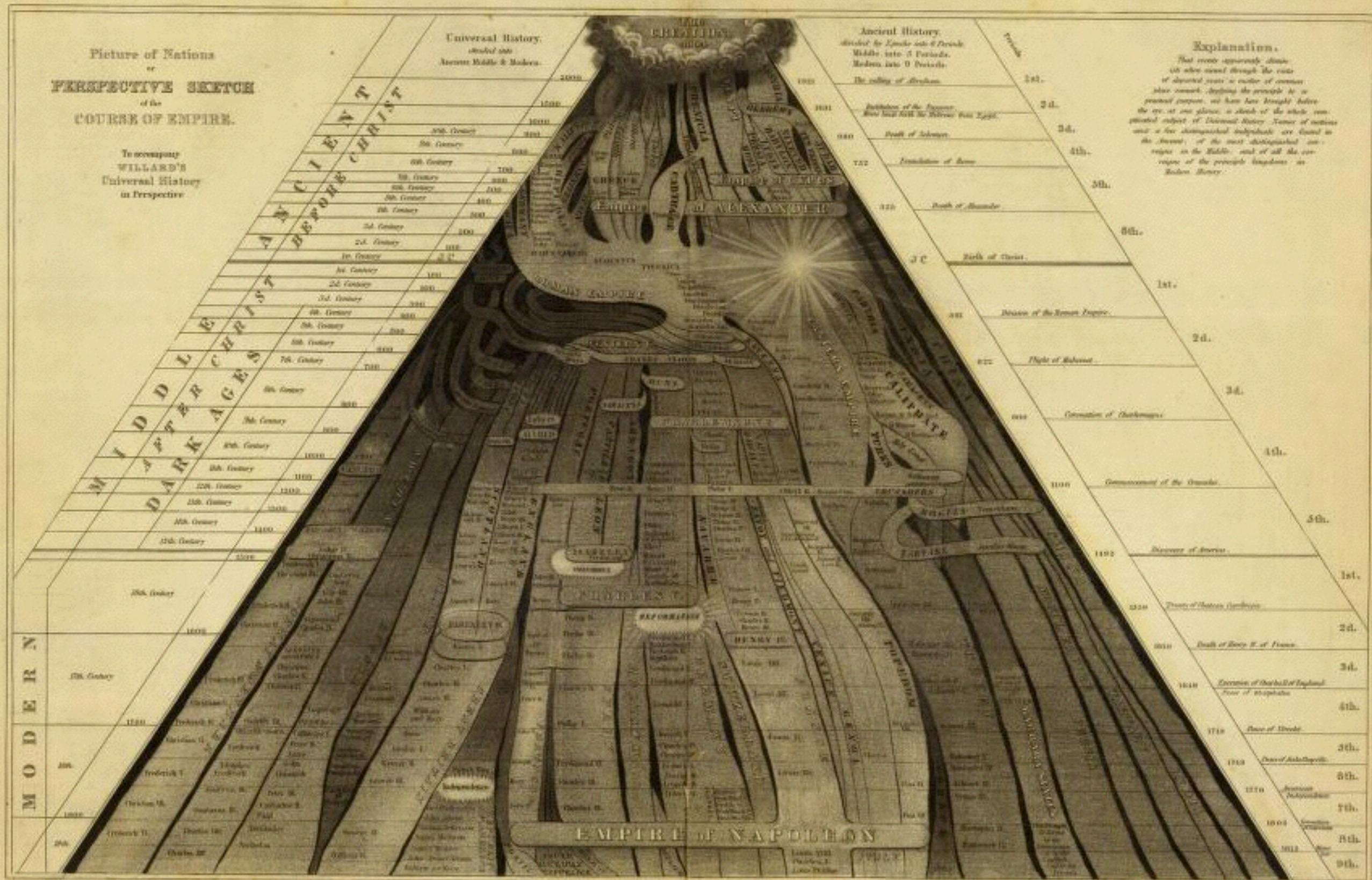
The Bottom line is divided into Years, the Right hand line into £10,000
Published as the Act directs, 1st May 1786, by W^m Playfair

Revenues and Debts of
England commerce

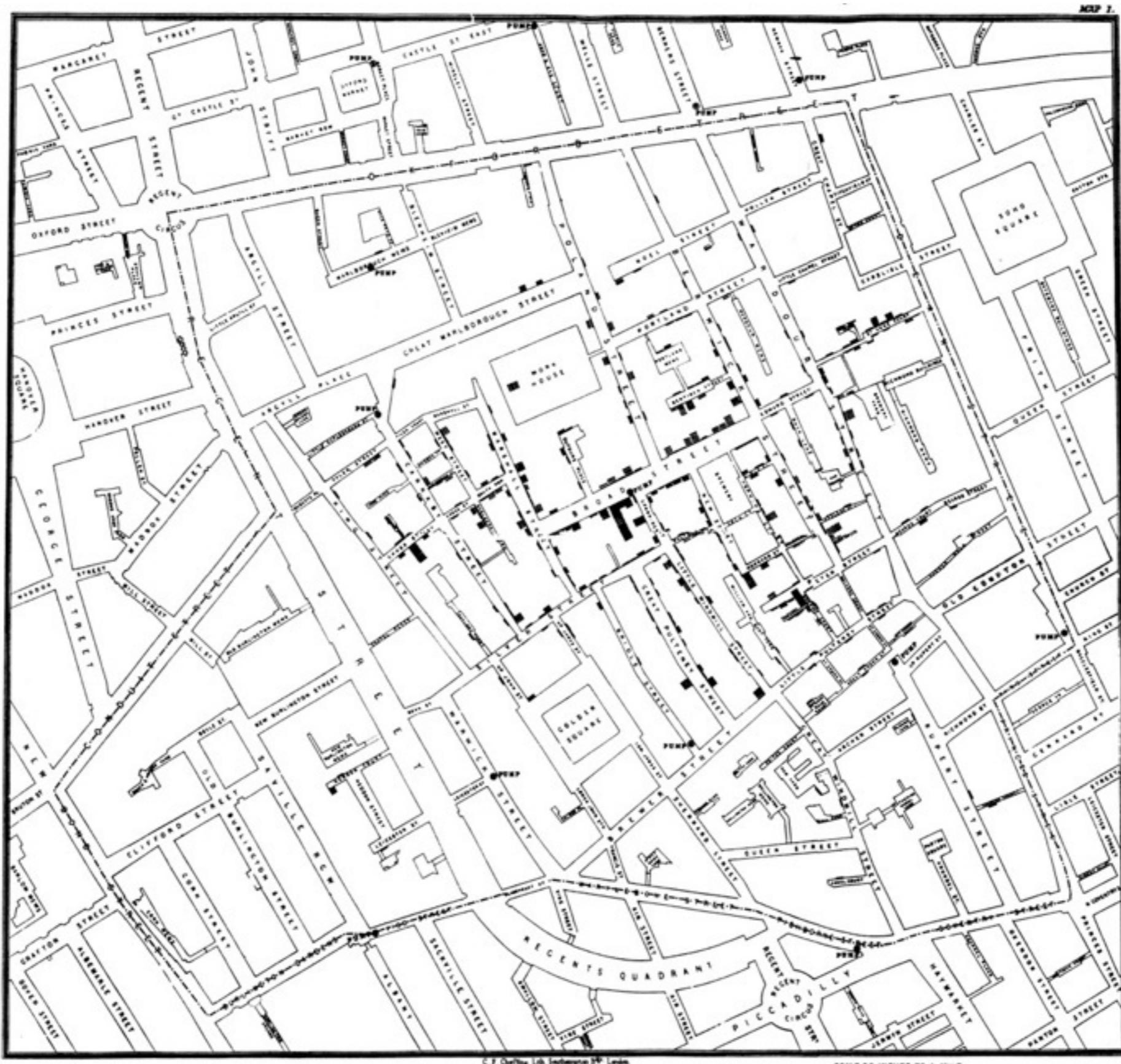
E.J. Marey | Train Schedule Paris-Lyon (1880)



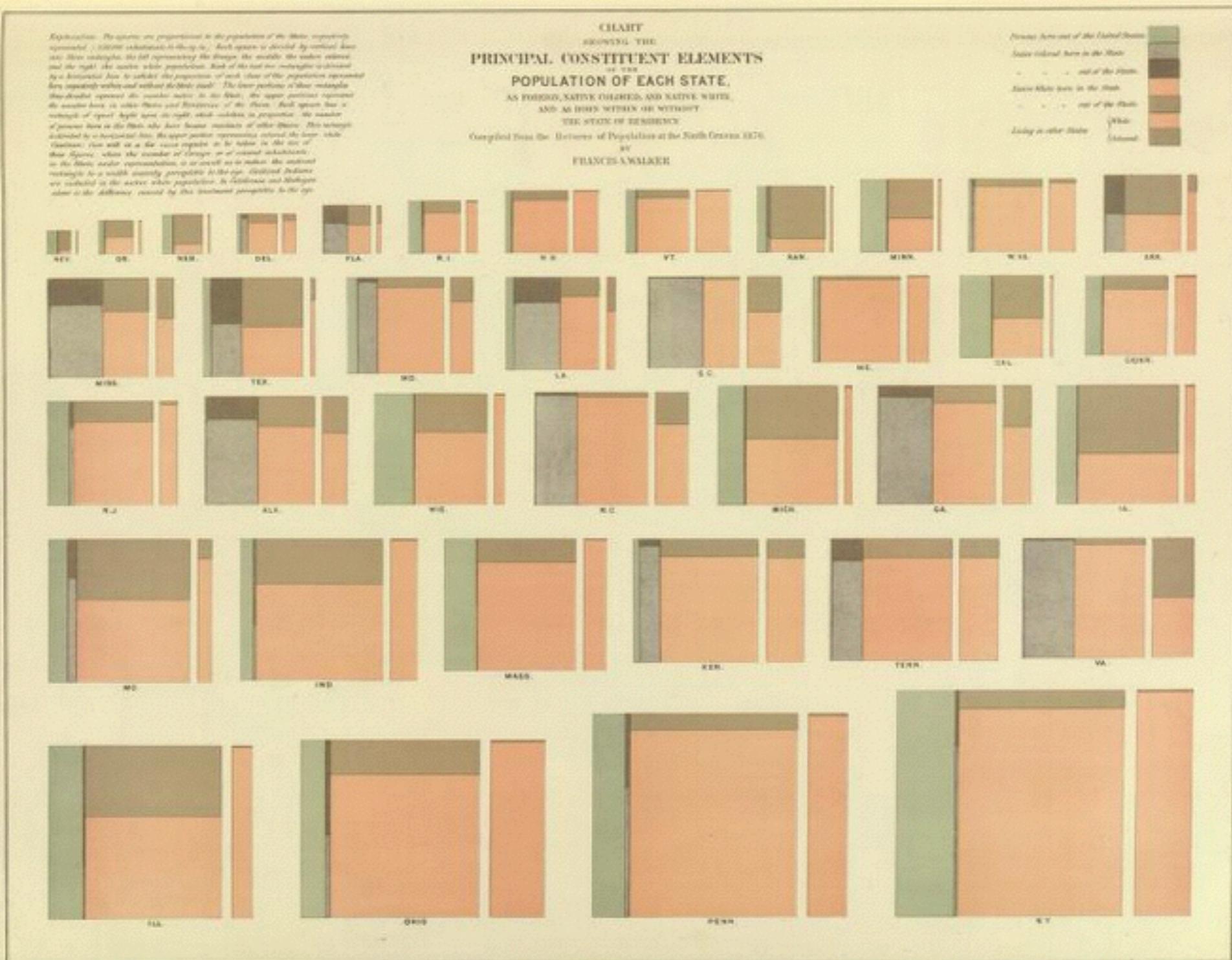
Emma Willard | Picture of Nation: (1835)



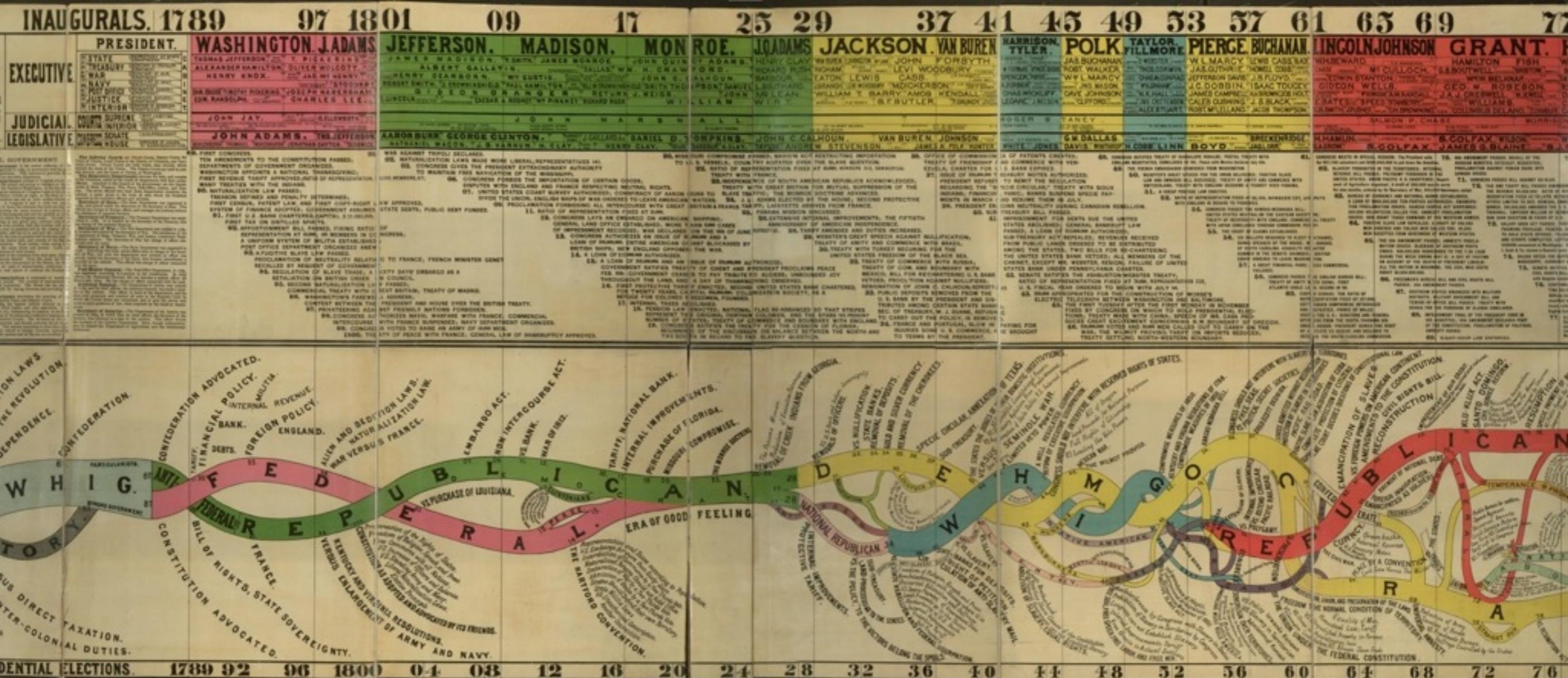
John Snow | Communication of Cholera (1854)



Francis Walker | Principal Constituent Elements (1874)



Walter Houghton | Conspectus of the History of Political Parties (1880)



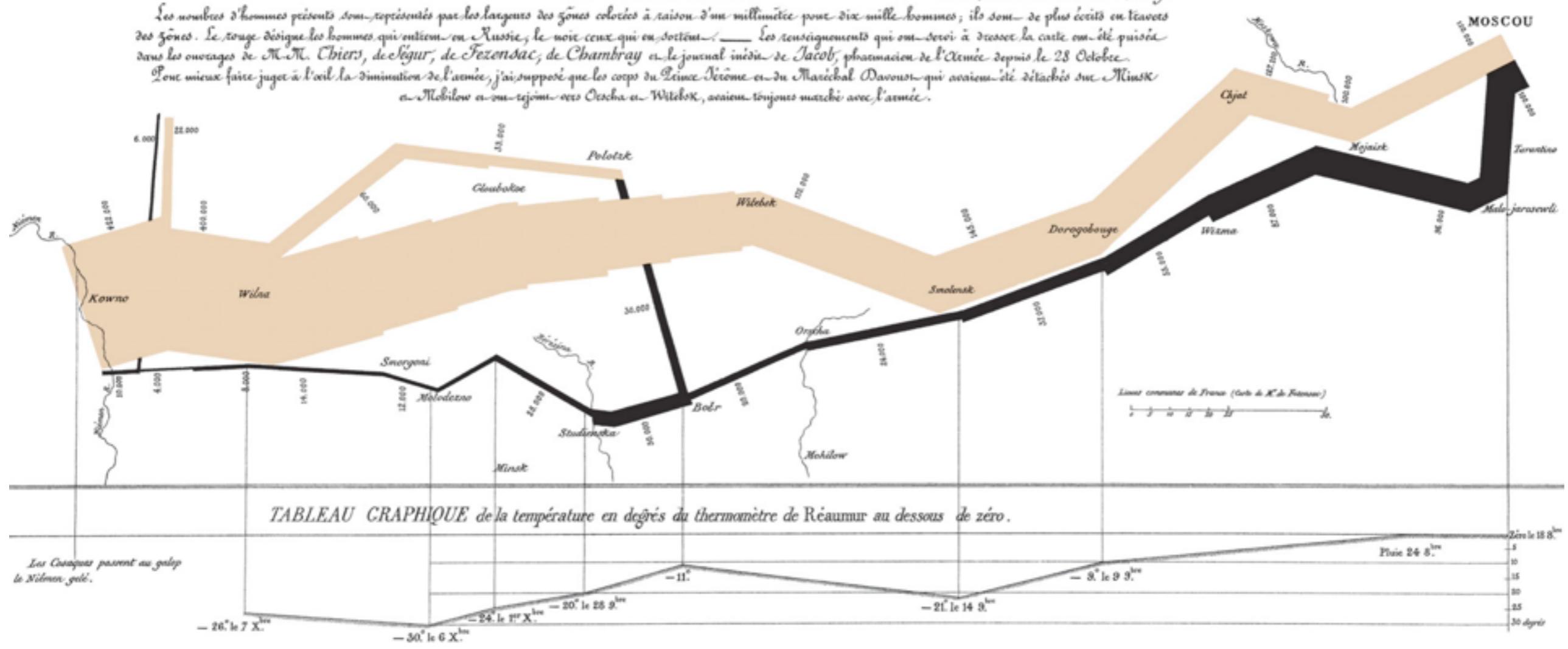
Charles Minard | Map of Napoleon's March (1869)

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

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

Les nombres d'hommes perdus sont représentés par les larges des zones colorées à raison d'une millième pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui ont été tués en Russie; le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Léger, de Fezensac, de Chambray et le journal médical 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 Napoléon et du Maréchal Davout, qui avaient été détachés sur Minsk et Malibow au commencement de Ossia et Witebsk, avaient toujours marché avec l'armée.



Dmitri Mendeleev | Periodic Table of Elements (1869)

hydrogen 1 H 1.0079																		helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	chlorine 17 Cl 35.453
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.967	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.908	iron 26 Fe 55.845	cobalt 27 Co 58.903	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80	
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	nobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29	
caesium 55 Cs 132.91	barium 56 Ba 137.33	lutetium 71 57-70 * 174.97	hafnium 72 178.49	tantalum 73 180.95	tungsten 74 183.84	rhenium 75 186.21	osmium 76 190.23	iridium 77 192.22	platinum 78 195.08	gold 79 196.97	mercury 80 200.59	thallium 81 204.38	lead 82 207.2	bismuth 83 208.98	polonium 84 [209]	astatine 85 [210]	radon 86 [222]	
francium 87 Fr [223]	radium 88 Ra [226]	lawrencium 103 89-102 ** [262]	rutherfordium 104 [261]	dubnium 105 [262]	seaborgium 106 [266]	bohrium 107 [264]	hassium 108 [269]	meitnerium 109 [268]	ununnilium 110 [271]	unununium 111 [272]	ununbium 112 [277]	ununquadium 114 [289]						

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europlum 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	yterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

** Actinide series

Failed attempts

A PERIODIC TABLE OF VISUALIZATION METHODS

> < C continuum	Data Visualization Visual representations of quantitative data in schematic form (either with or without axes)												Strategy Visualization The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations.												> < G graphic facilitation
> < Tb table	> < Ca cartesian coordinates	> < Bi bar chart	> < Ac area chart	> < R radar chart cobweb	> < Pa parallel coordinates	> < Hy hyperbolic tree	> < Cy cycle diagram	> < T timeline	> < Ve venn. diagram	< > Mi mindmap	< > Sq square of oppositions	> < Cc concentric circles	> < Ar argument slide	> < Co communication diagram	> < Fp flight plan	> < Ms metro map	> < Tm temple	< > St story template	> < Tr tree	> < Ct cartoon					
> < Pi pie chart	> < L line chart	> < Hi histogram	> < Sc scatterplot	> < Sa sankey diagram	> < In information lens	> < E entity relationship diagram	> < Pt petri net	> < Fl flow chart	< > Cl clustering	> < Lc layer chart	> < Py minto pyramid technique	> < Ce cause-effect chains	> < Tl toulmin map	> < Sw swim lane diagram	> < Gc gantt chart	< > Pm perspectives diagram	< > D dilemma diagram	< > Pr parameter ruler	< > Kn knowledge map						
> < Tk tukey box plot	> < Sp spectrogram	> < Da data map	> < Tp treemap	> < Cn cone tree	> < Sy system dyn./ simulation	> < Df data flow diagram	< > Se semantic network	> < So soft system modeling	< > Sn synergy map	< > Fo force field diagram	> < Ib ibis argumentation map	> < Pr process event chains	> < Pe pert chart	< > Ev evocative knowledge map	> < V Vee diagram	< > Hh heaven 'n' hell chart	> < I infomural	> < Lm learning map							
> < Cy Process Visualization	<p>Note: Depending on your location and connection speed it can take some time to load a pop-up picture.</p> <p>© Ralph Lengler & Martin J. Eppler; www.visual-literacy.org</p> <p>version 1.5</p>																								

Cy Process Visualization

Hy Structure Visualization

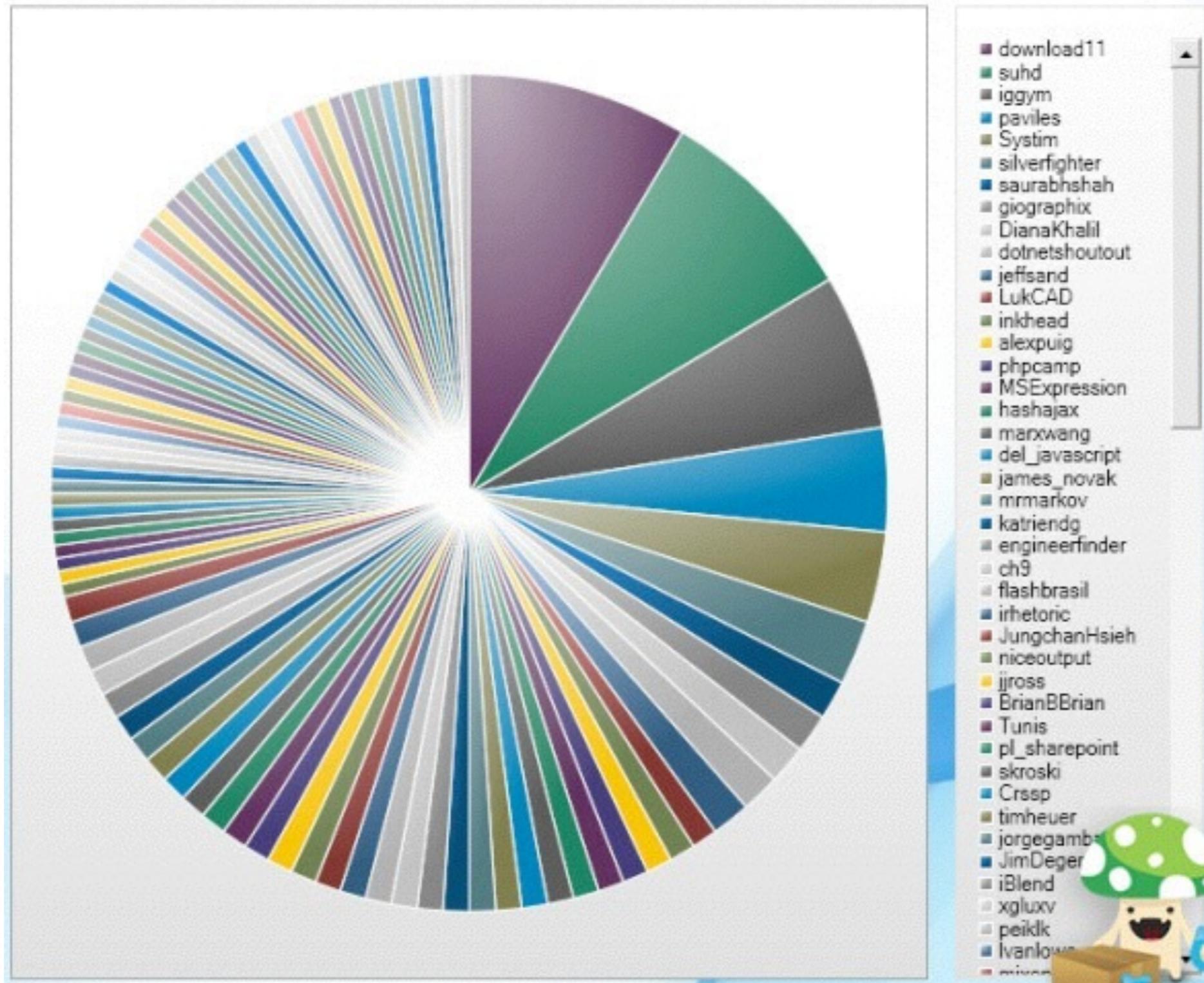
○
□
Detail
Overview

○
Detail AND Overview

< >
Divergent thinking
> <
Convergent thinking

> < Su supply demand curve	> < Pc performance charting	> < St strategy map	> < Oc organisation chart	< > Ho house of quality	> < Fd feedback diagram	□ Ft failure tree	> < Mq magic quadrant	> < Ld life-cycle diagram	> < Po porter's five forces	< > S s-cycle	> < Sm stakeholder map	< > Is ishikawa diagram	< > Tc technology roadmap
> < Ed edgeworth box	> < Pf portfolio diagram	> < Sg strategic game board	> < Mz mintzberg's organigraph	< > Z zwicky's morphological box	< > Ad affinity diagram	□ De decision discovery diagram	> < Bm bcg matrix	> < Stc strategy canvas	> < Vc value chain	< > Hy hyper-cycle	< > Sr stakeholder rating map	> < Ta taps	< > Sd spray diagram

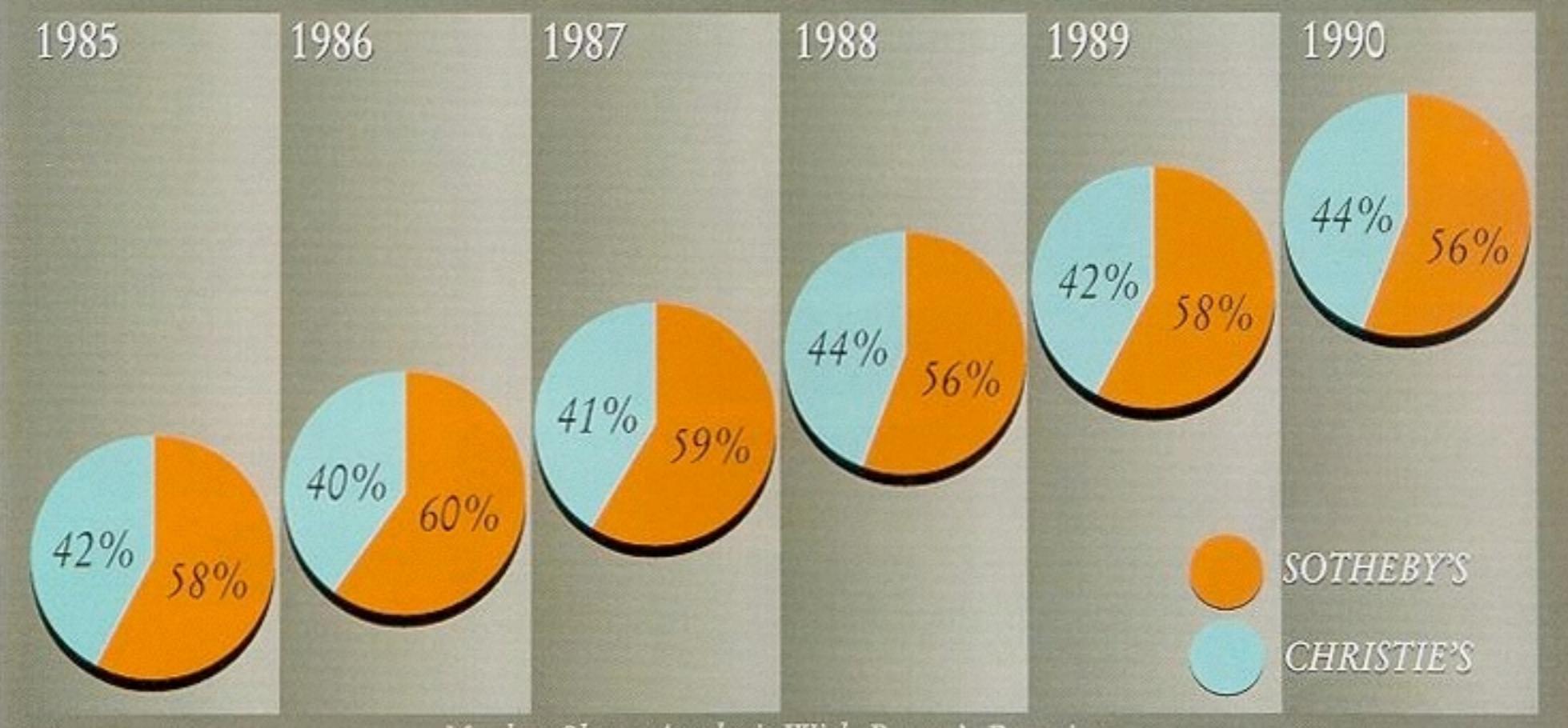
100 Most Active Tweeters

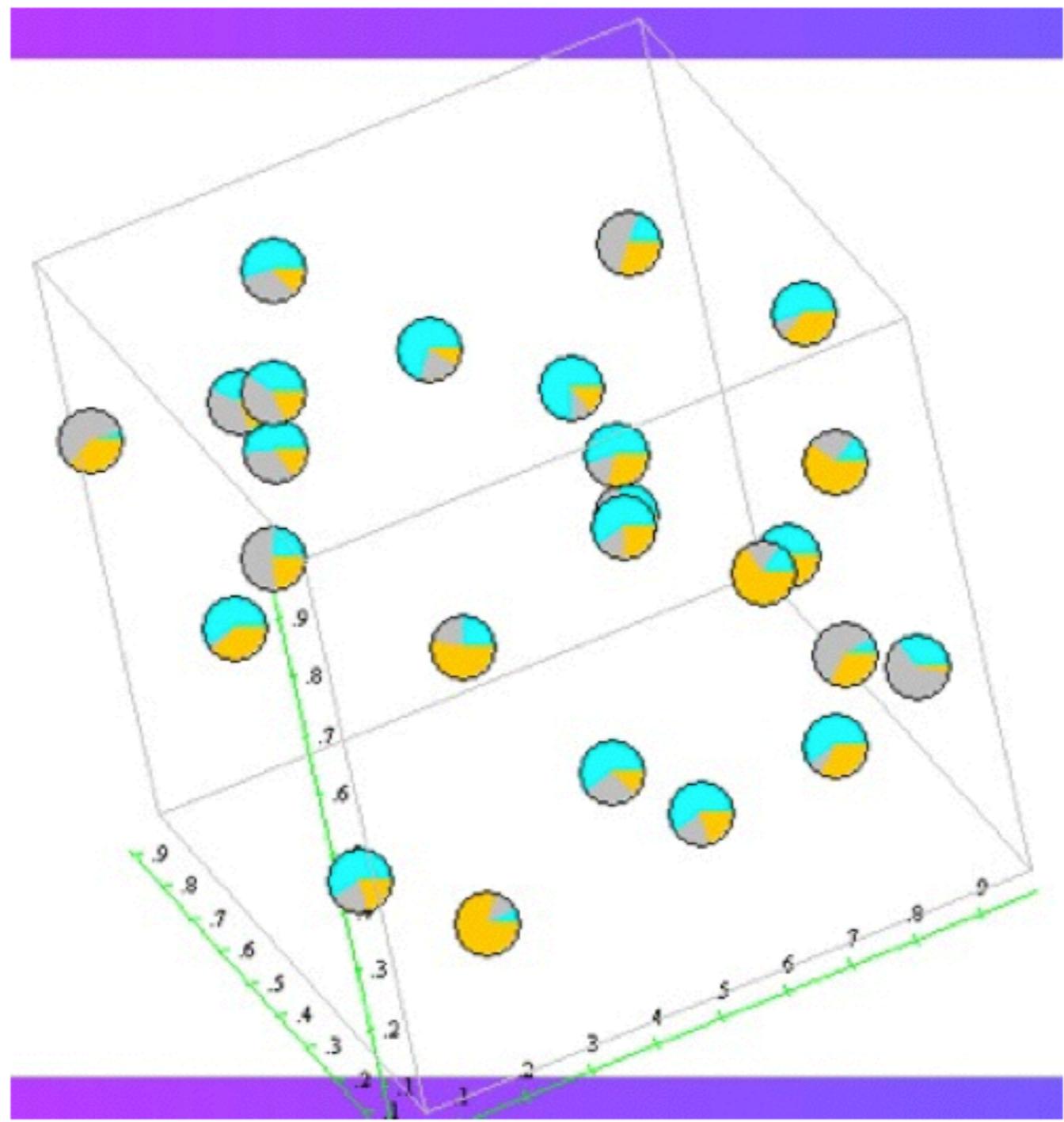


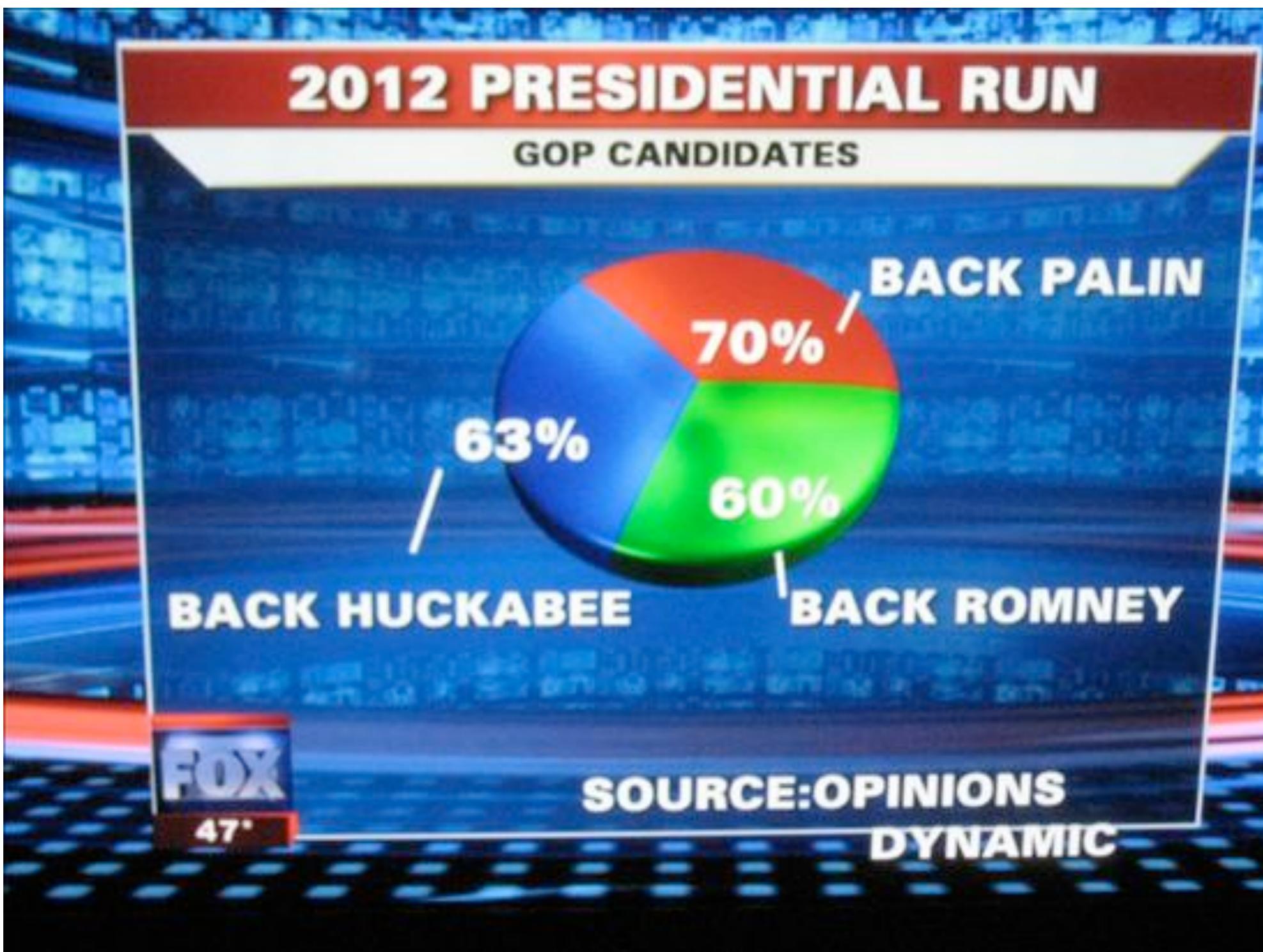
Sotheby's / Christie's

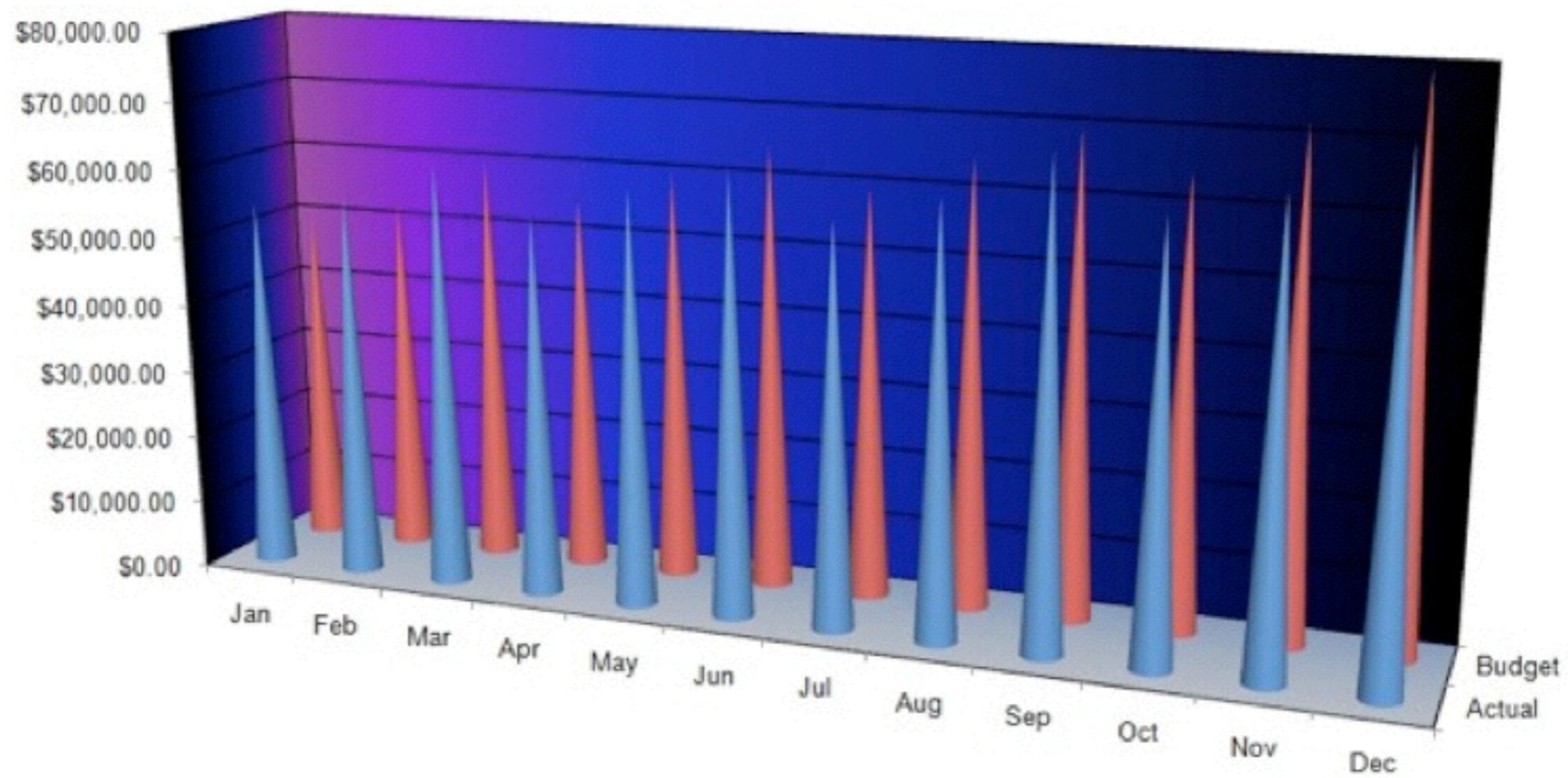
Worldwide Sales

Market Share Analysis





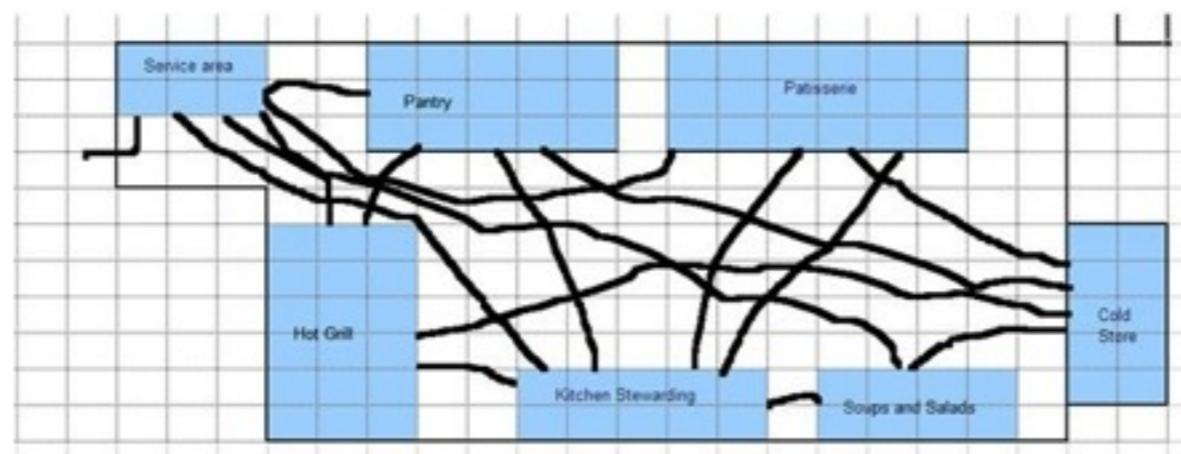




Expenses Percentage Variance from Budget

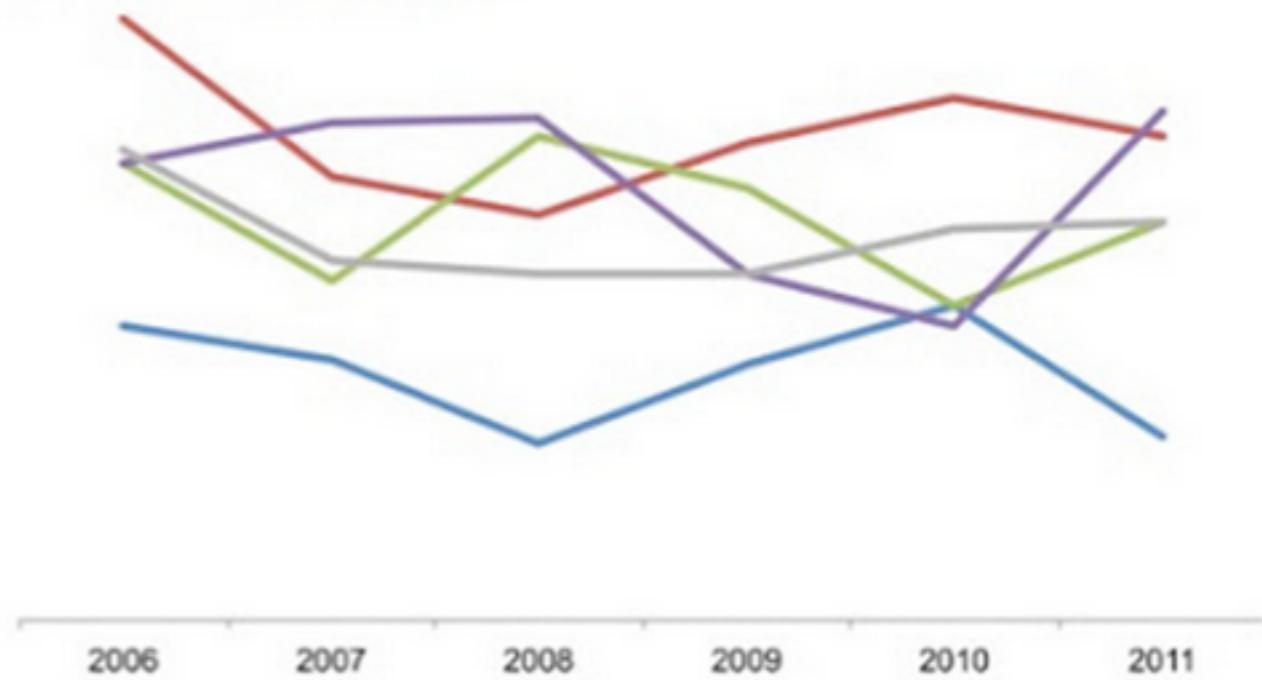


Spaghetti Graph



The Spaghetti Graph

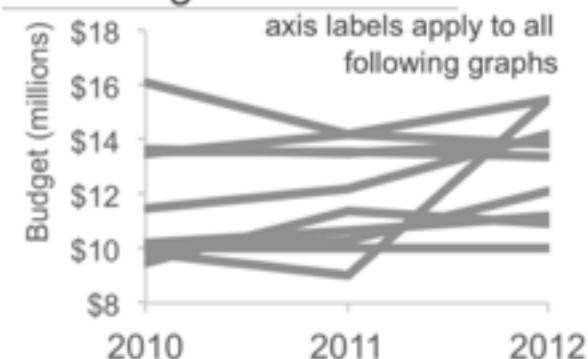
It doesn't even matter what the details are because it is nearly impossible to pull any insight from this visual



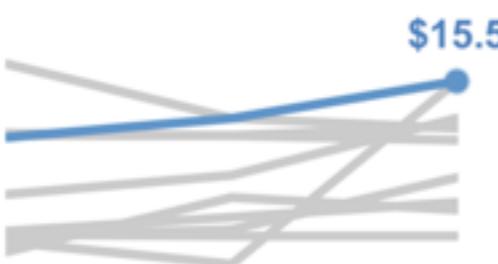
Spaghetti Graph

Budget over time by category

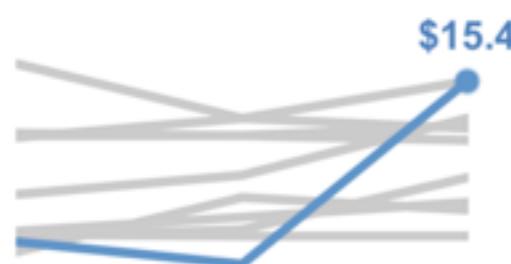
All Categories



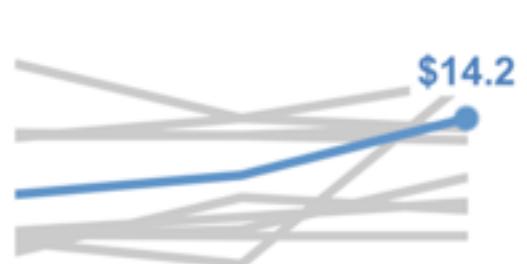
Category 1



Category 2



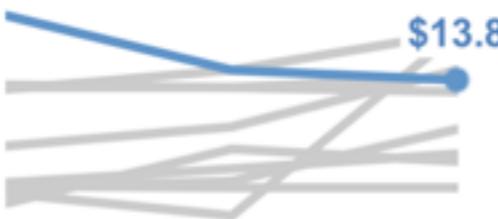
Category 3



Category 4



Category 5



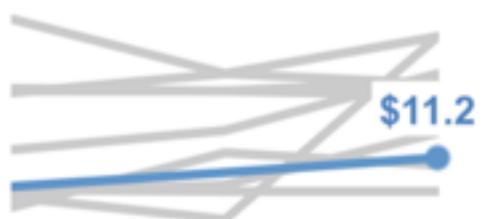
Category 6



Category 7



Category 8



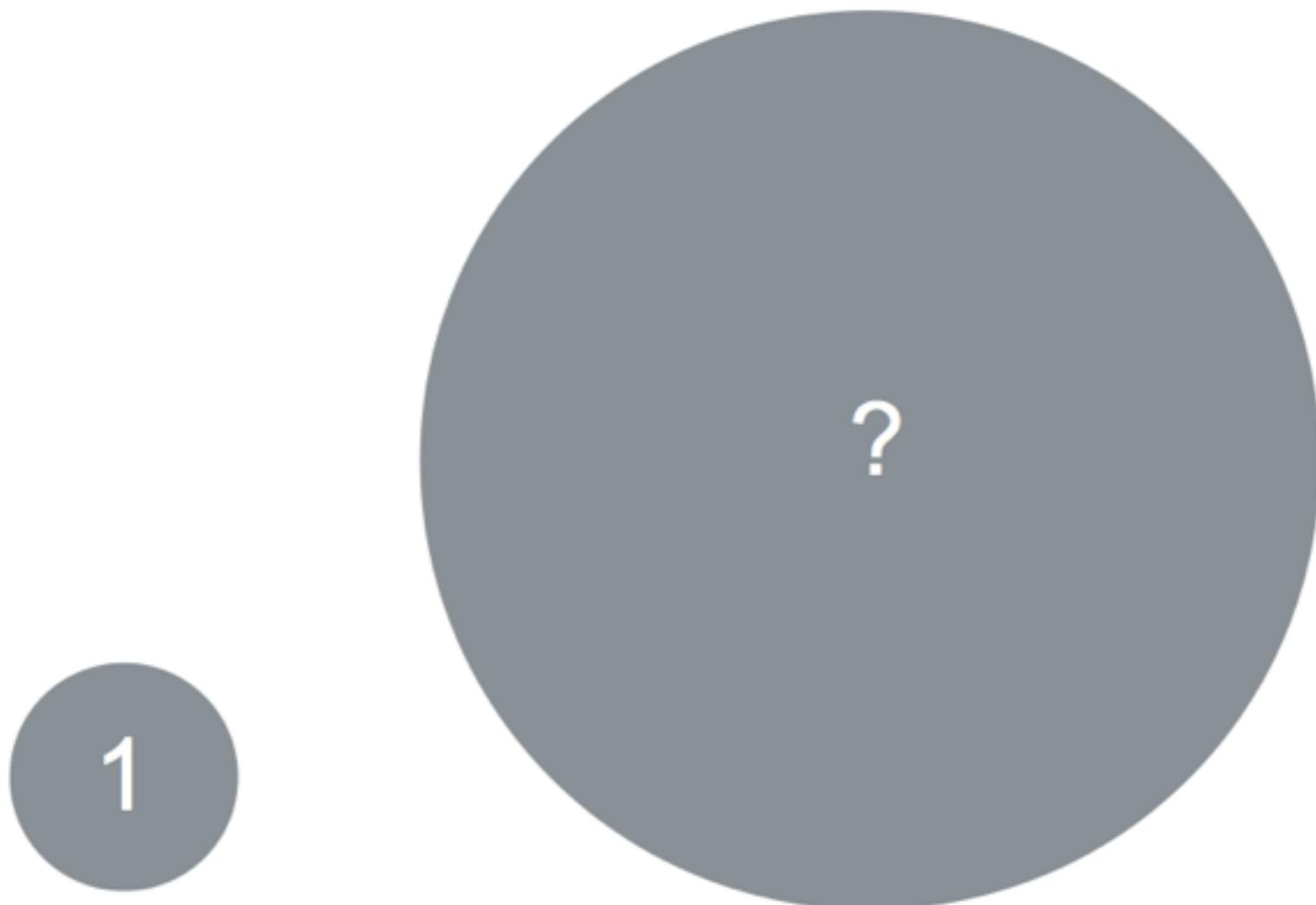
Category 9



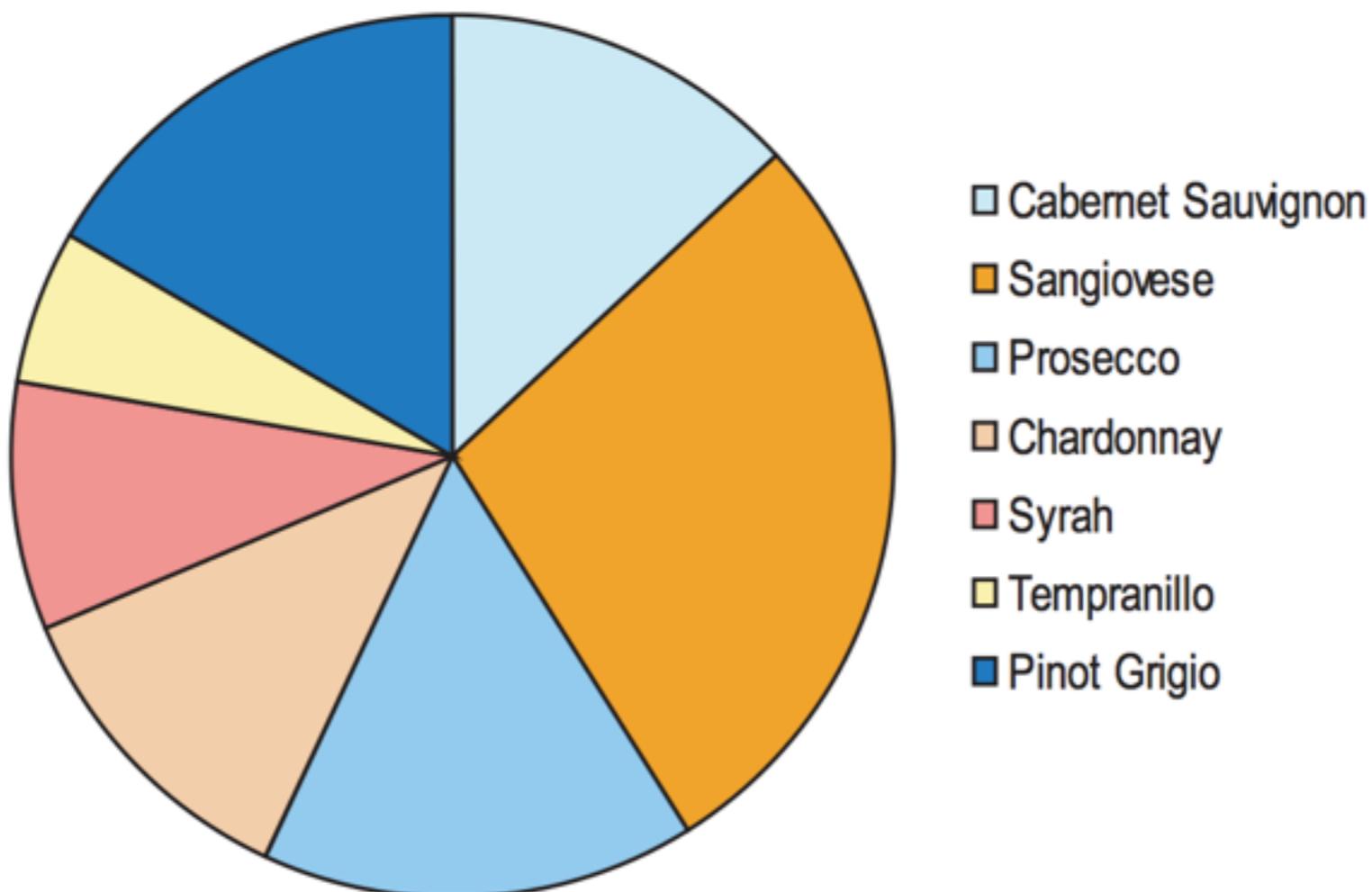
Category 10



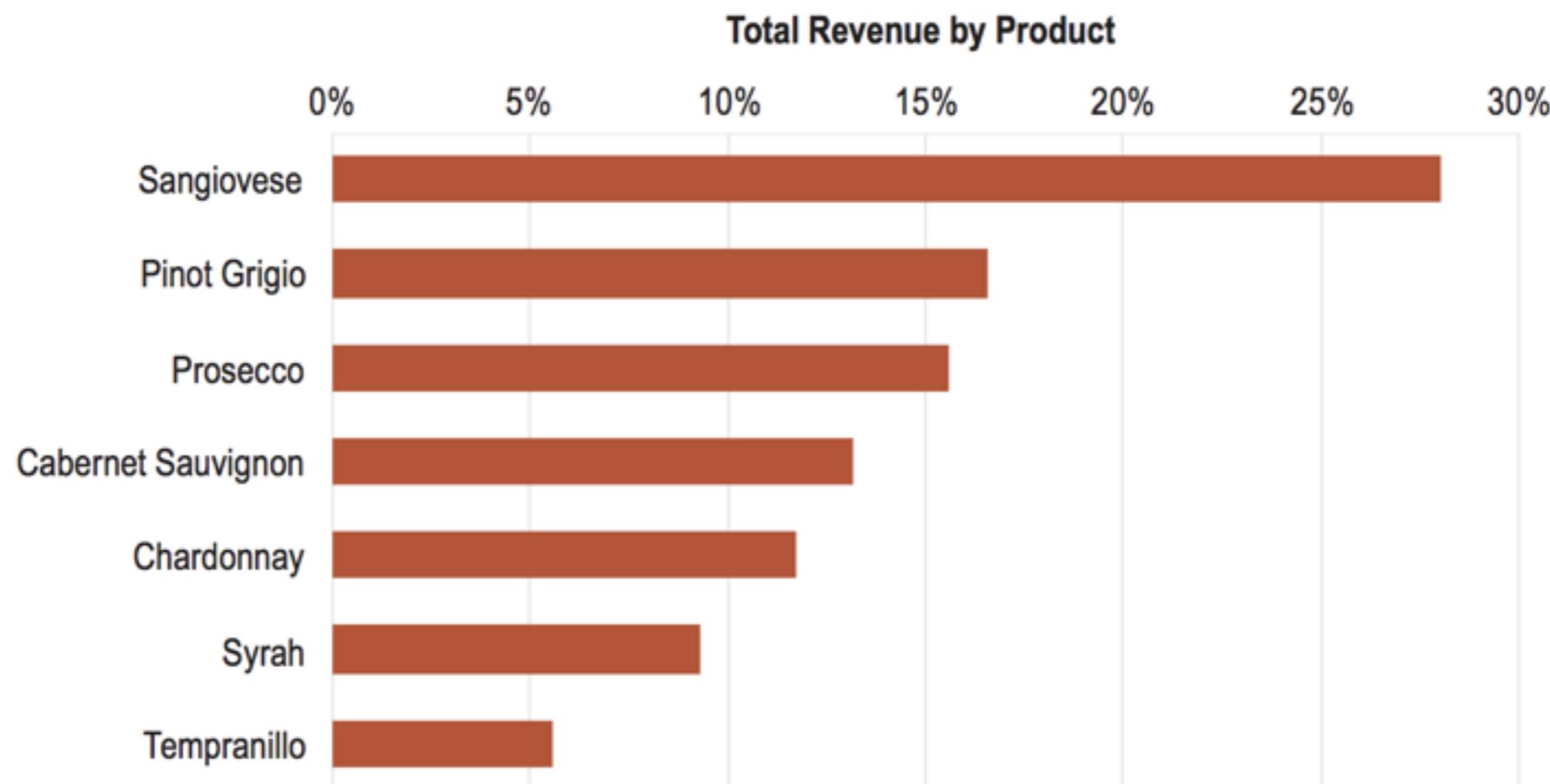
Save the Pies for Dessert



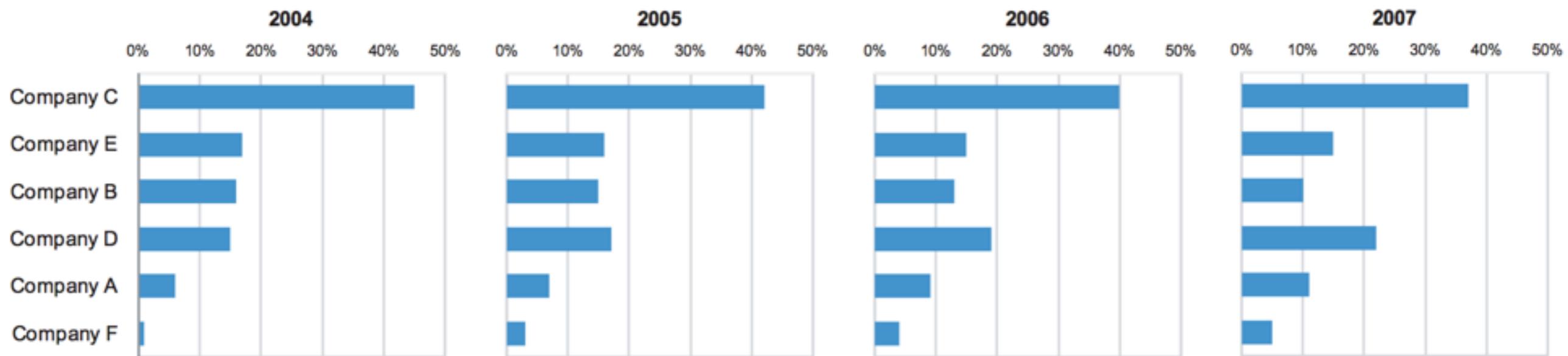
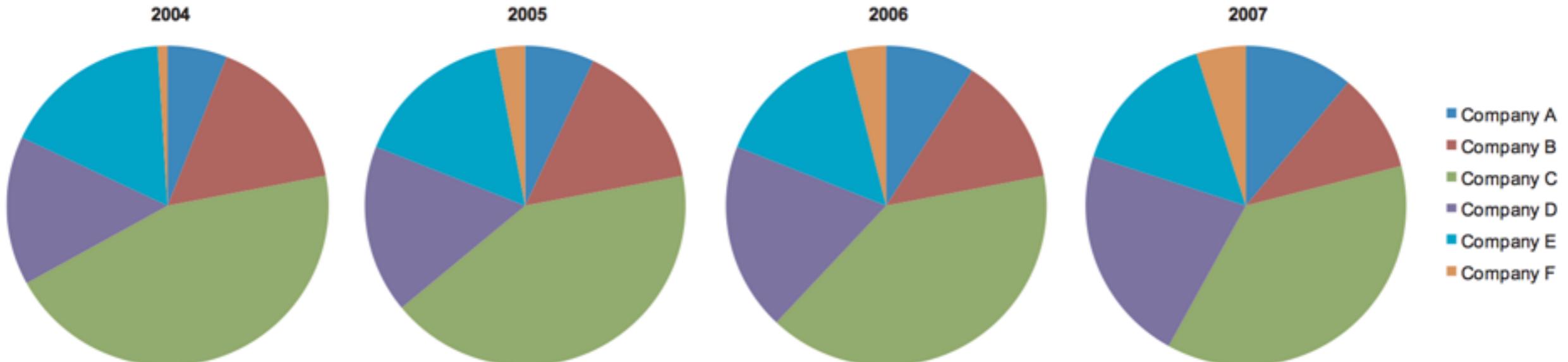
Save the Pies for Dessert



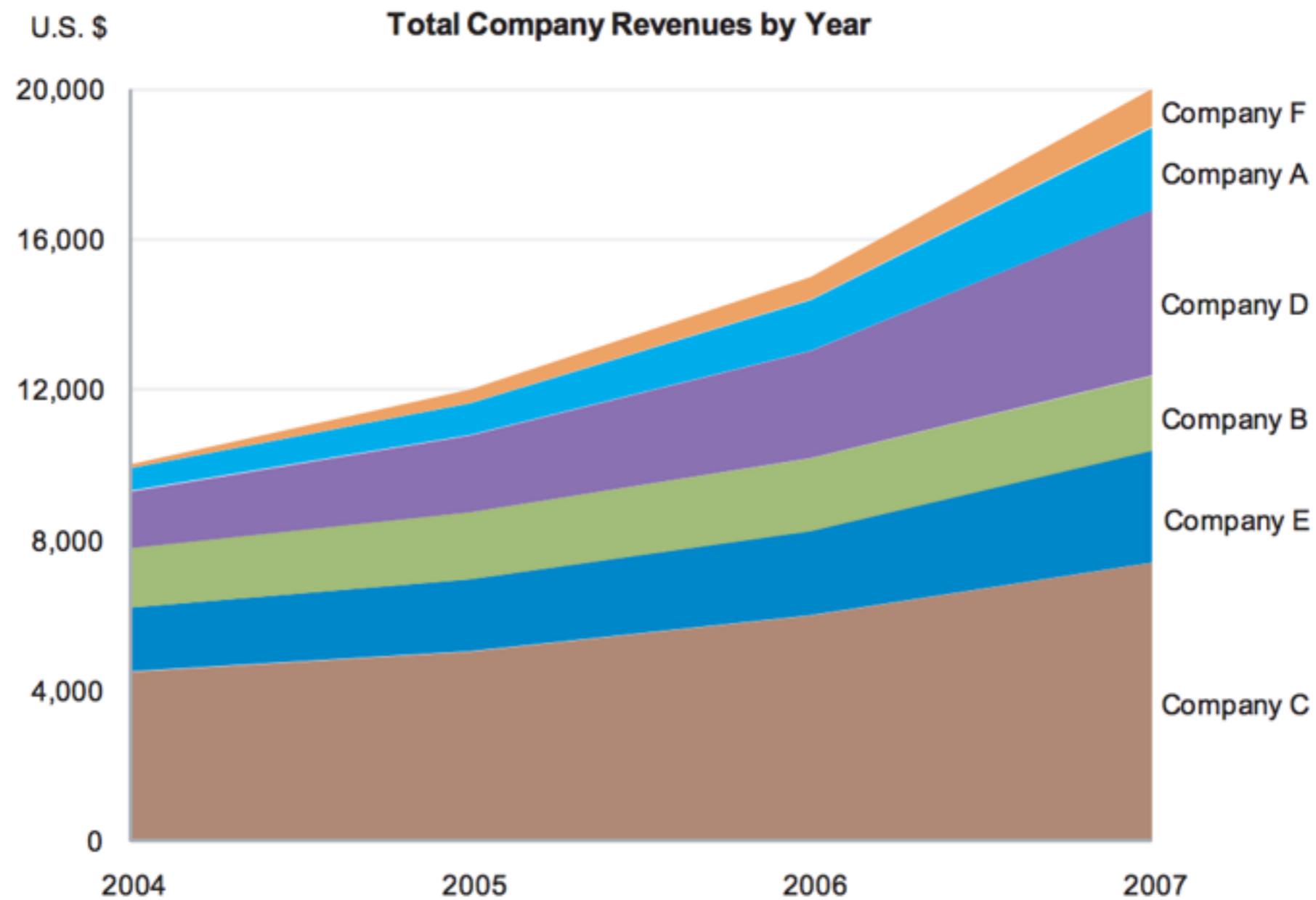
Save the Pies for Dessert



Save the Pies for Dessert

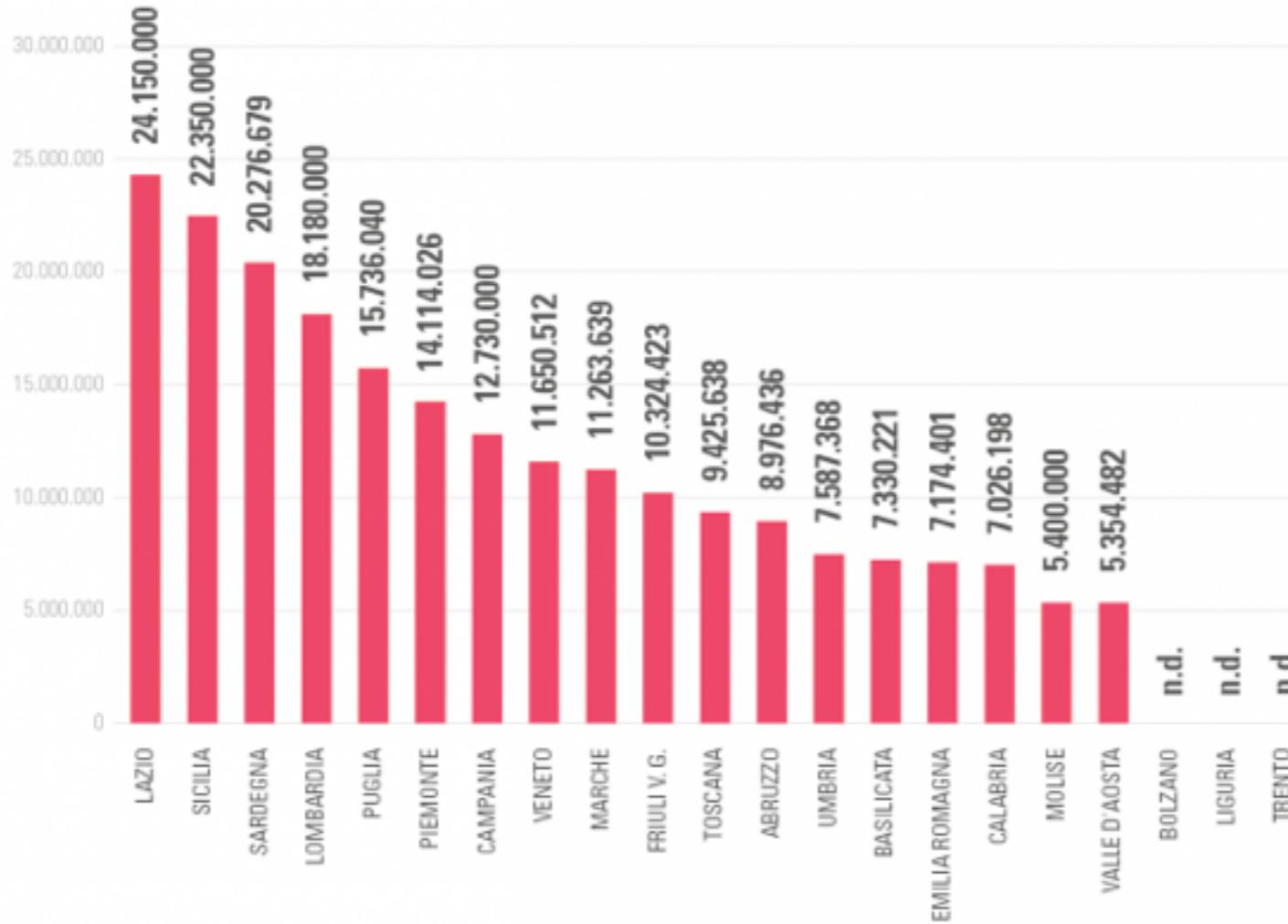


Save the Pies for Dessert

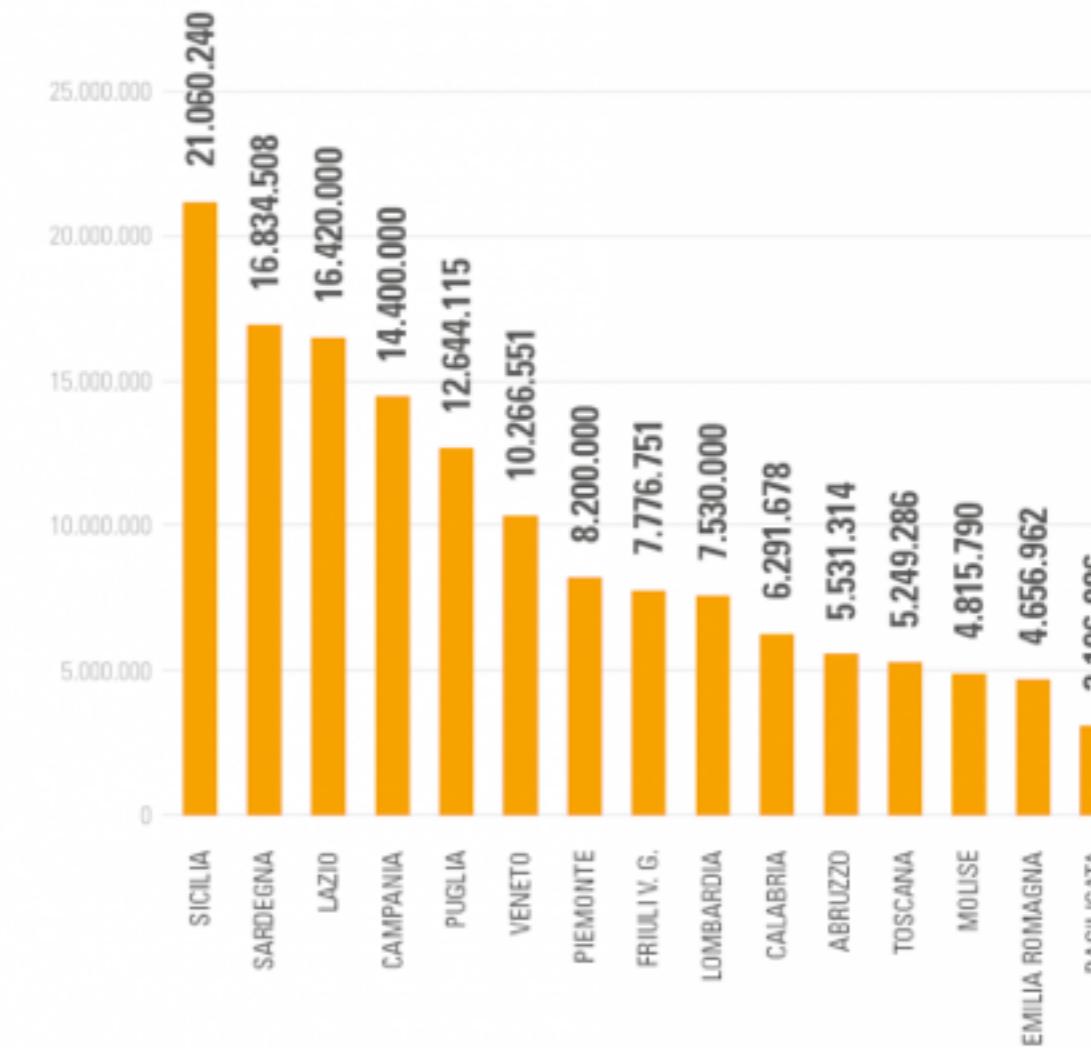


Cost of Local Councillors

INDENNITÀ



VITALIZI (*)



(*) non sono considerate le indennità di fine mandato

The Shift

The field has become less reserved for experts and less expensive

The **science** used visualization
as a tool for understanding data.

Now the same paradigms
belong also to the **design** culture

alliances allocation **analysis** appraisal approach assessment benefit bidding building
business capital chain **change** china communities **competence** complexity
construction contract contractor control coordination **cost**
criteria critical culture cycle decision design **development** earned-value
education engineering evaluation **factors** fuzzy governance human
implementing incentive individuals **industry** information infrastructure initiative
innovation integration international joint knowledge leadership
learning life making **management** matrix maturity
method model multi-project network **organisation** partnerships
performance planning portfolio practice private processes
procurement product program **project** public quality
relationships research **rISK** safety scheduling sector selection simulation soft software
stakeholder strategic management **strategy** structure **SUCCESS** supply
systems team technology theory trust uncertainty value
work

We need to define
what is a **Beautiful** and **Effective**
Visualization

Shows the data

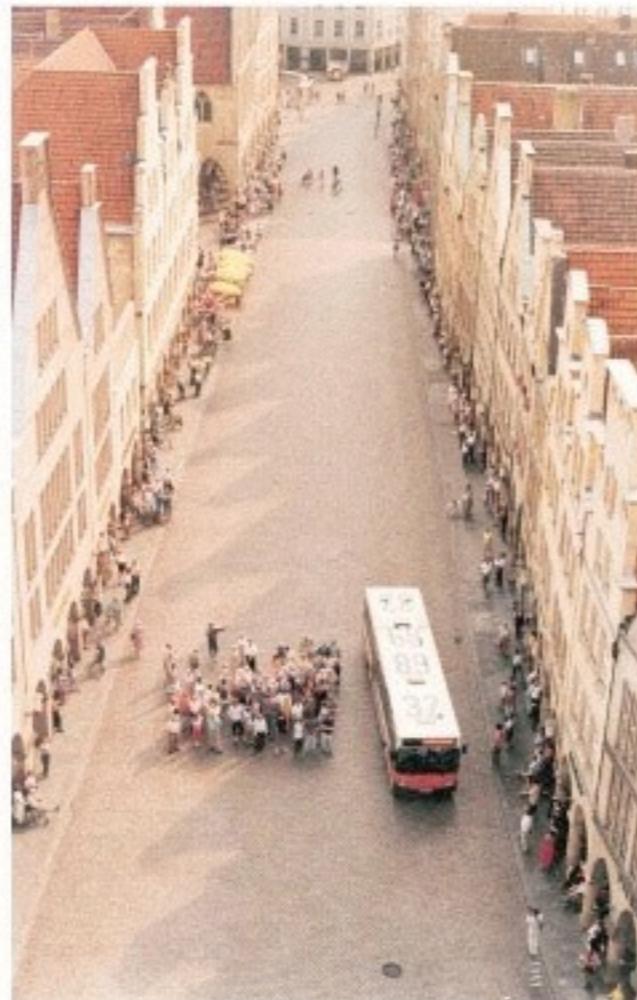
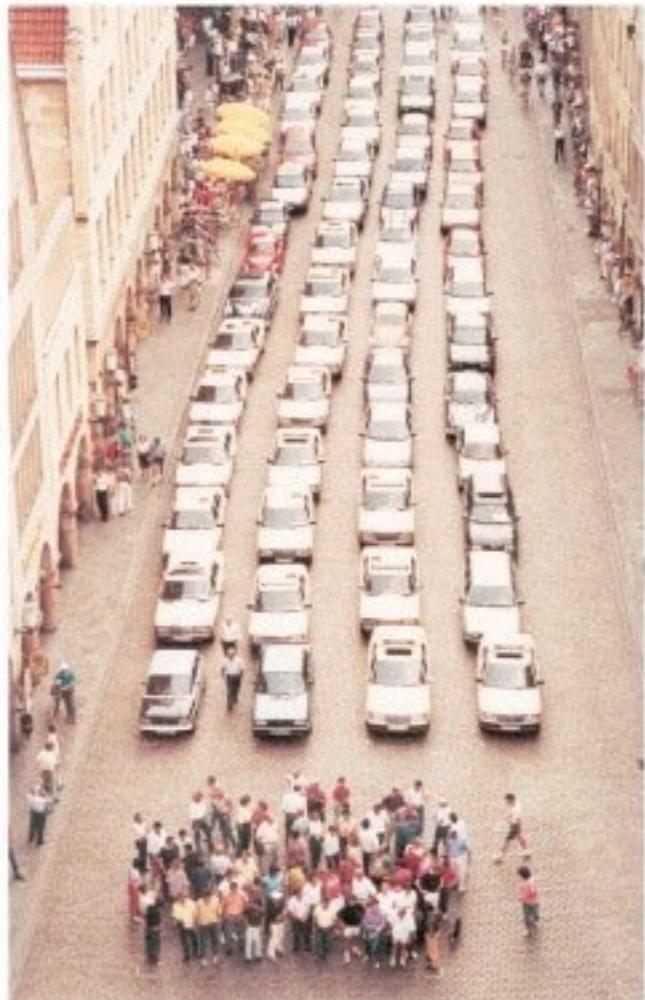
Provides meaningful informations

Provides a clear message

Attracts the users in some way

Allows further explorations

Amount of space required to transport the same number of passengers by car, bus or bicycle.



Car?

Bus?

Bicycle?

(Poster in city of Muenster Planning Office, August 2001)

Credit: Press-Office City of Münster, Germany

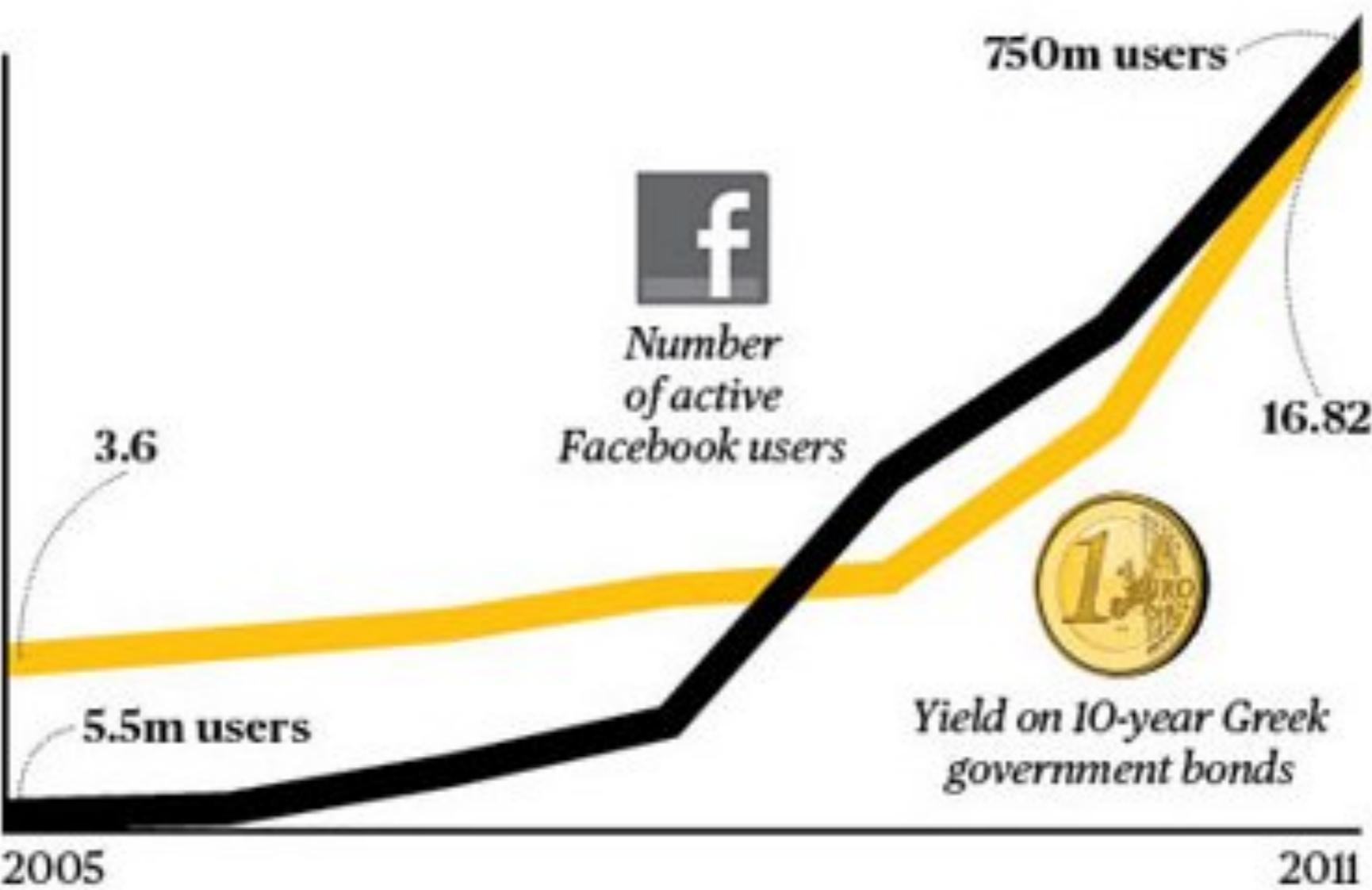
SPACE

taken by 60 people



Correlation == Causation?
(nope!)

Fig. 1
**IS FACEBOOK DRIVING
THE GREEK DEBT CRISIS?**



Finding stories

The greatest value of a picture is when it forces us
to notice what we never expected to see.

—John Tukey

Important stories live in our data.

The AOL case

RELEASED SEARCH DATA FOR ROUGHLY
658,000 ANONYMIZED USERS
OVER A THREE MONTH PERIOD FROM
MARCH TO MAY

The AOL case

The User 17556639 search history

how to kill your wife
how to kill your wife
wife killer
how to kill a wife
poop
dead people
pictures of dead people
killed people
dead pictures
dead pictures
dead pictures
murder photo
steak and cheese
photo of death
photo of death
death
dead people photos
photo of dead people
www.murderpeople.com
decapitated photos
decapitated photos
car crashes3
car crashes3
car crash photo

The AOL case

Thelma Arnold recognized as user No. 4417749



The Google Oracle

Weirdest Things Thousands Of People Google Every Month

<http://www.fastcocreate.com/3029902/infographic-these-are-the-weirdest-things-thousands-of-people-google-every-month#1>

“How to hide a dead body”

1K

AVG. MONTHLY SEARCHES

“Cat Dating”

110

AVG. MONTHLY SEARCHES

“I hate my job”

22K

AVG. MONTHLY SEARCHES

“How to ask a guy out”

14.8K

AVG. MONTHLY SEARCHES

“How to get away with murder” **1.9K**

AVG. MONTHLY SEARCHES

“How to make my cat love me” **390**

AVG. MONTHLY SEARCHES

“Is Lady Gaga a Man?” **18.1K**

AVG. MONTHLY SEARCHES

“Why did I get married?” **40.5K**

AVG. MONTHLY SEARCHES

“How do I use Google”

1K

AVG. MONTHLY SEARCHES

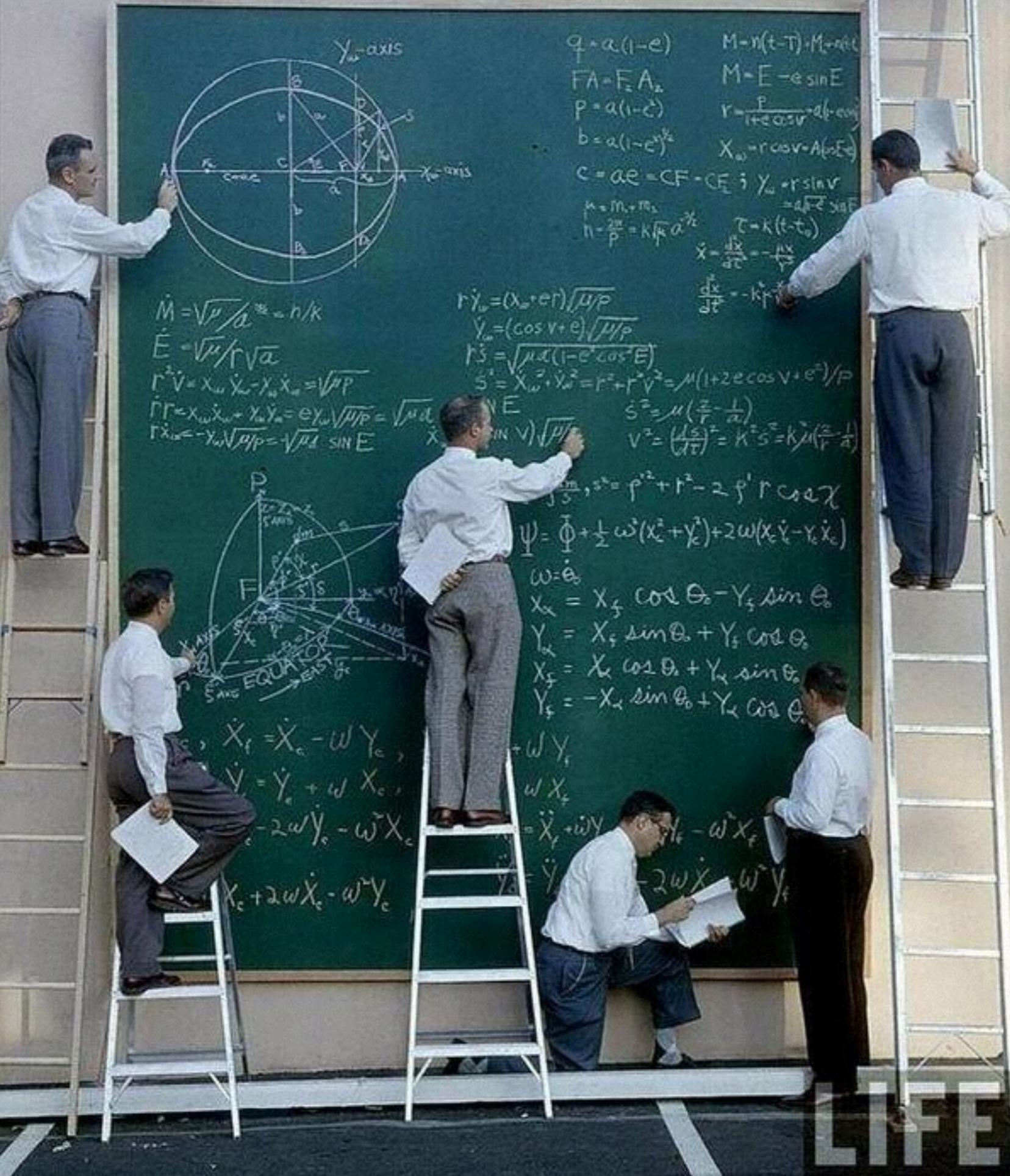
“Is Santa real?”

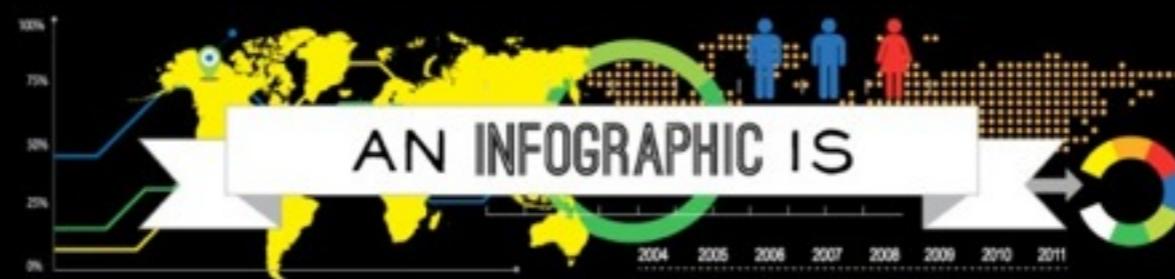
60.5K

AVG. MONTHLY SEARCHES

The Process

A combination of many disciplines

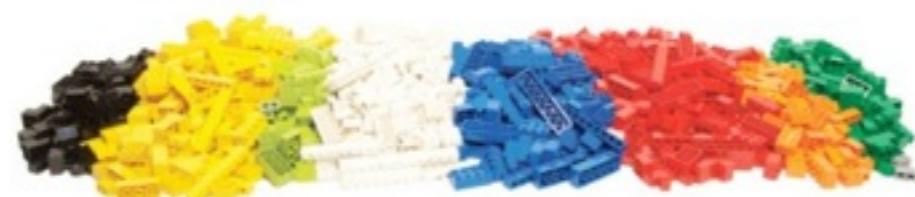




DATA



SORTED



ARRANGED

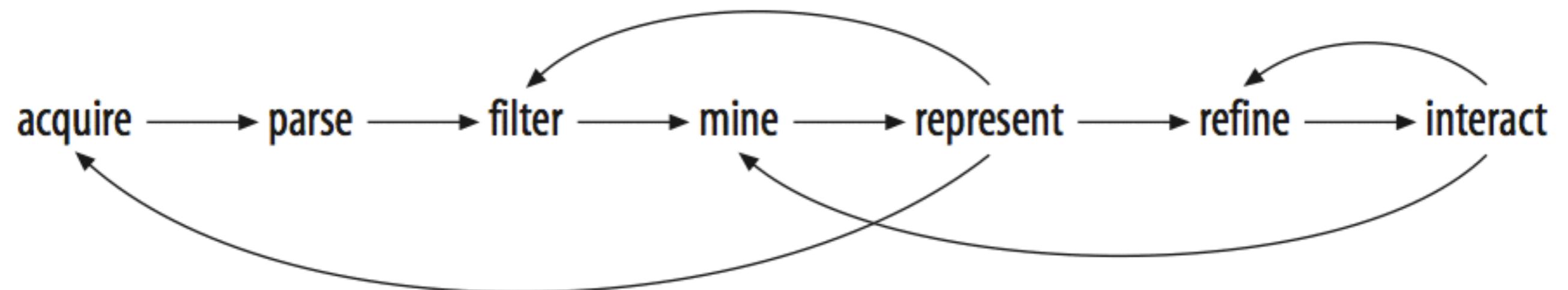


PRESENTED
VISUALLY



PHOTOGRAPHY BY BRANDON ROSEN PHOTOGRAPHY WWW.BRANDONROSSEN.COM @BRANDONROSSEN

Iterations



The Process

1. ACQUIRE THE DATA
2. CONVERSION & CLEANING
3. VISUALIZE QUICKLY
4. FIND FACTS, ASK QUESTIONS
5. ITERATE
6. SKETCH VISUAL MODEL
7. DESIGN TONE OF VOICE, LOOK AND FEEL
8. ADD LAYERS (ANIMATION, TRANSITION, INTERACTIVITY)

Successful Visualizations

Visualizations that mean something

Katie Lewis

<http://katiehollandlewis.com>

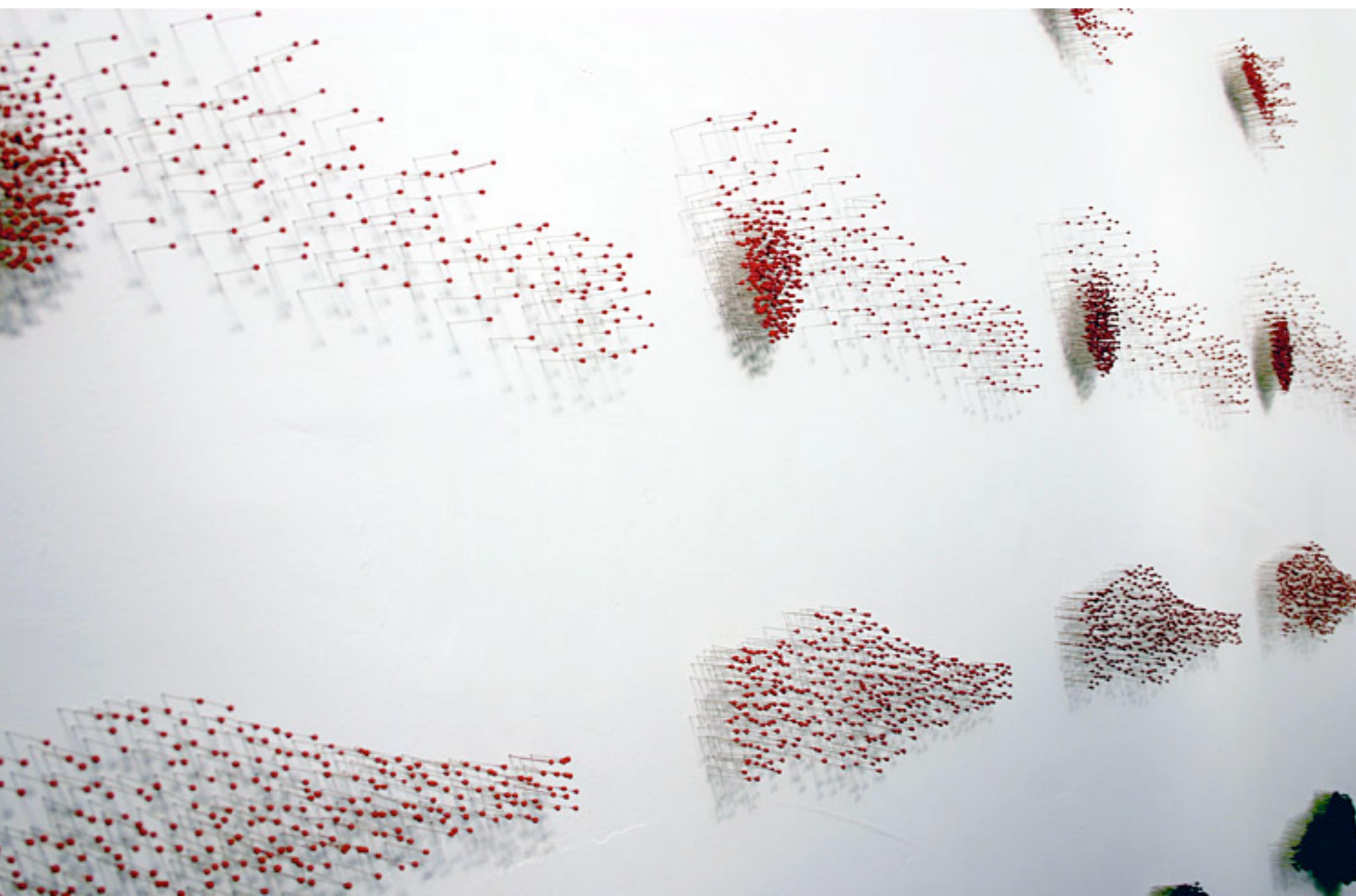
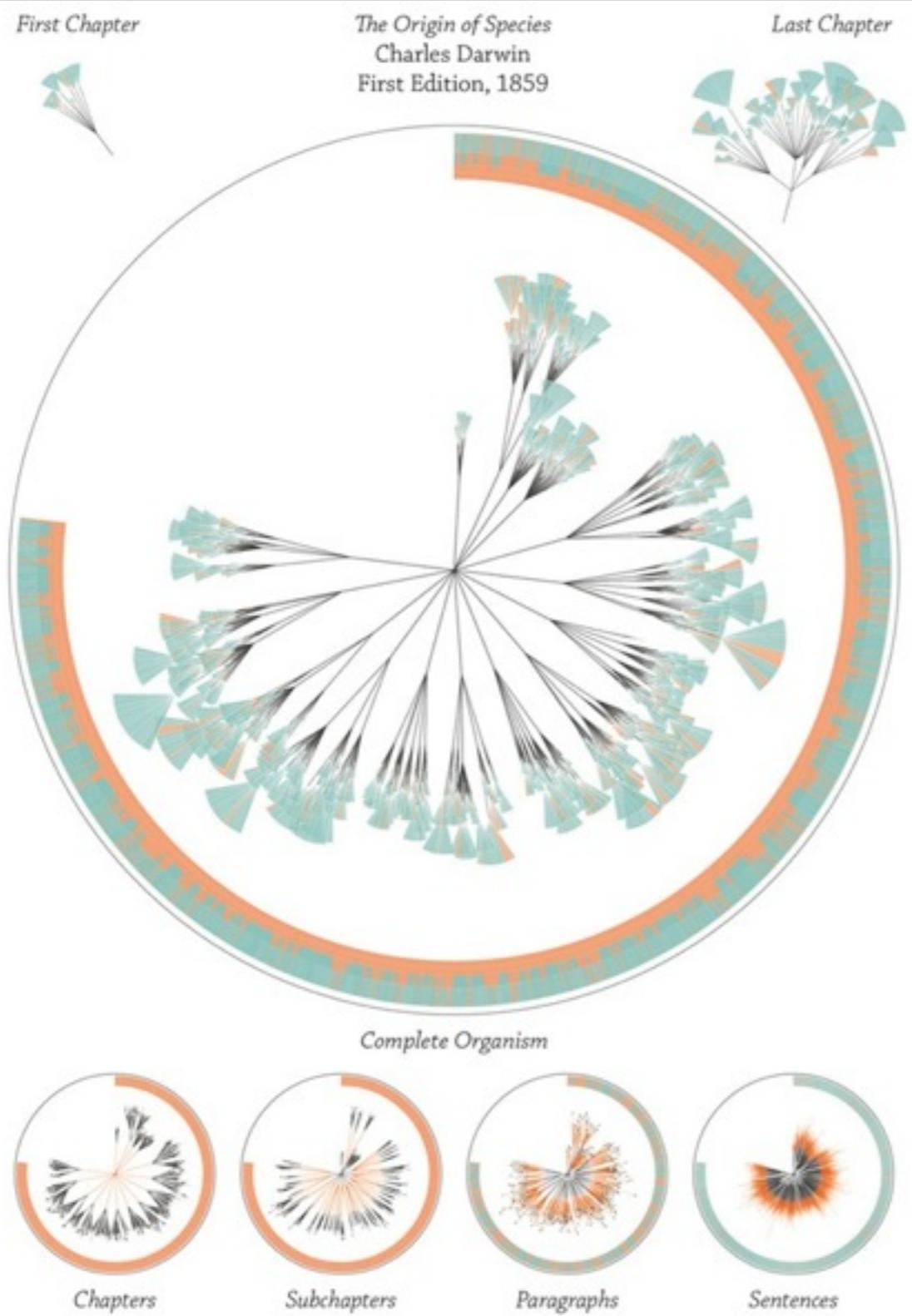


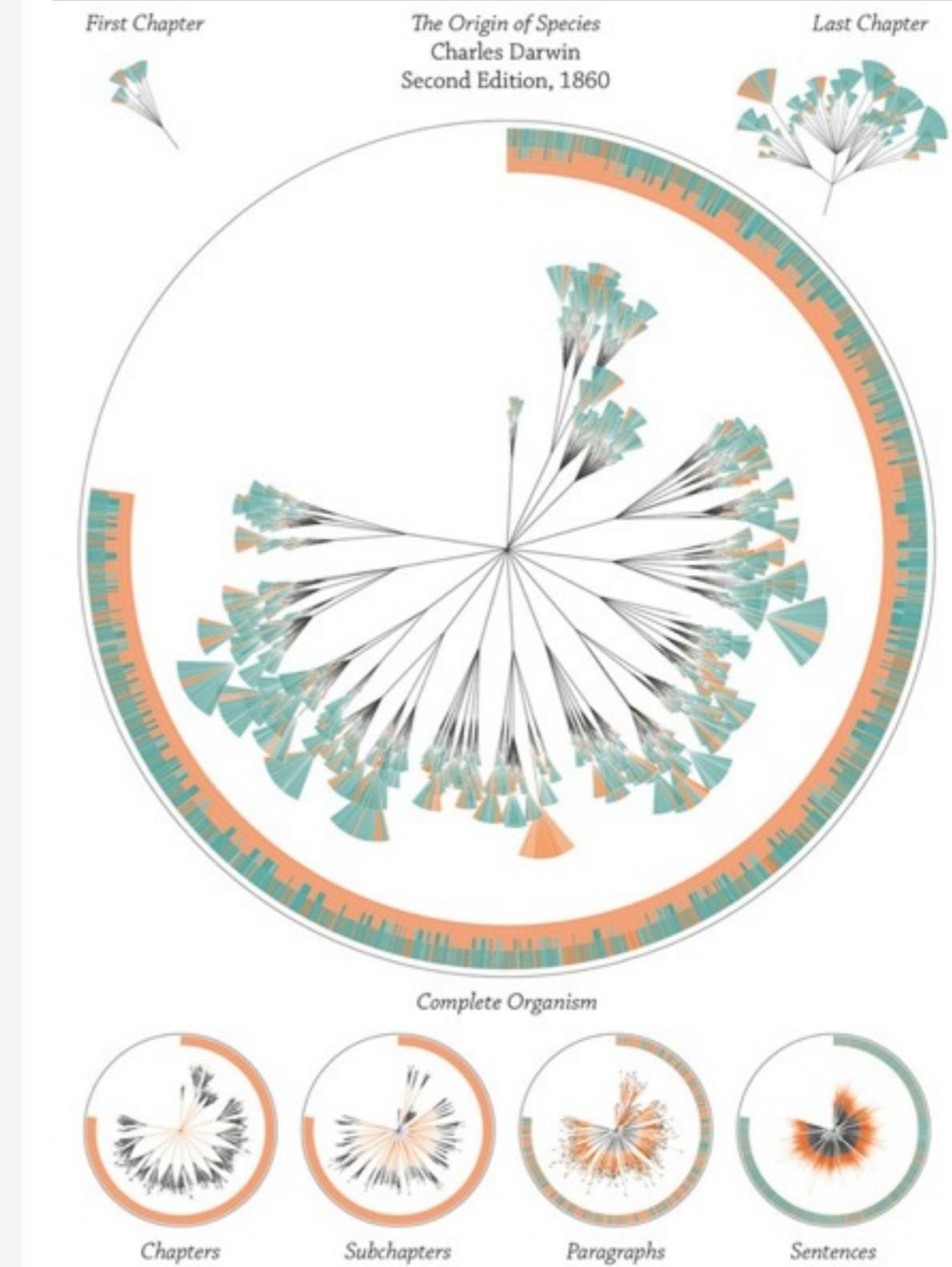
PLATE 1



(En)tangled Word Bank

Greg McInerny & Stefanie Posavec

PLATE 2



(En)tangled Word Bank

Greg McInerny & Stefanie Posavec

Prime Number Patterns

El Patrón de los Números Primos

Prime Number Patterns

by [Jason Davies](#).

For each natural number n , we draw a periodic curve starting from the origin, intersecting the x-axis at n and its multiples. The prime numbers are those that have been intersected by *only two* curves: the prime number itself and one.

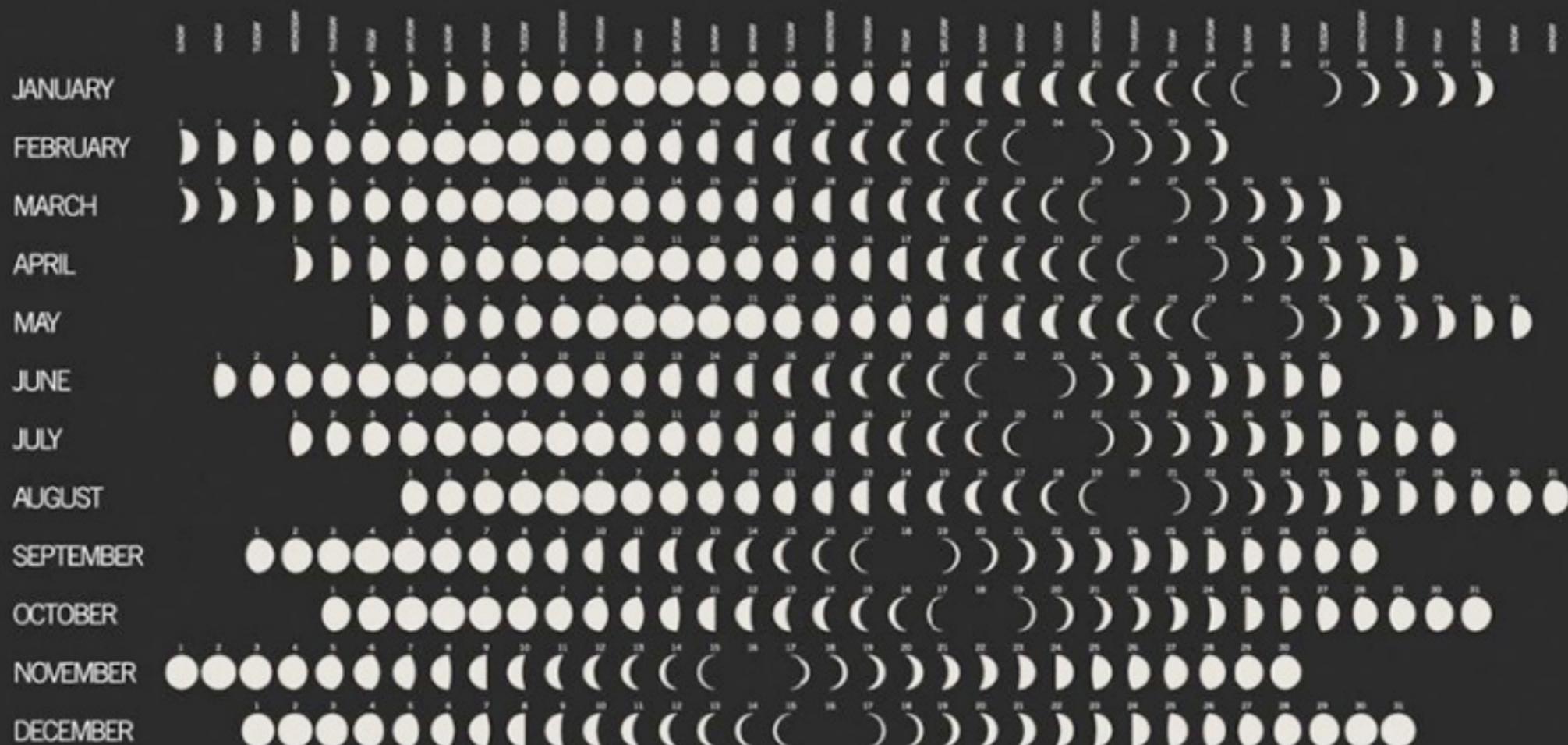
Below the currently highlighted number, we also show its [sum of divisors](#) $\sigma(n)$, and its aliquot sum $s(n) = \sigma(n) - n$, which indicate whether the number is [prime](#), [deficient](#), [perfect](#) or [abundant](#).

Based on [Sobre el patrón de los números primos](#) by Omar E. Pol.

2 3 5 7 11 13 17 19 23

2011 Moon Phase Calendar by Irwin Glusker

2011 PHASES OF THE MOON



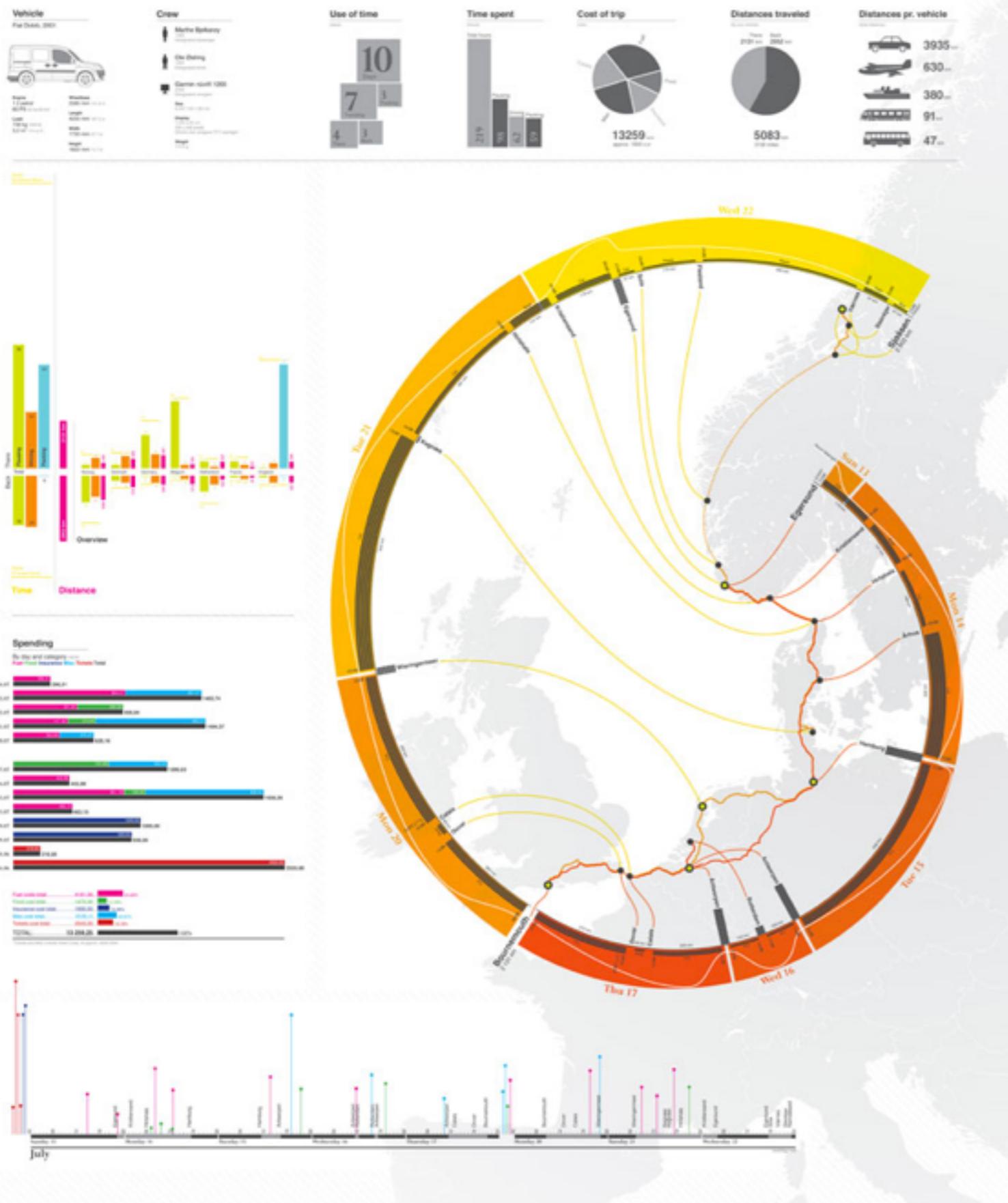
©2011 MoMA. The Museum of Modern Art logo is a registered trademark of The Museum of Modern Art.

Roadtrip 2009

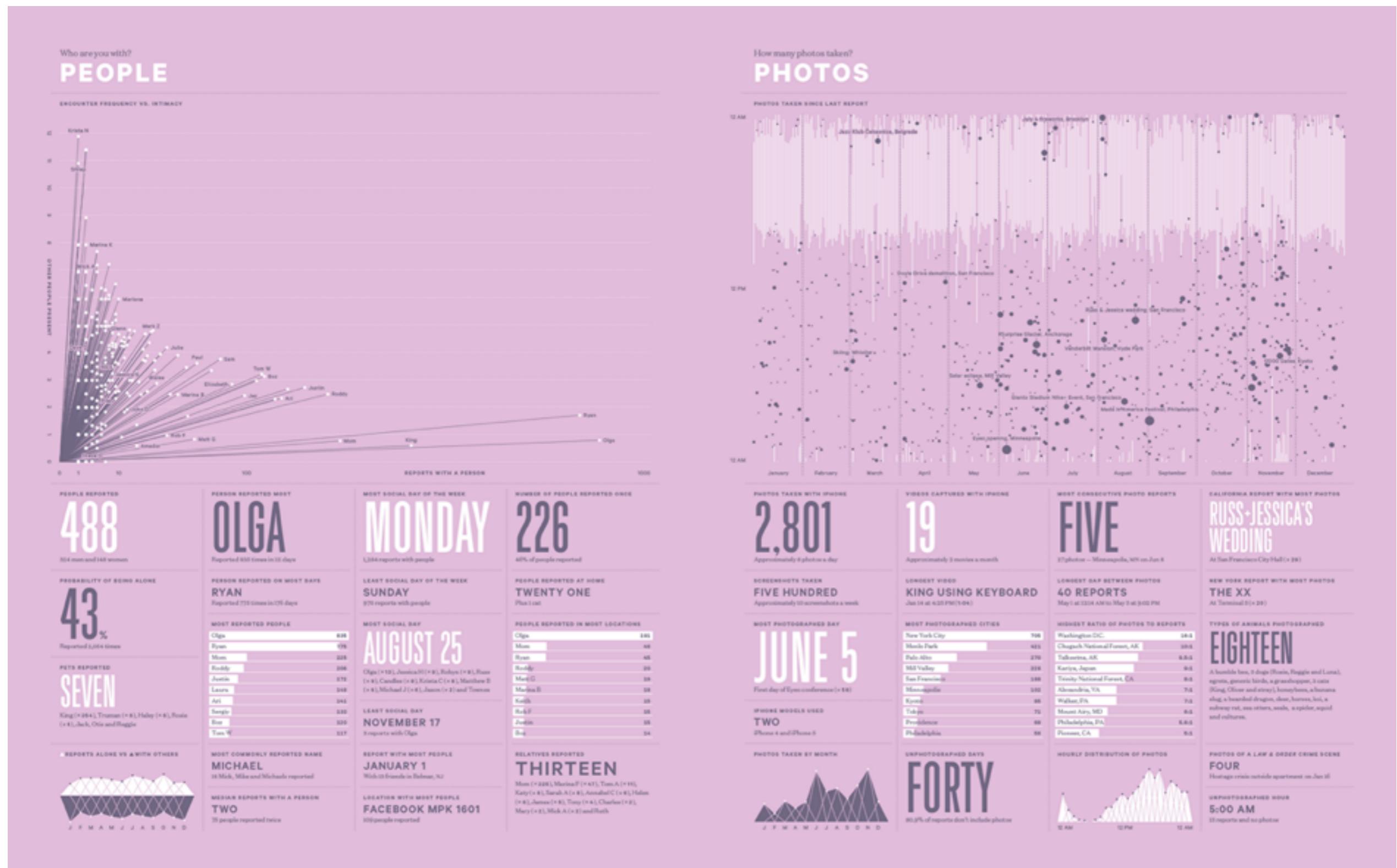
Moving home and visiting-month western Europe

130-227-200

A visual explanation of a travel by car, measured in distance, time and cost.

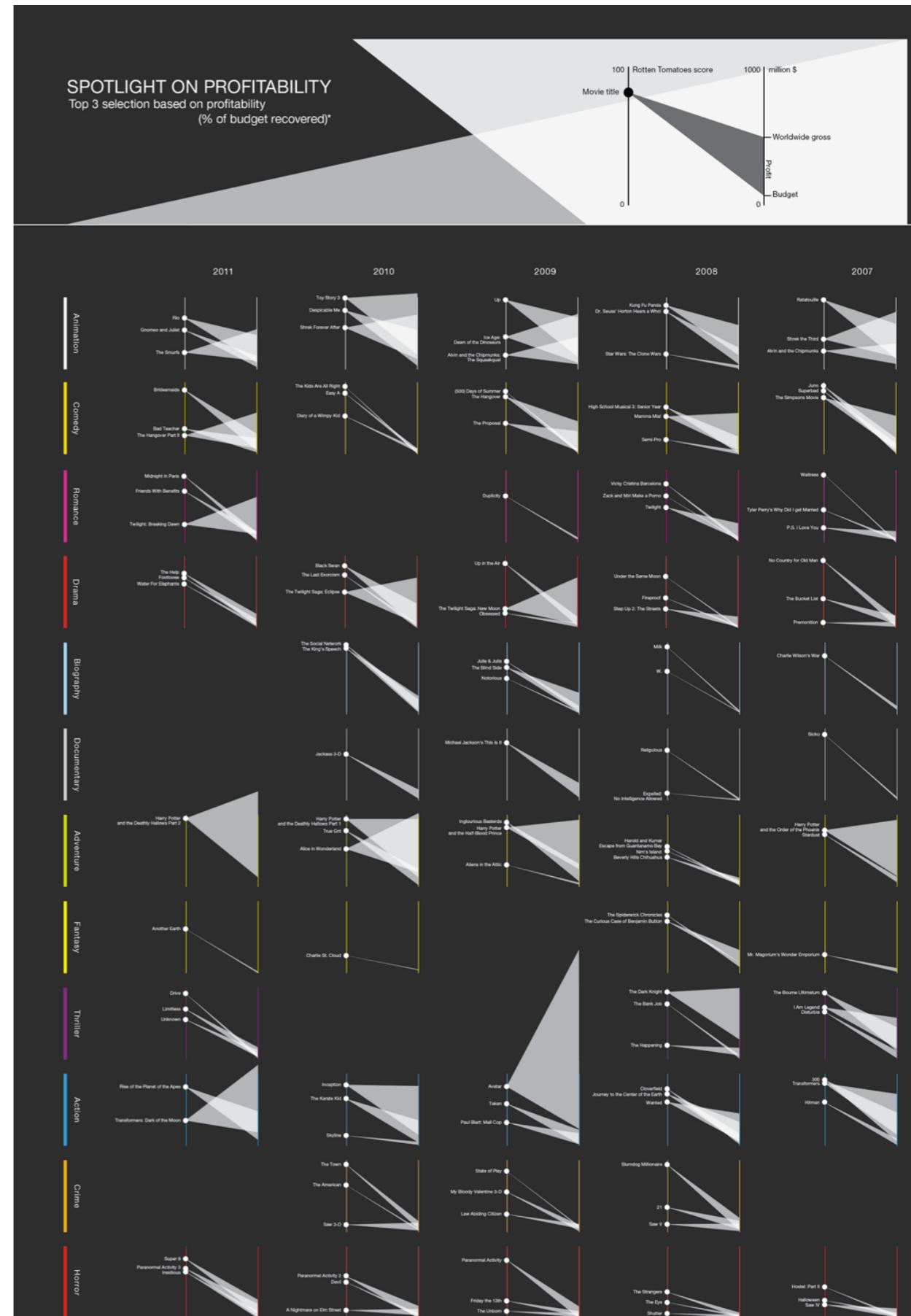
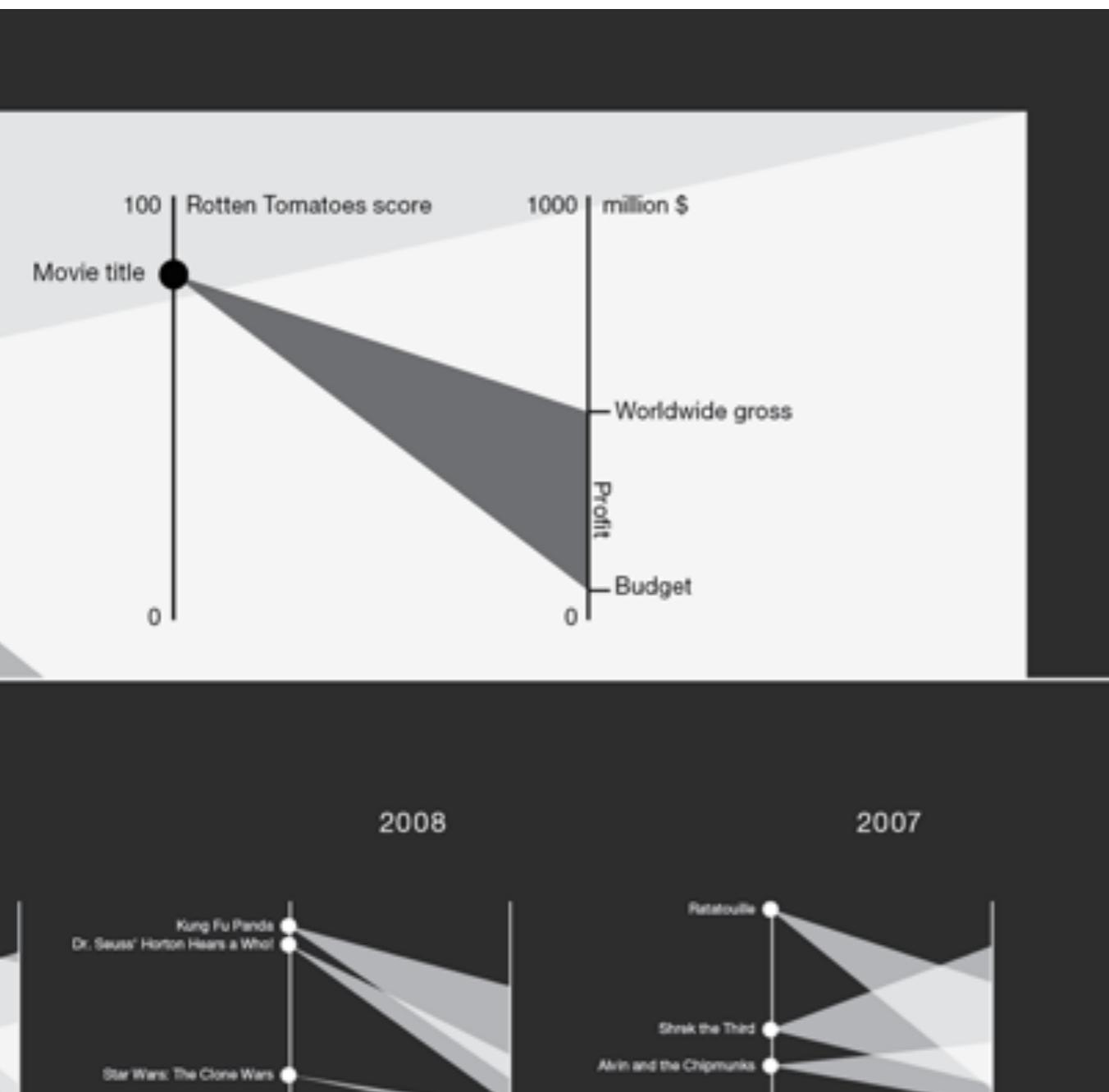


The Feltron Annual Report

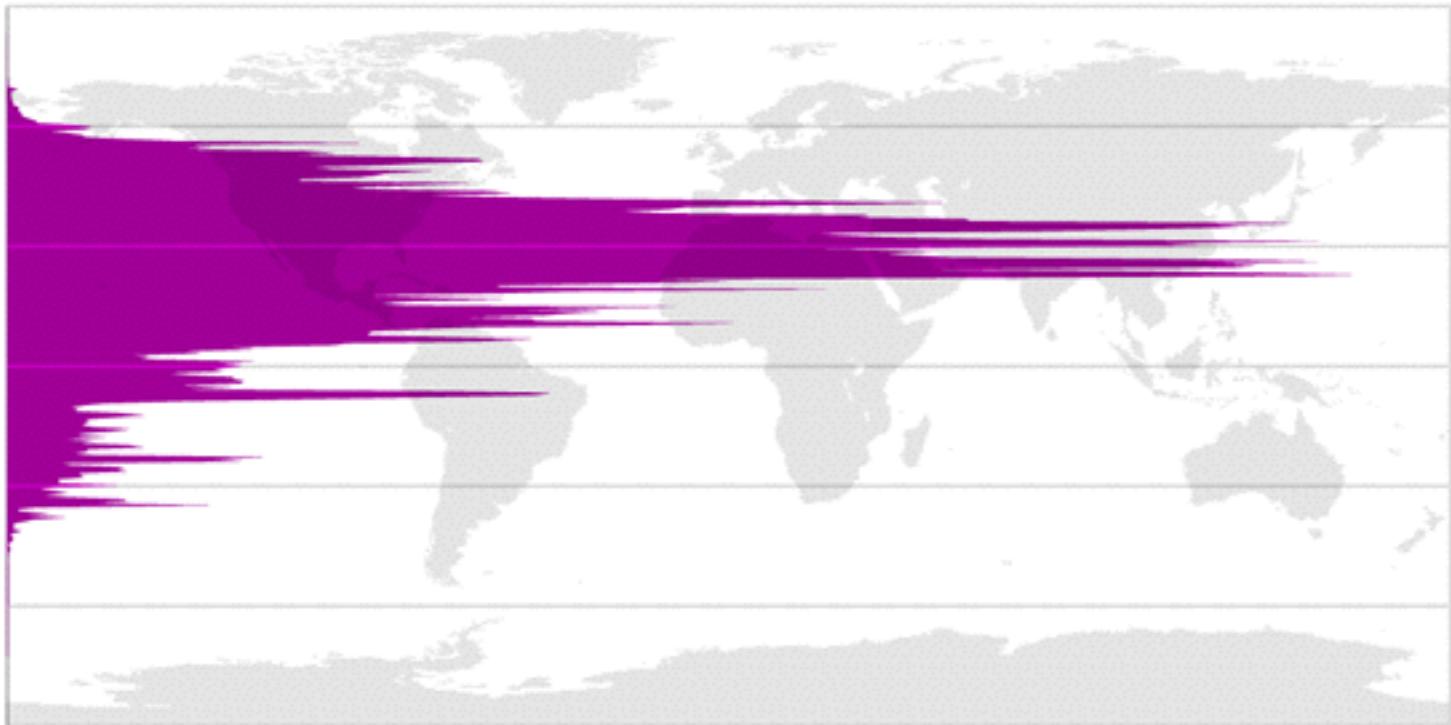


Spotlight on Profitability

<http://szucs.krisztina.hu>

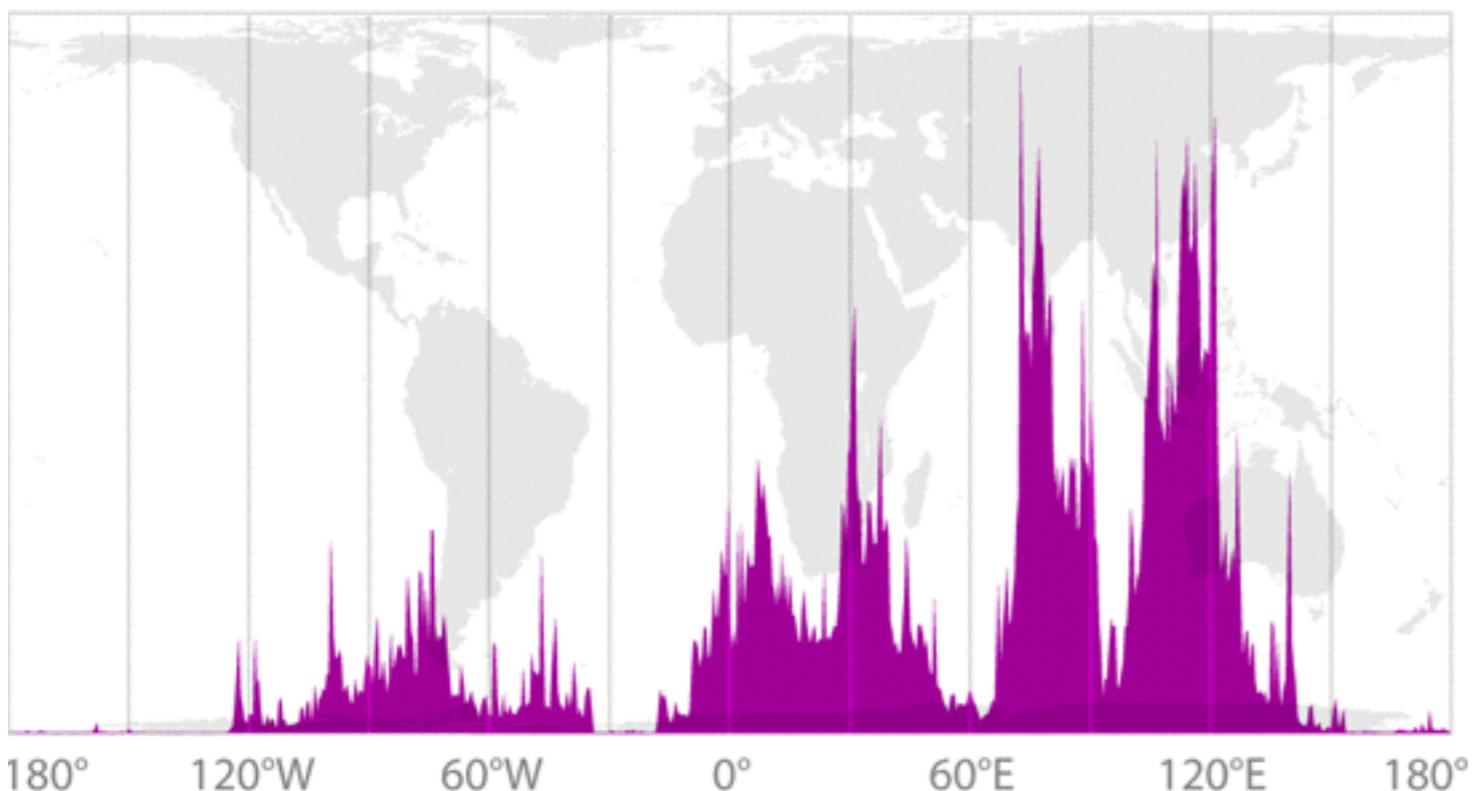


The World's Population in 2000, by Latitude



(horizontal axis shows the sum of all population at each degree of latitude)

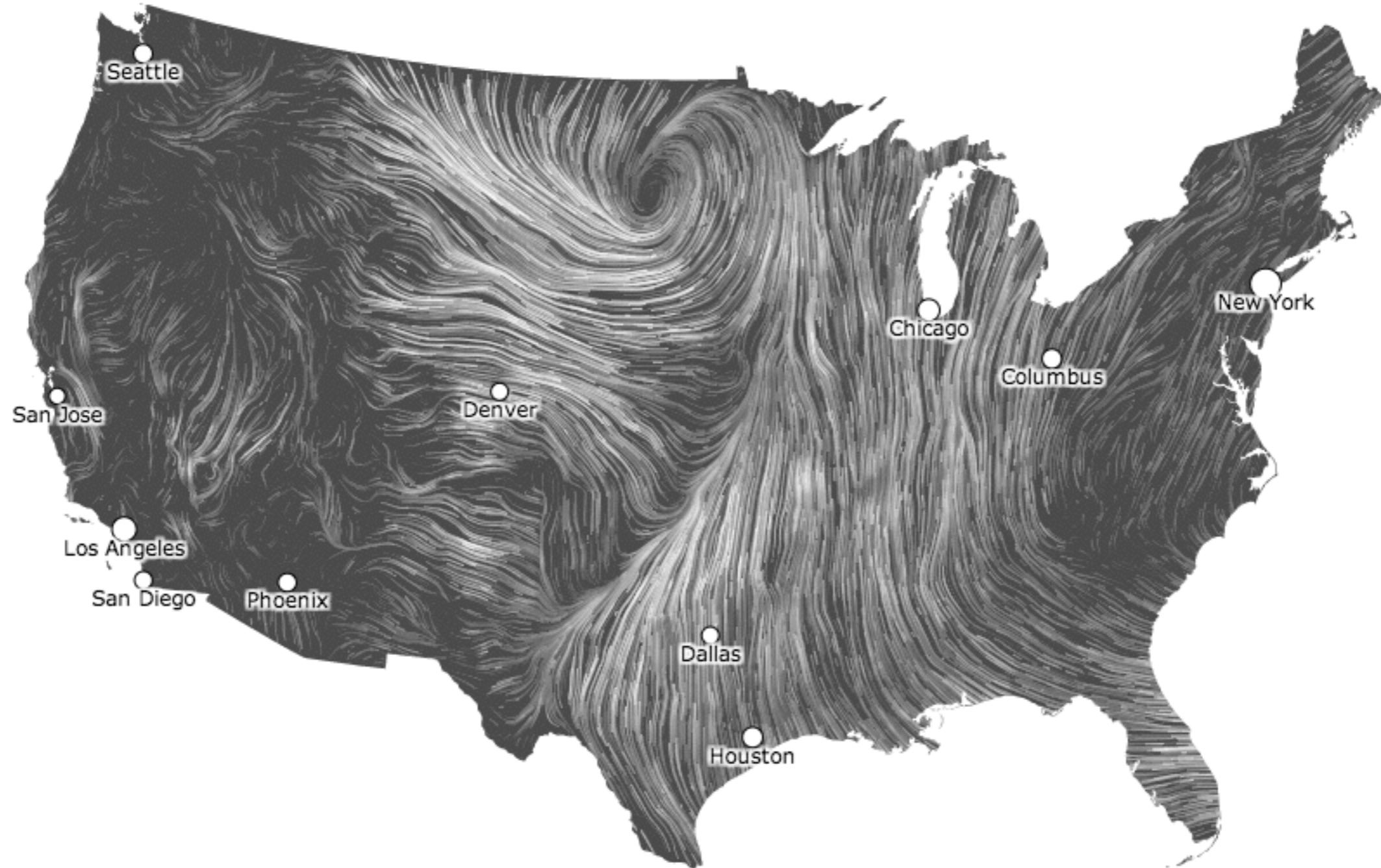
The World's Population in 2000, by Longitude



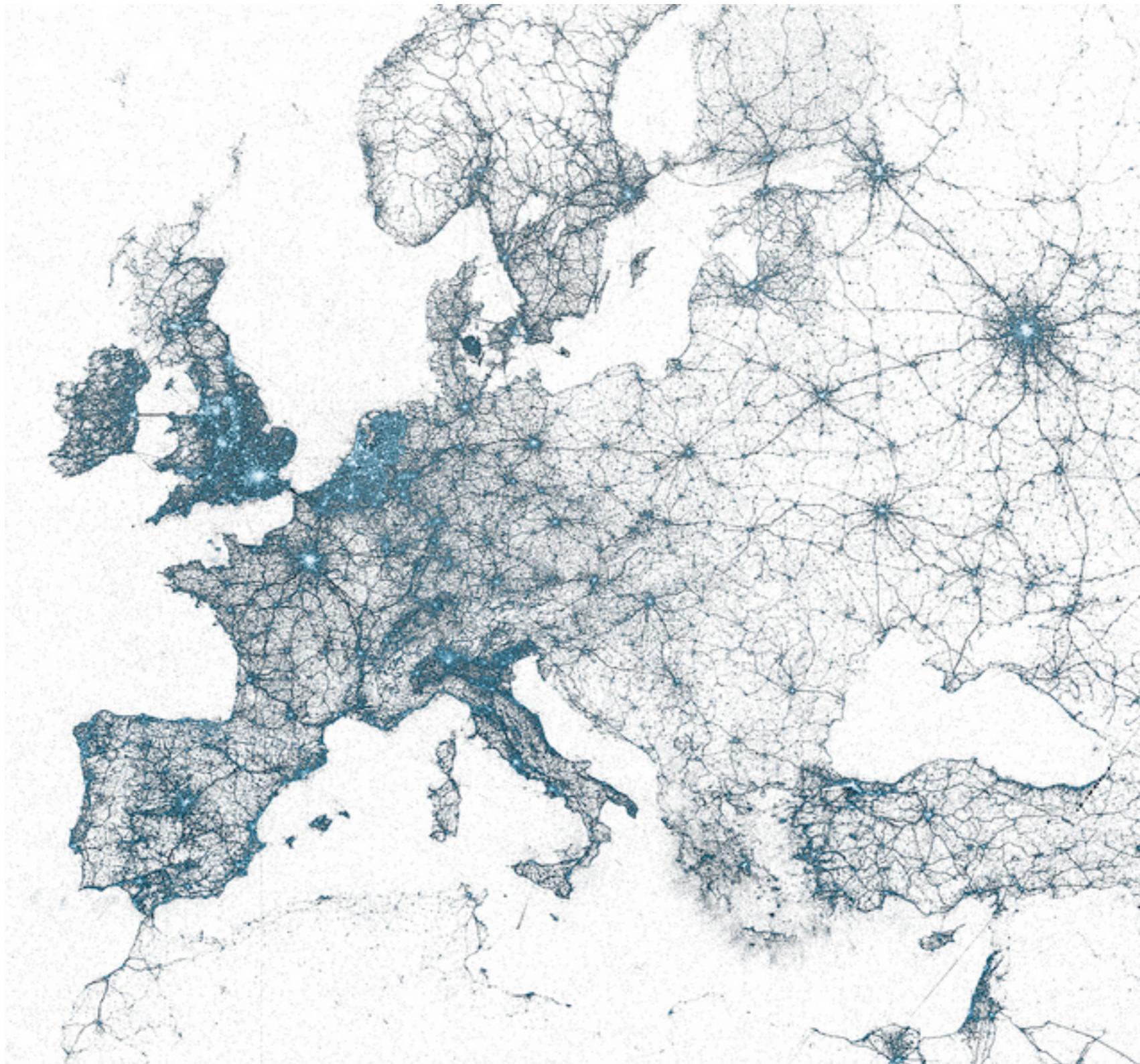
(vertical axis shows the sum of all population at each degree of longitude)

[http://urbandemographics.blogspot.it/2010/08/
world-population-distribution-map.html](http://urbandemographics.blogspot.it/2010/08/world-population-distribution-map.html)

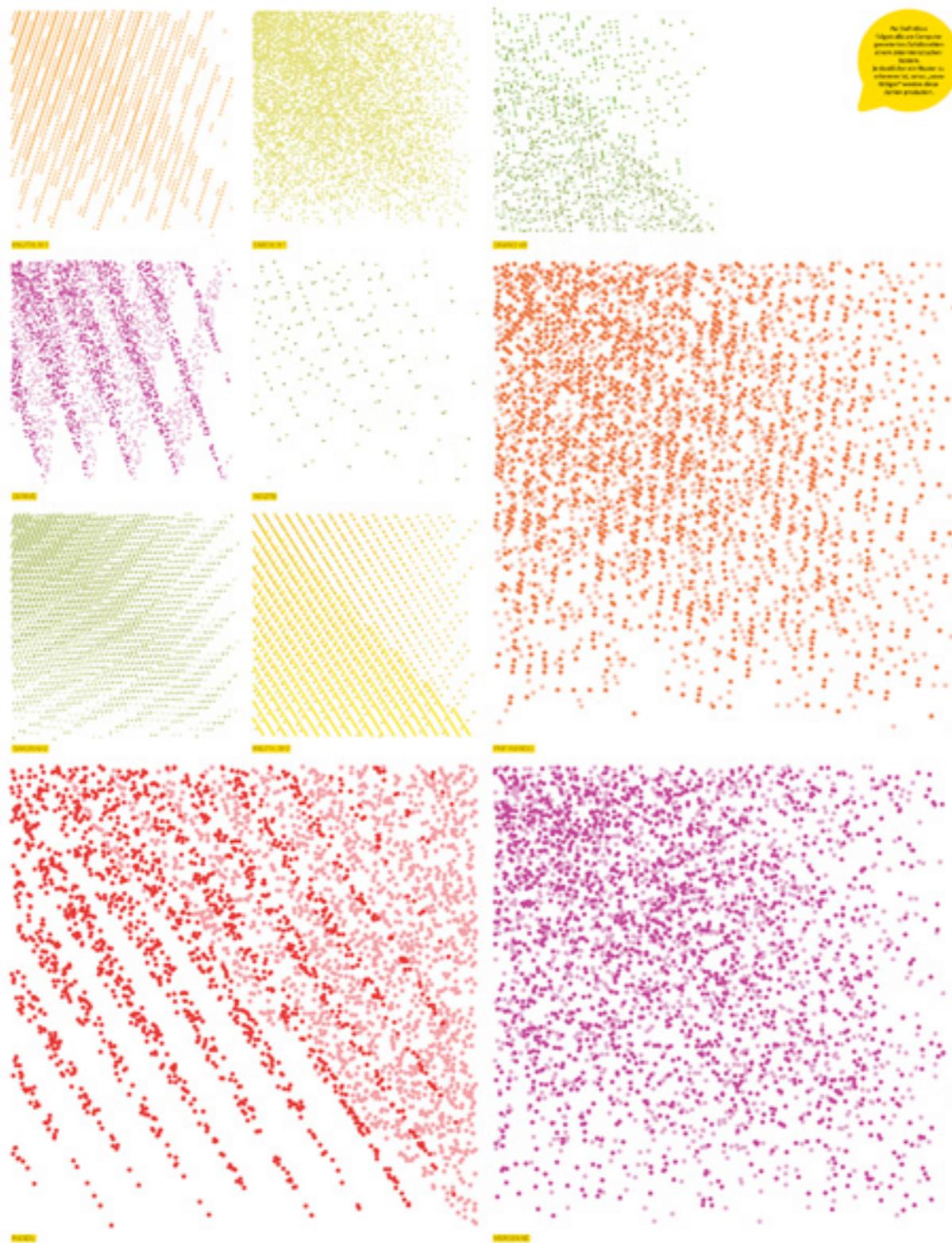
Wind Map



The geography of Tweets | All geo-tagged Tweets since 2009



WHAT DOES RANDOMNESS LOOK LIKE?



BRÜDER DER ZUFALL

Eiglich viele mathematische Modelle, mit denen der Computer Zufallszahlen produziert, diese von einem Zufall kann er nicht trennen, da der Computer vollständig deterministisch funktioniert. Wenn speziell solche von Pseudo-Zufallszahlen, hier sind jeweils 20.000 Zufallszahlen zwischen eins und zehn eingeschlossen.

Zufallszahlen produziert werden. Plädiert man die produzierten Zufallszahlen in einem abzählbaren Maß, wird immer eine aufeinanderfolgende Zahlen (z.B. 1. und 2. Klammer) etwas, wenn wir bei der Aufzählung auf die Wiederholung charakteristische Rauten. Diese Regelmäßigkeiten werden darauf hin, dass die Zufallszahlen

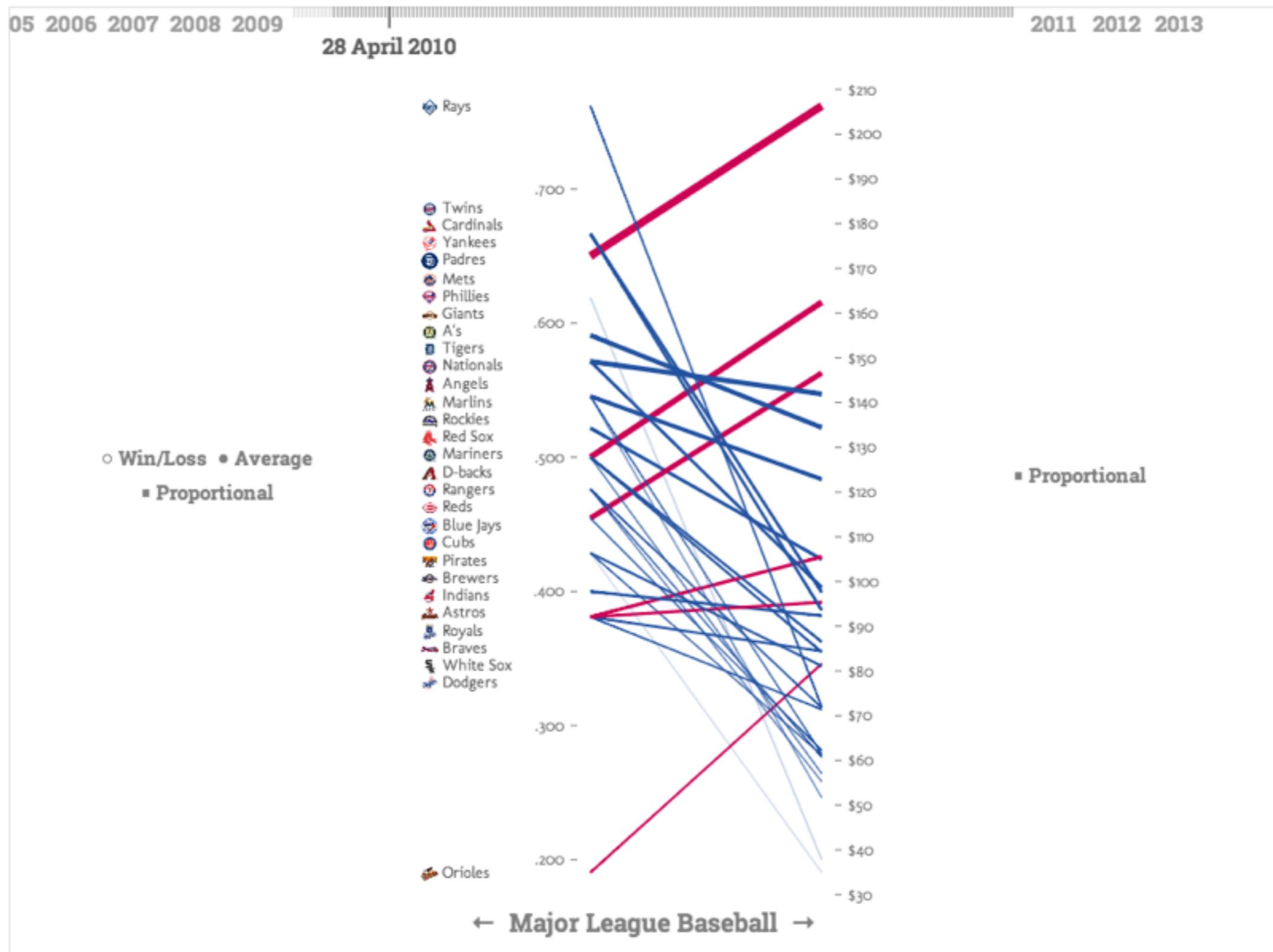
bestimmt Zahlen bewirkt zeigt (z.B. bestimmen einige Zufallszahlen, das ist ein Maß für eines qualitativ unterschiedlichen Zufallszahlen). Bei der Identität unter den Zufallszahlen ist der „Identische Zufall“ aus dem Jahre 1999, der keine Wiederholung aufweist.

RANDOM WALK

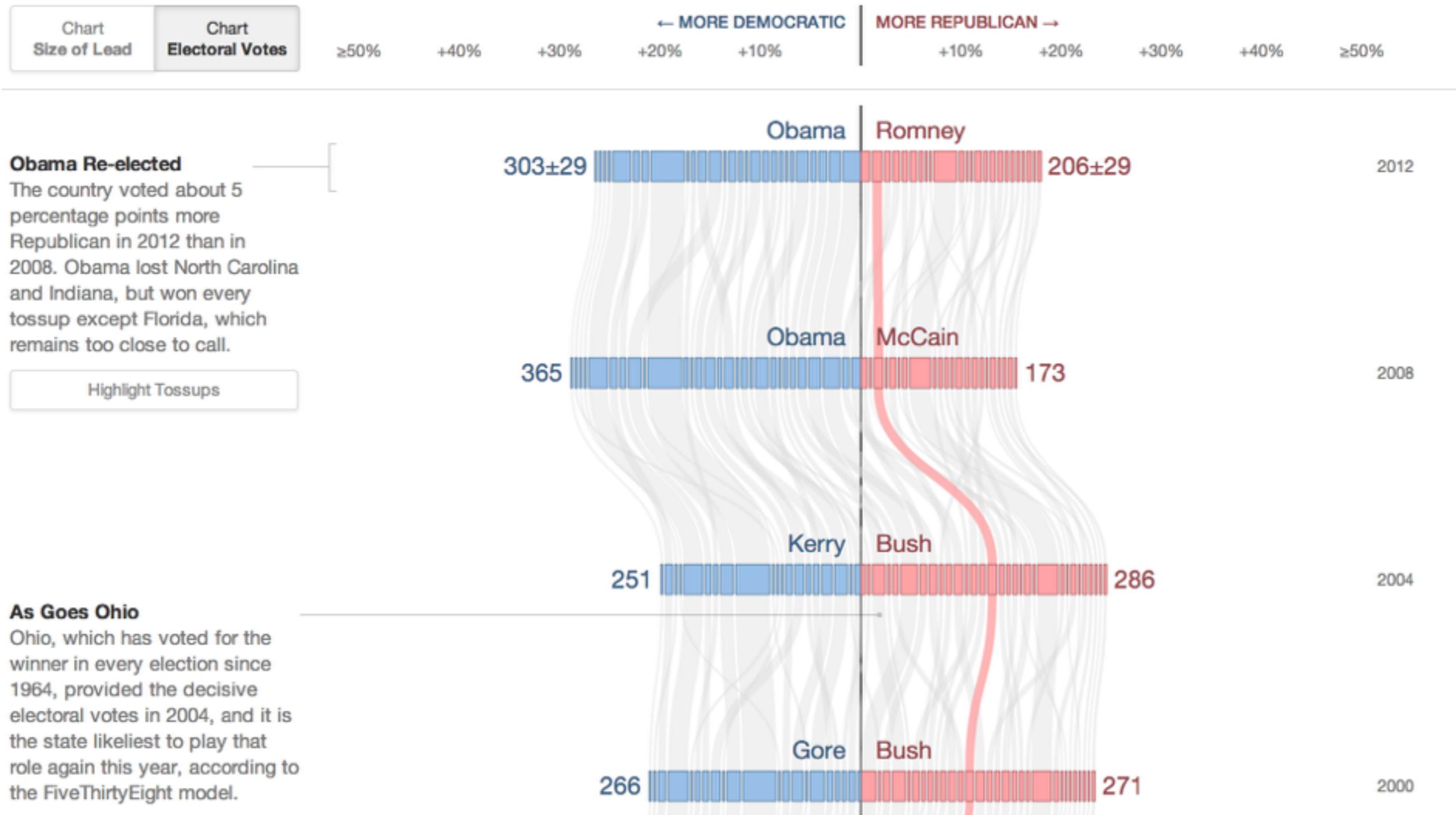
DIE VISUALISIERUNG DES ZUFALLS

<http://www.random-walk.com>

Salary vs Performance



Over the Decades, How States Have Shifted



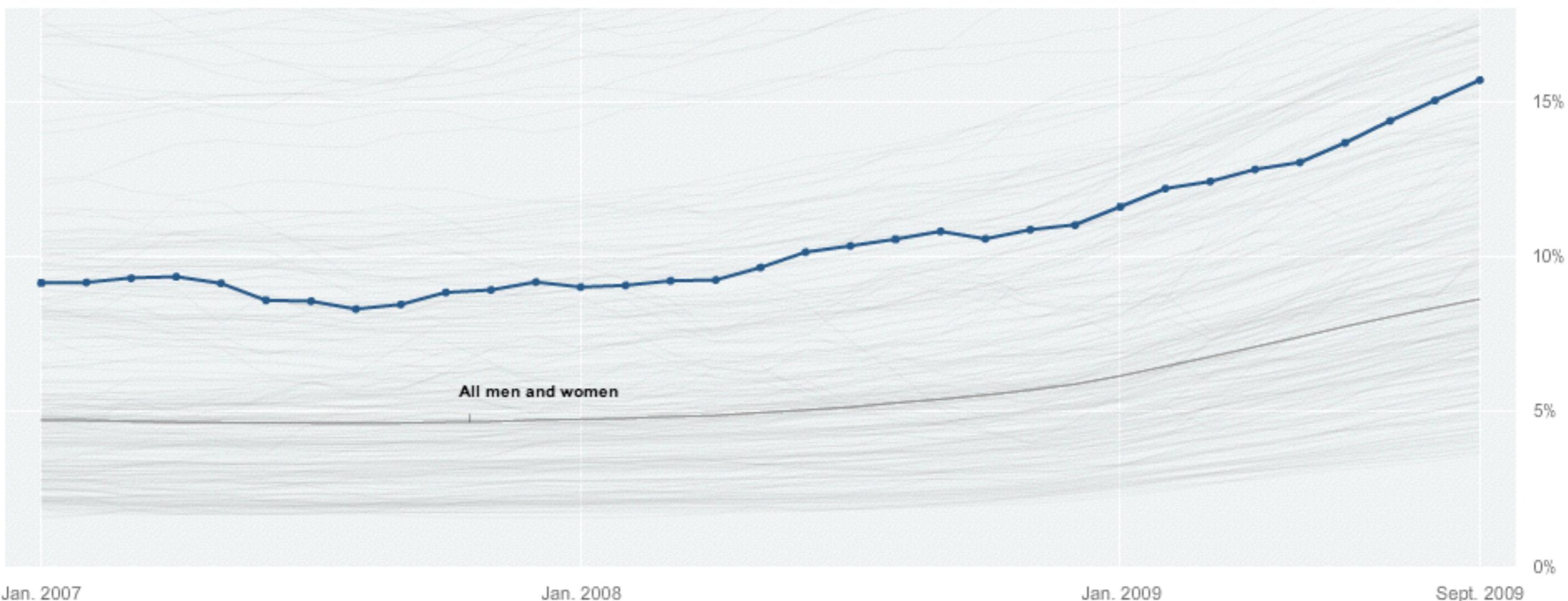
The Jobless Rate for People Like You



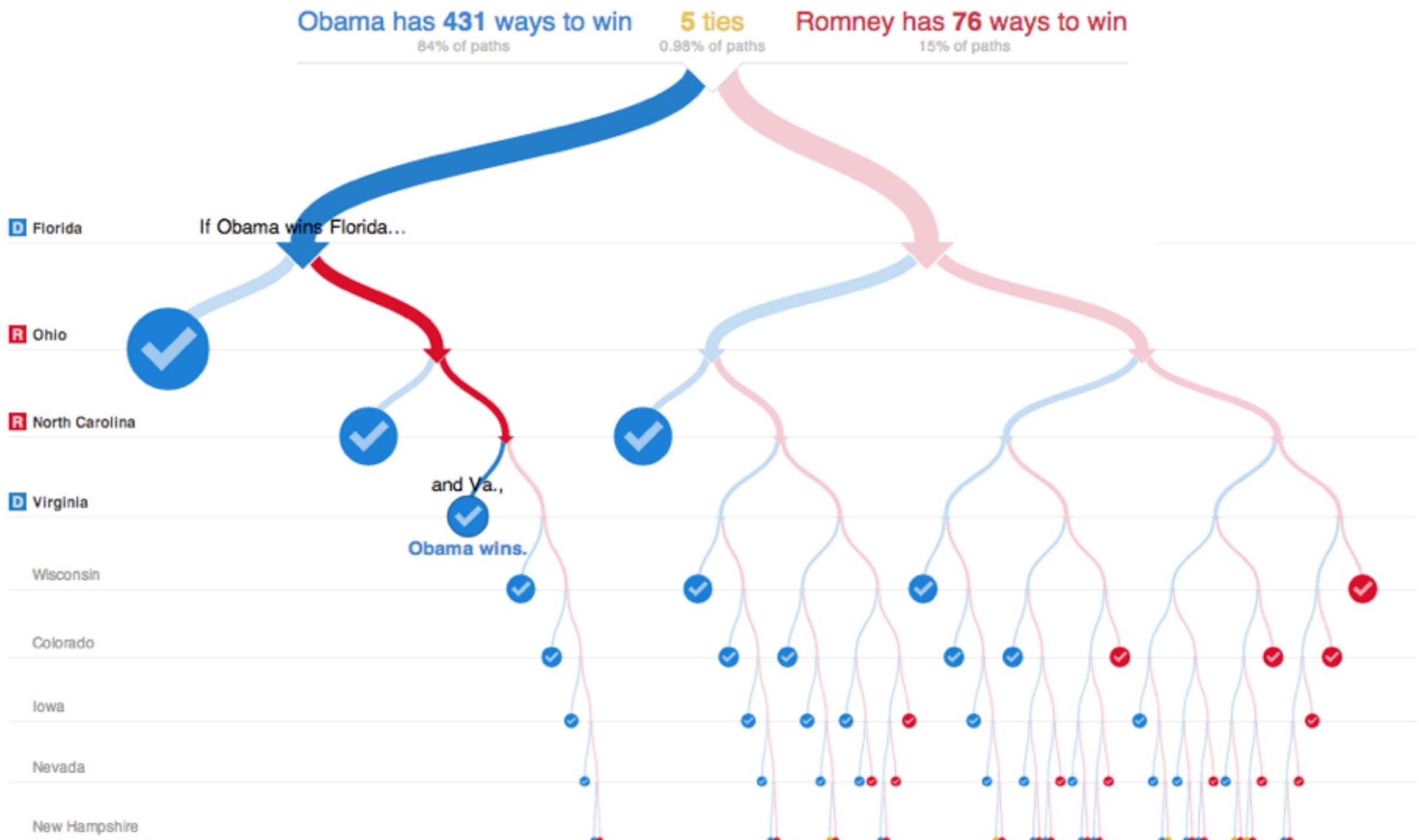
UNEMPLOYMENT RATE,
12 MONTH AVG. ENDING SEPT. '09

15.7%

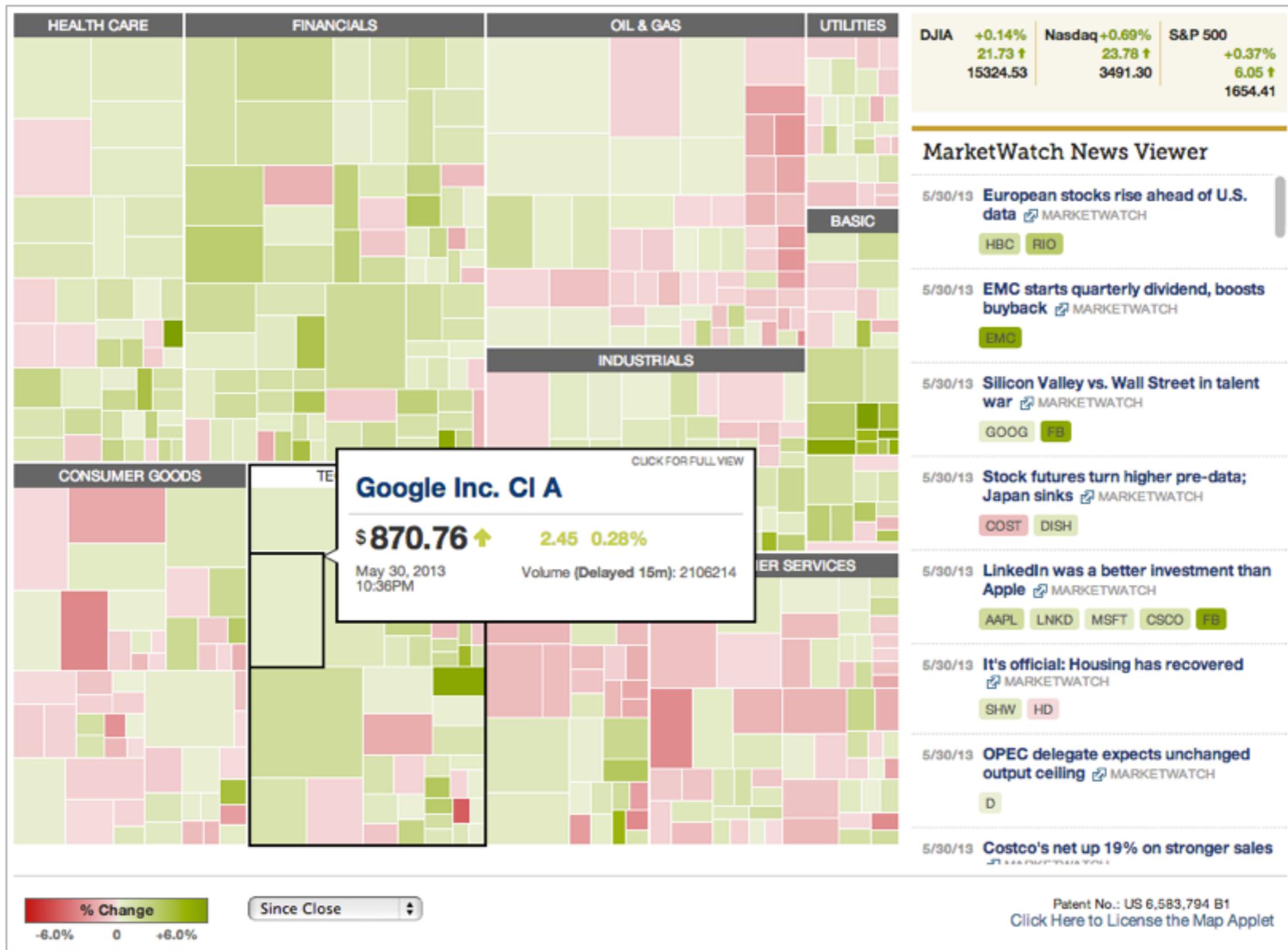
For Asian and American Indian women
and women of more than one race ages 15
to 24



512 Paths to the White House



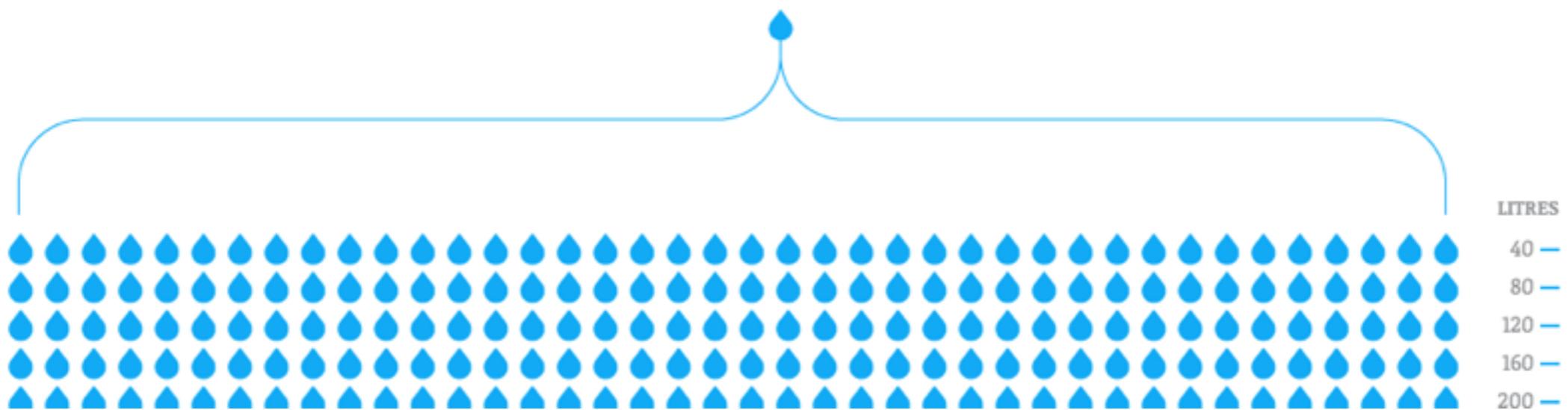
Map of the Market



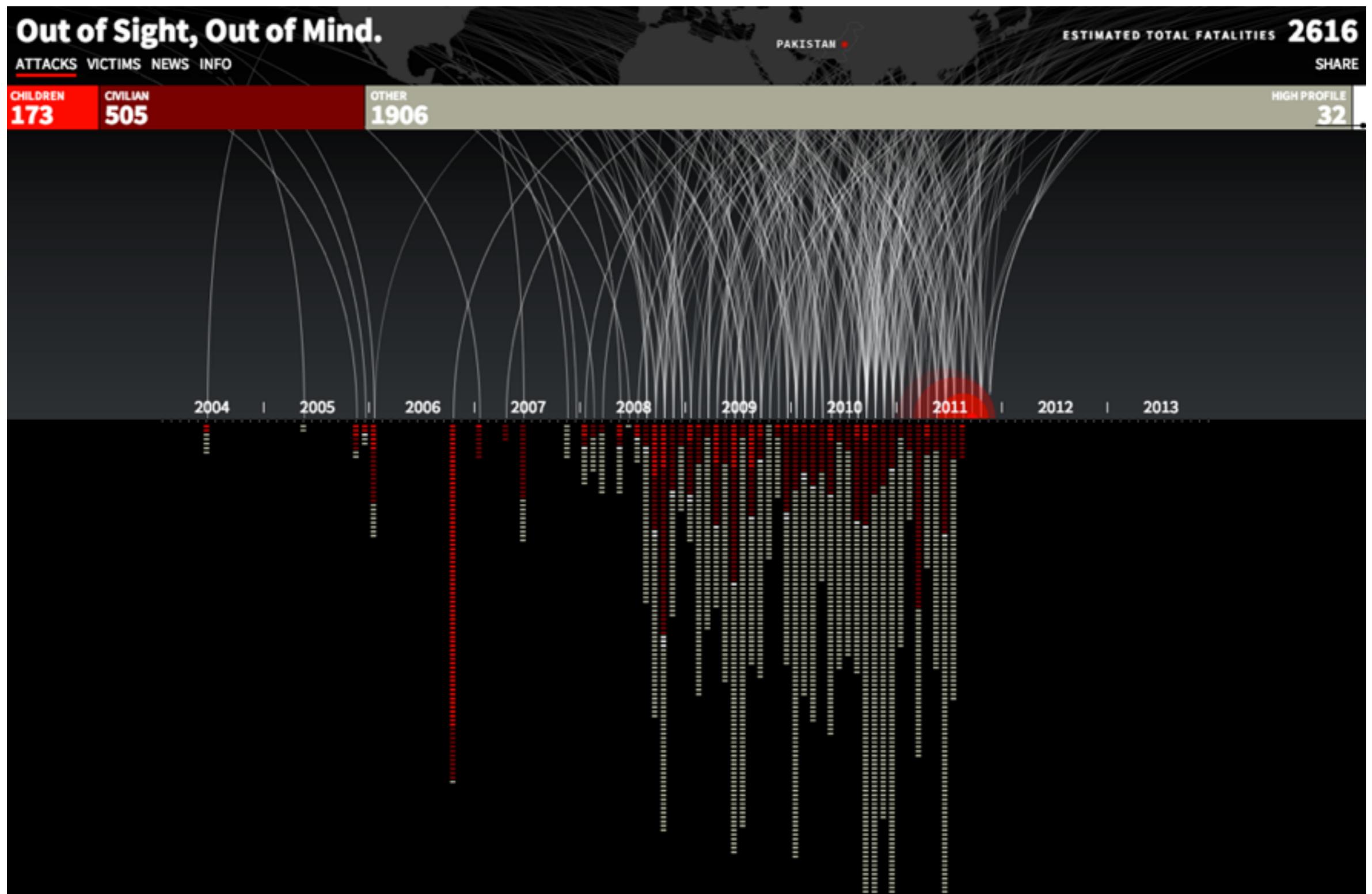
Water

What if I told you:

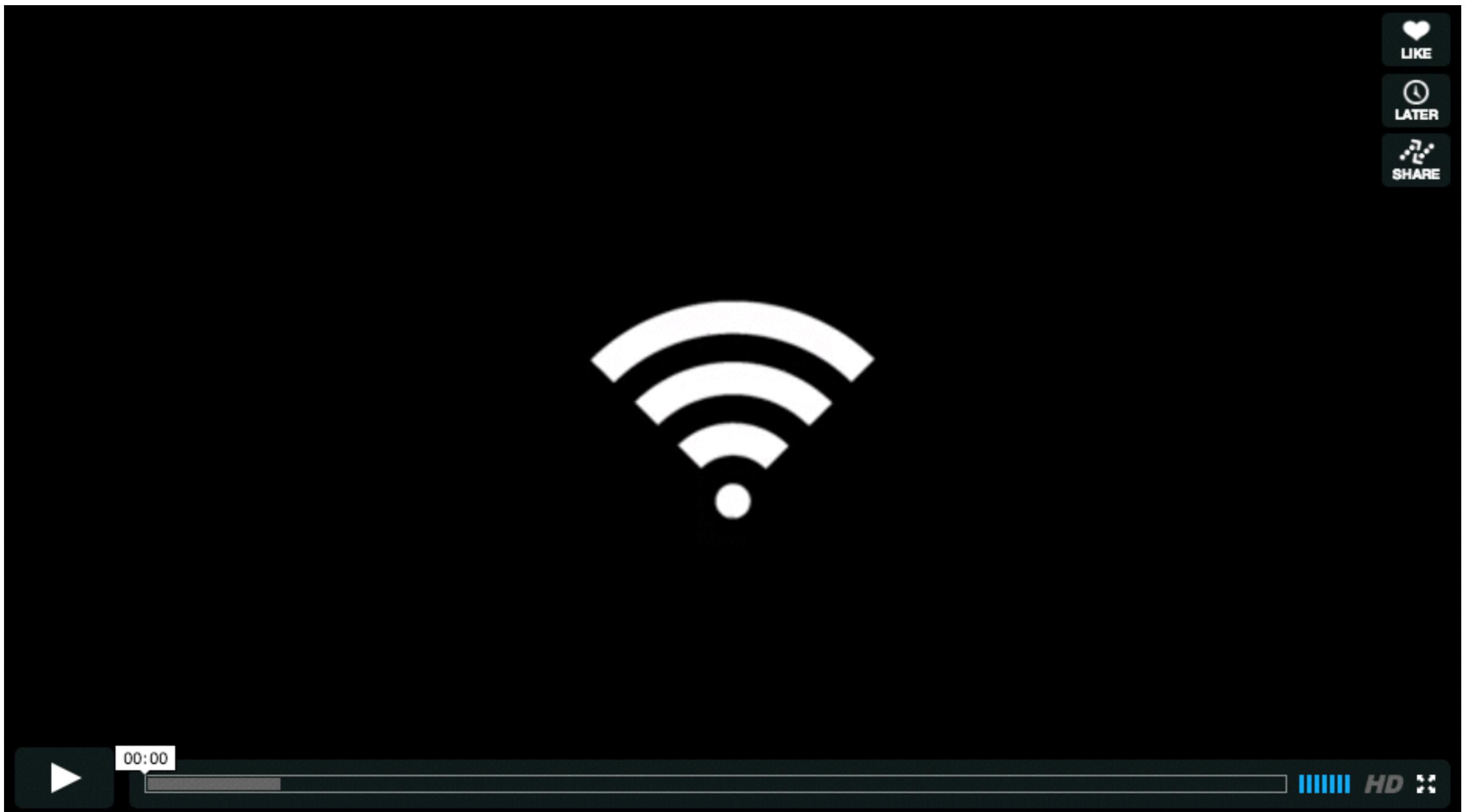
you eat 3496 litres of water



Out of Sight, Out of Mind



Light painting WiFi



<https://vimeo.com/20412632>

Thanks