

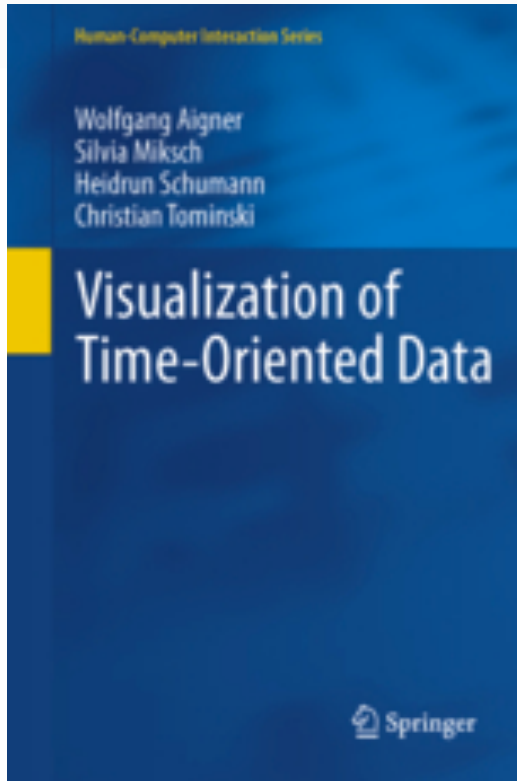
Overview of Temporal Data Visualization Approaches

3ème journée RESSTE



Pierre Dragicevic
Inria

Visualizing temporal data



Visualizing temporal data

A Review of Temporal Data Visualizations Based on Space-Time Cube Operations

B. Bach¹, P. Dragicevic¹, D. Archambault², C. Hurter³ and S. Carpendale⁴

¹INRIA, France

²Swansea University, UK

³ENAC, France

⁴University of Calgary, Canada

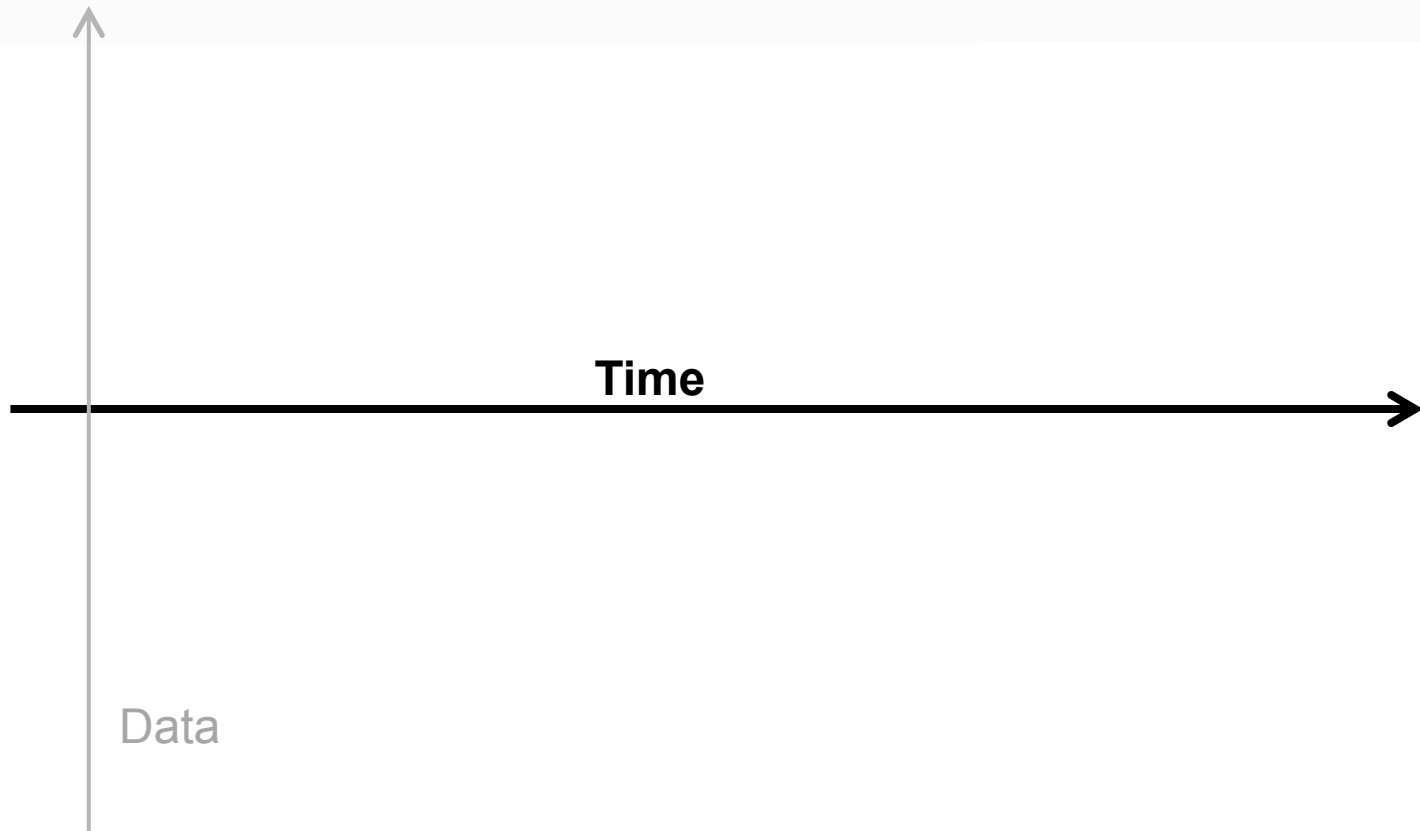
tinyurl.com/spacetime-bach

Time

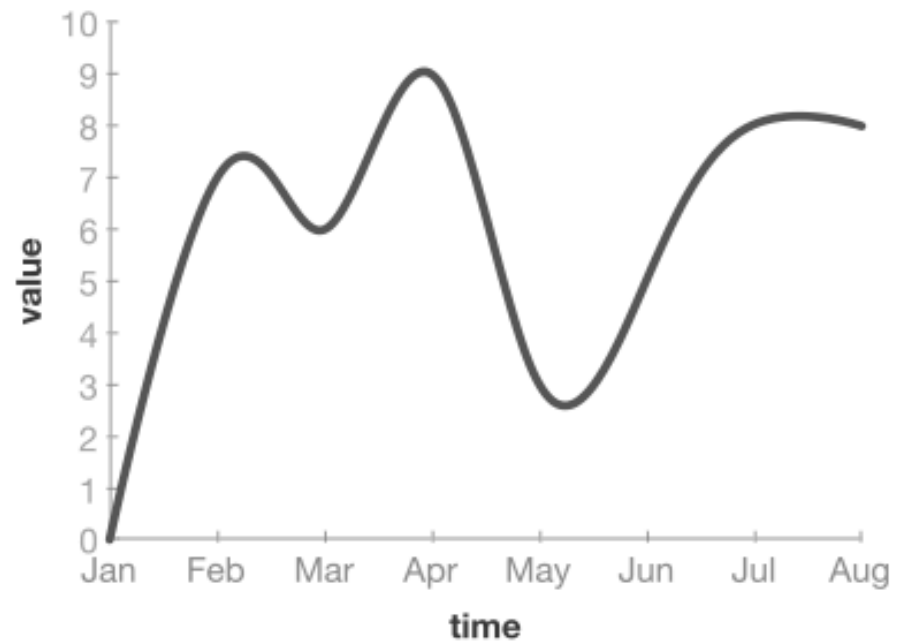
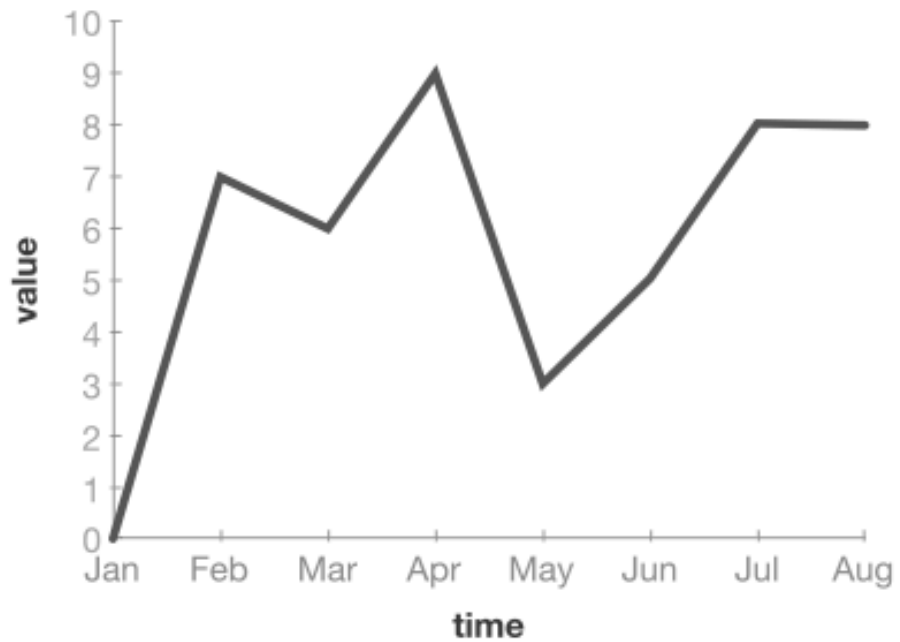
- **Ben Shneiderman's taxonomy:**
 - 1-dimensional data
 - 2-dimensional data
 - 3-dimensional data
 - **temporal data**
 - multi-dimensional data
 - tree data
 - network data

Mapping Time to Space

Mapping Time to an Axis

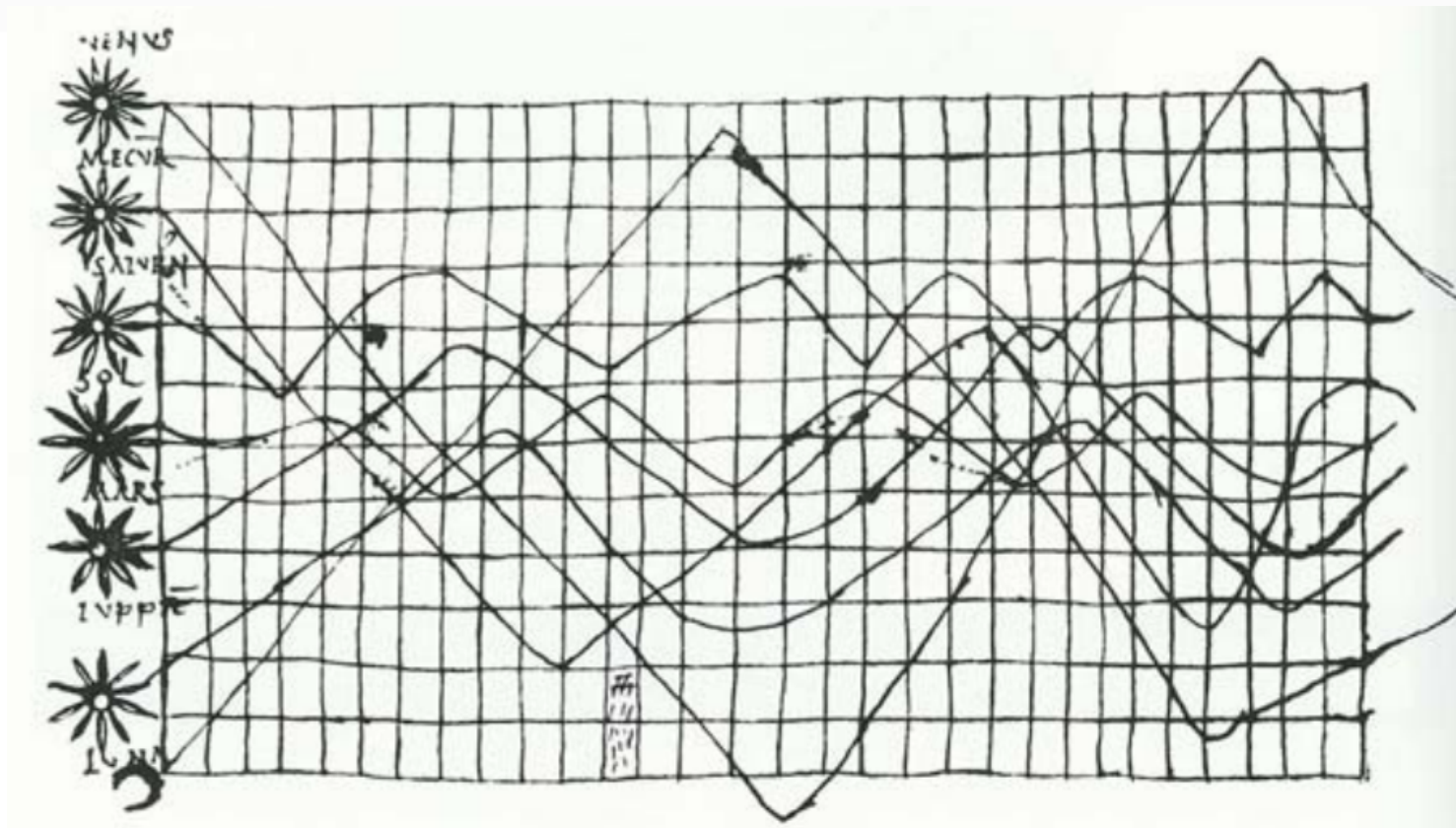


Line Charts



Line Charts

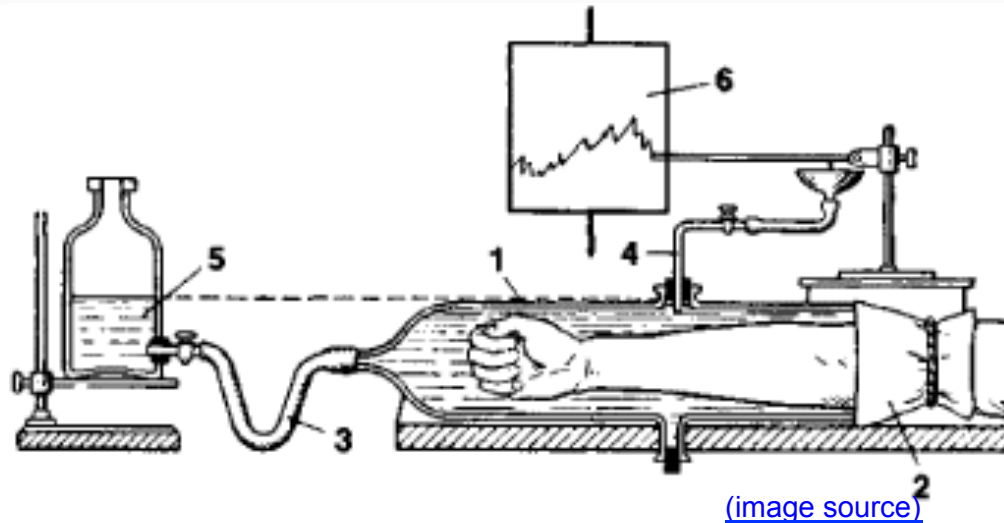
Inclinations of planetary orbits



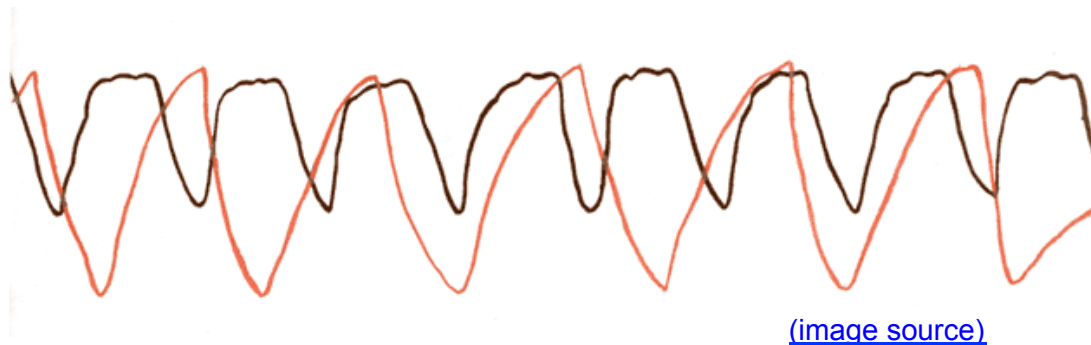
Macrobius, 10th or 11th century
cited in [Kendall, 1990](#)

Line Charts

Marey's Physiological Recordings



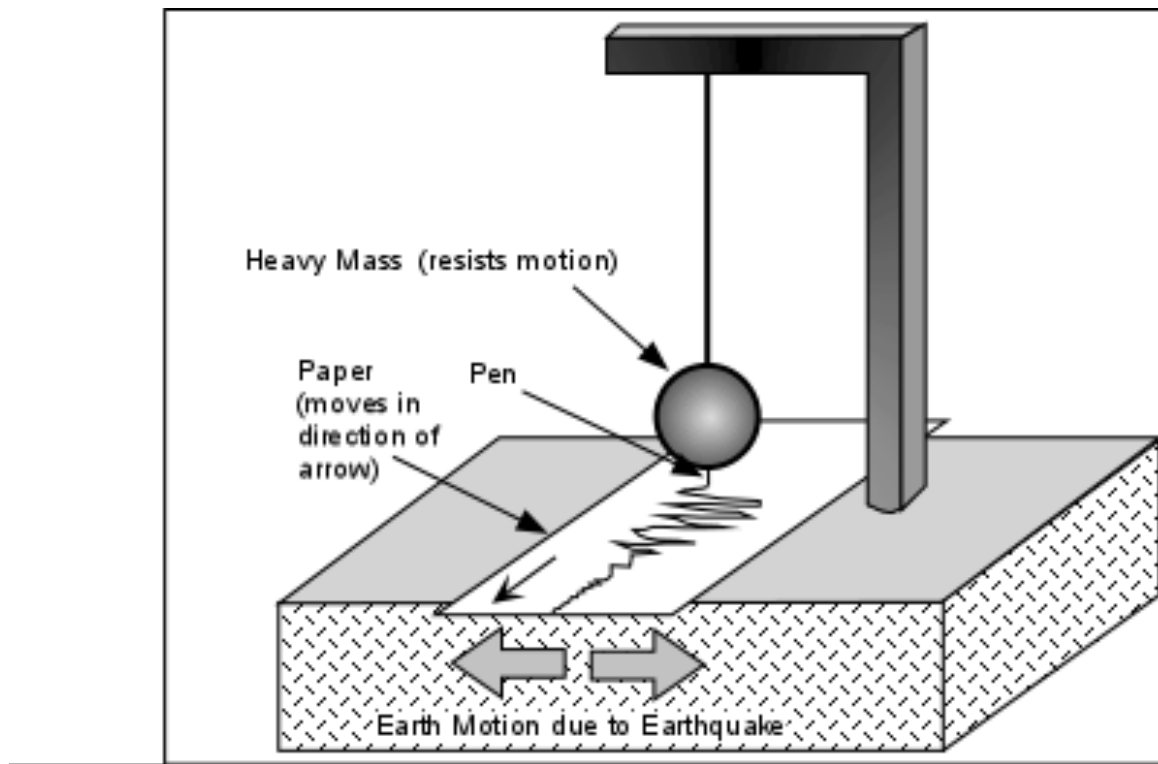
Plethysmograph
Étienne-Jules Marey, 1876



Pneumogram
Étienne-Jules Marey, 1876

Line Charts

Pendulum Seismograph

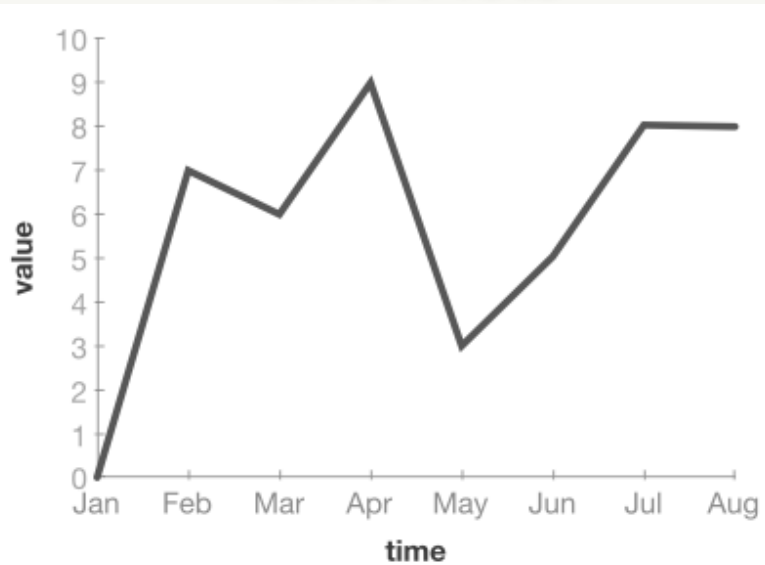


[\(image source\)](#)

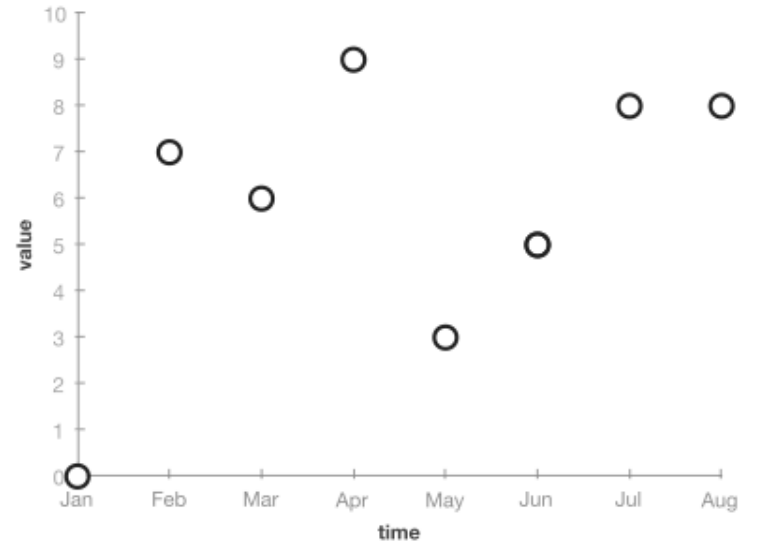
Andrea Bina, 1751
Possibly also 17th century [\(source\)](#)

Other Charts

Line Plots



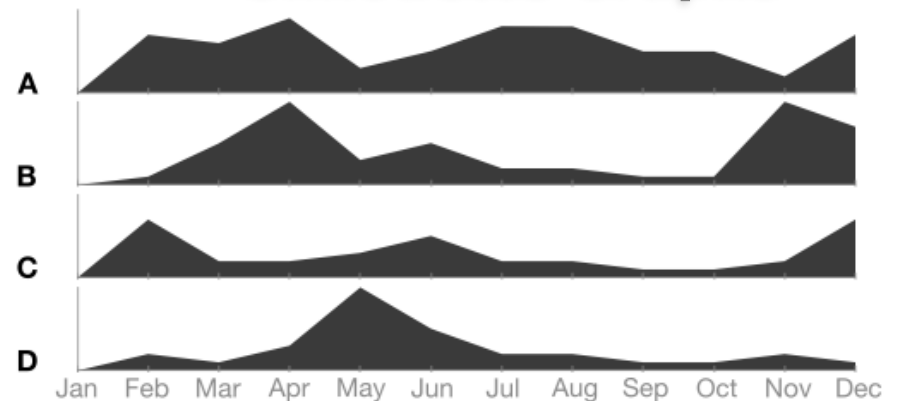
Point Plots



Bar Charts

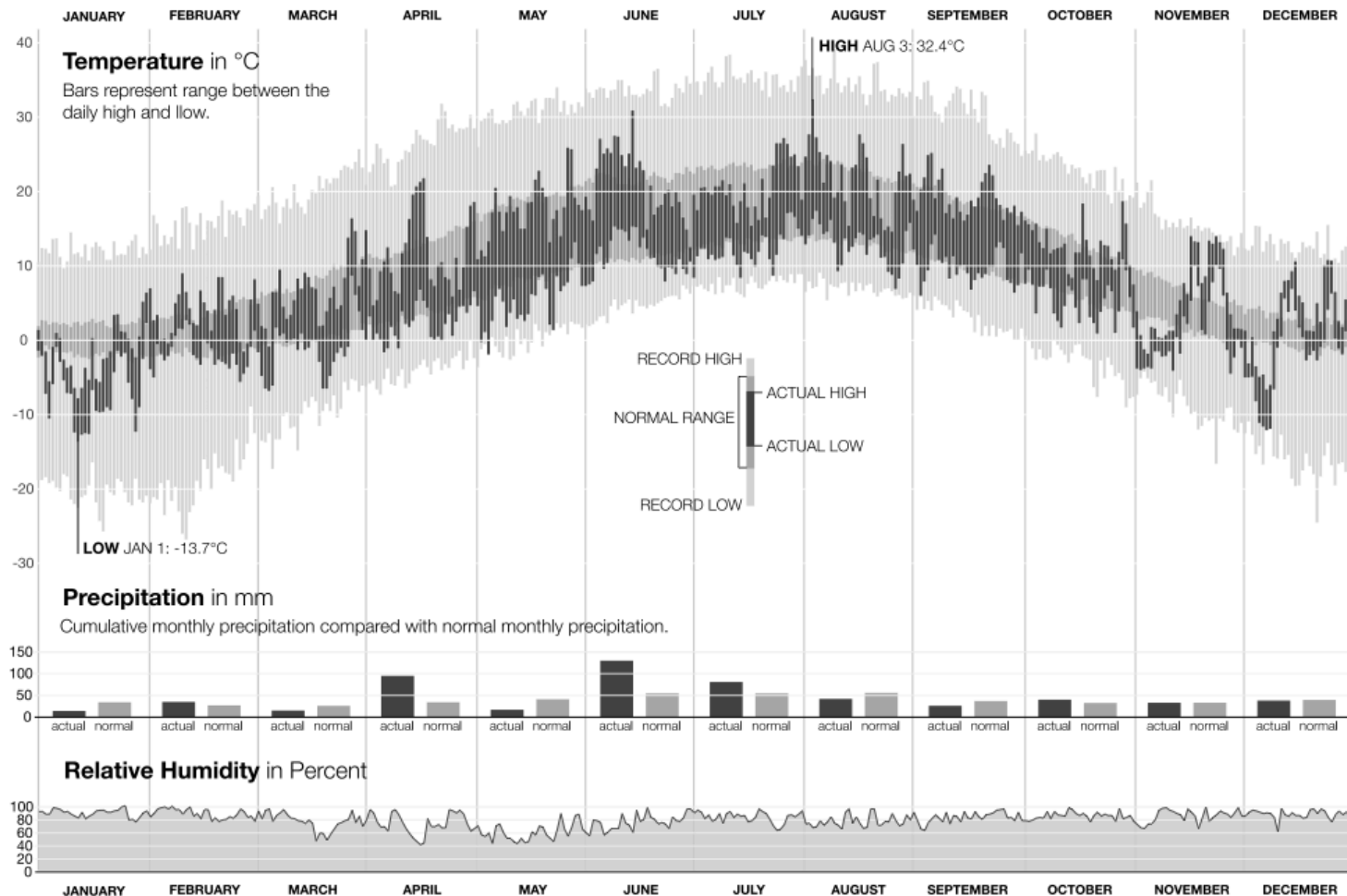


Silhouette Graphs



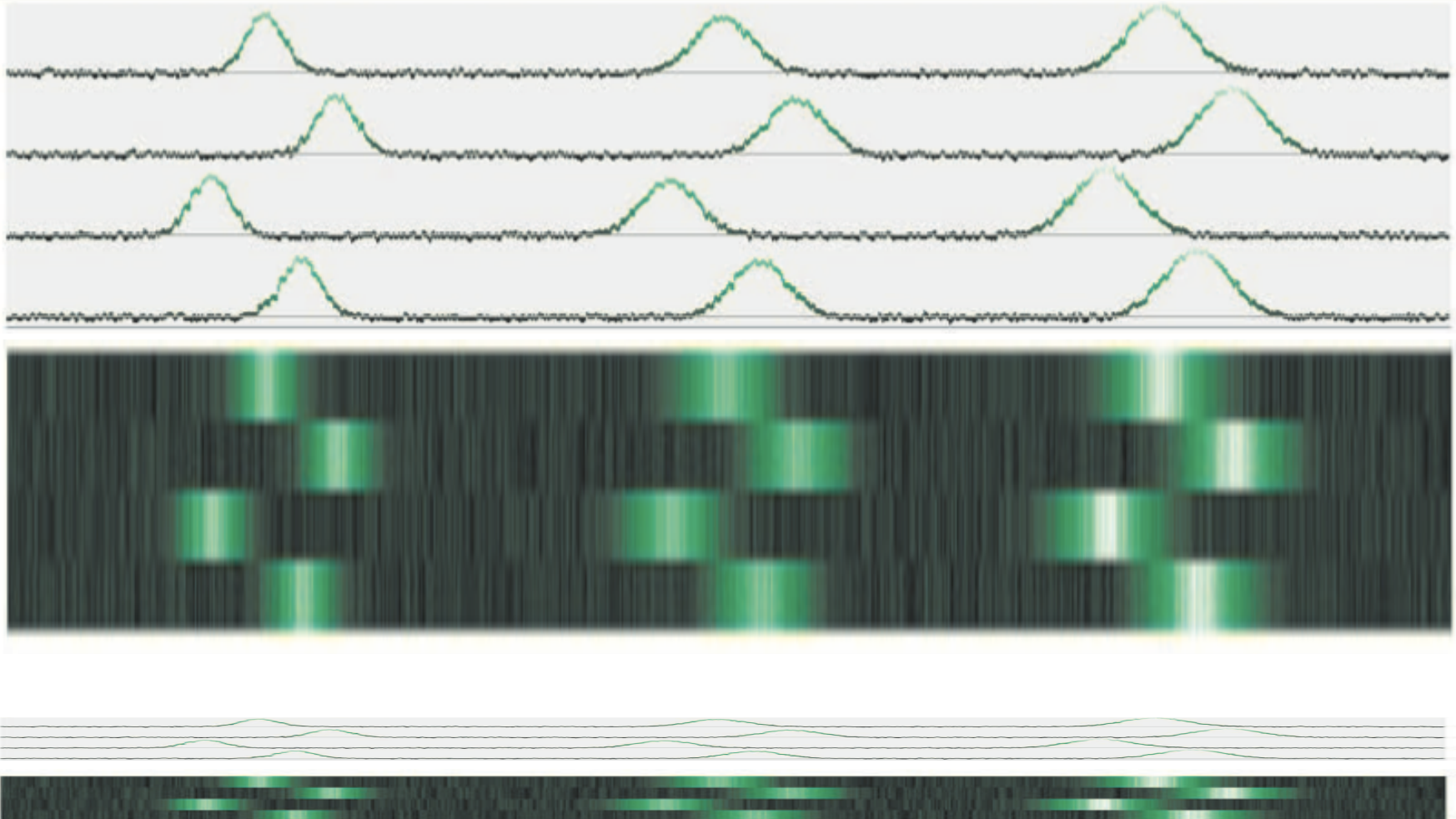
Other Charts

Combination - New York Times Weather Chart



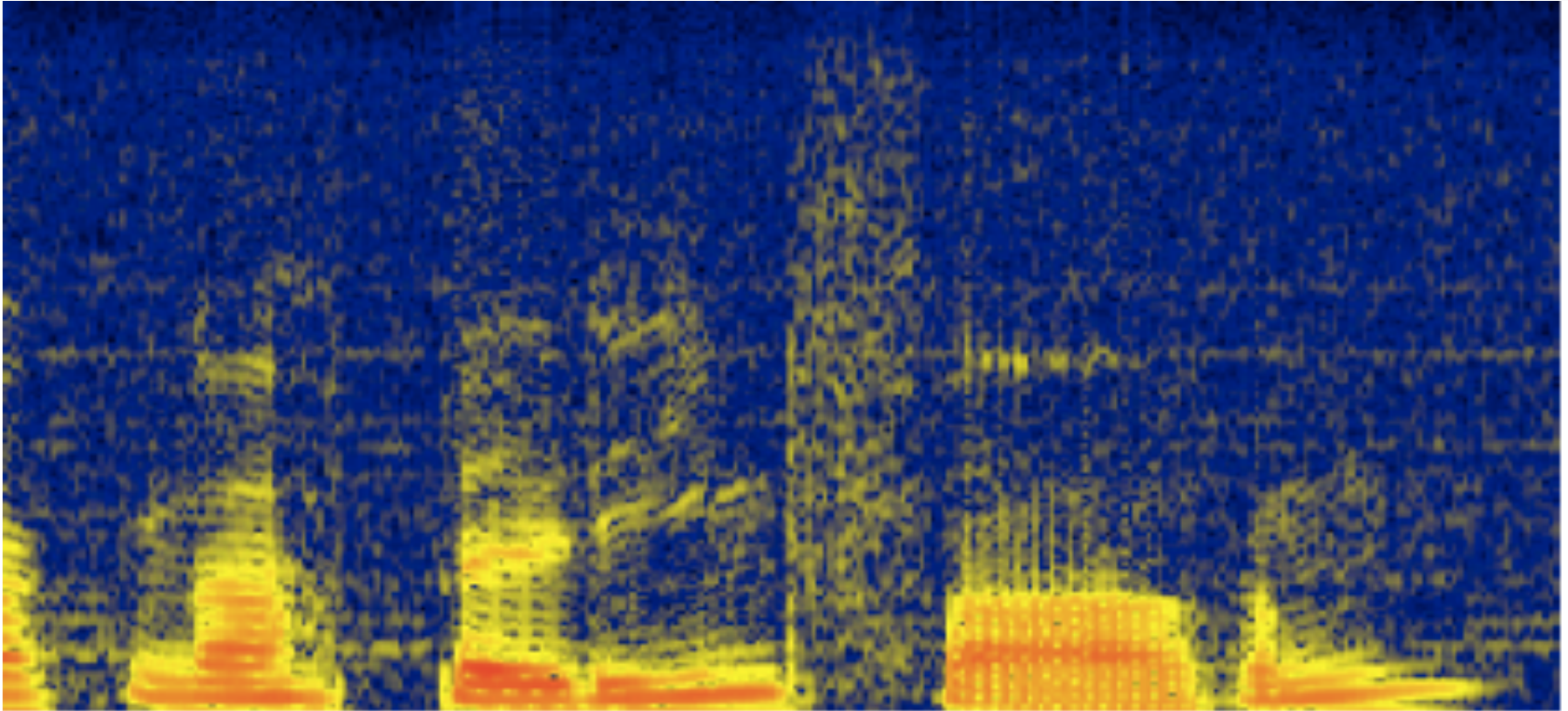
Other Charts

Color Encoding



Other Charts

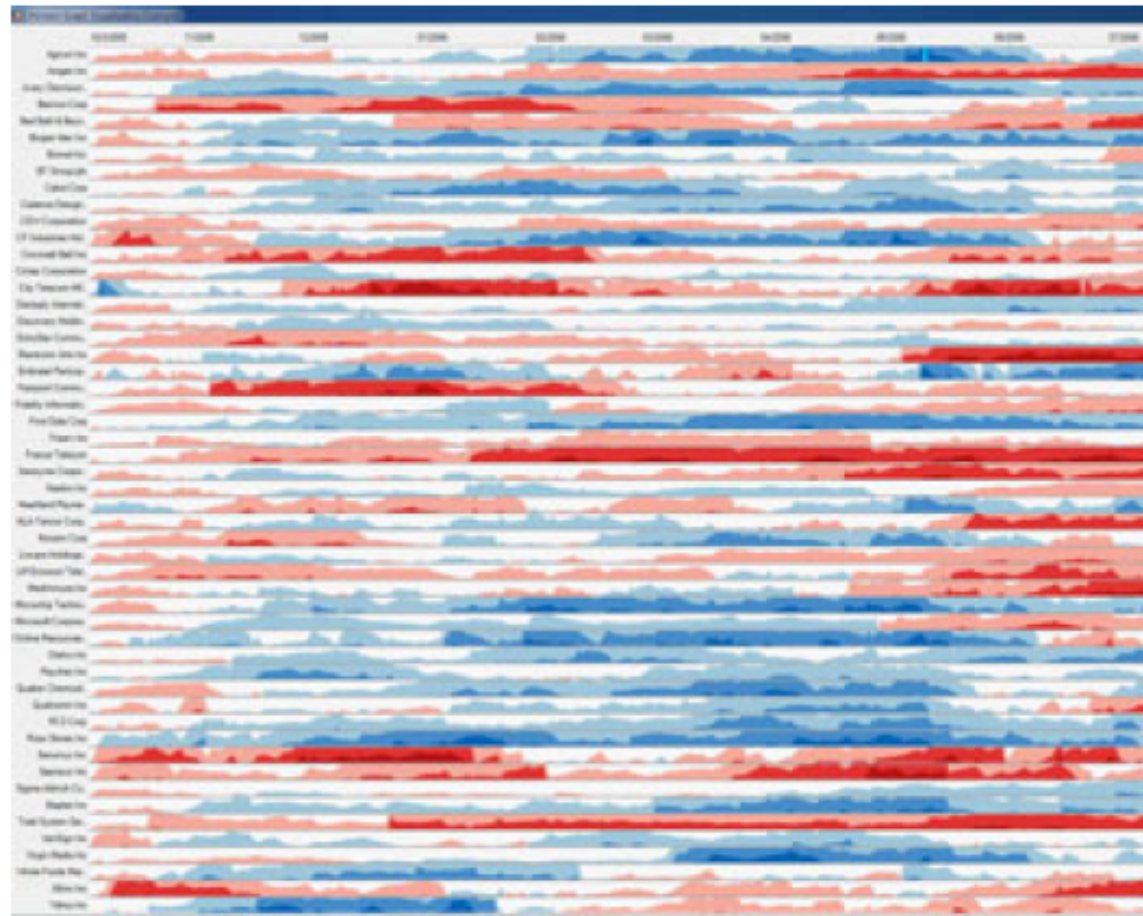
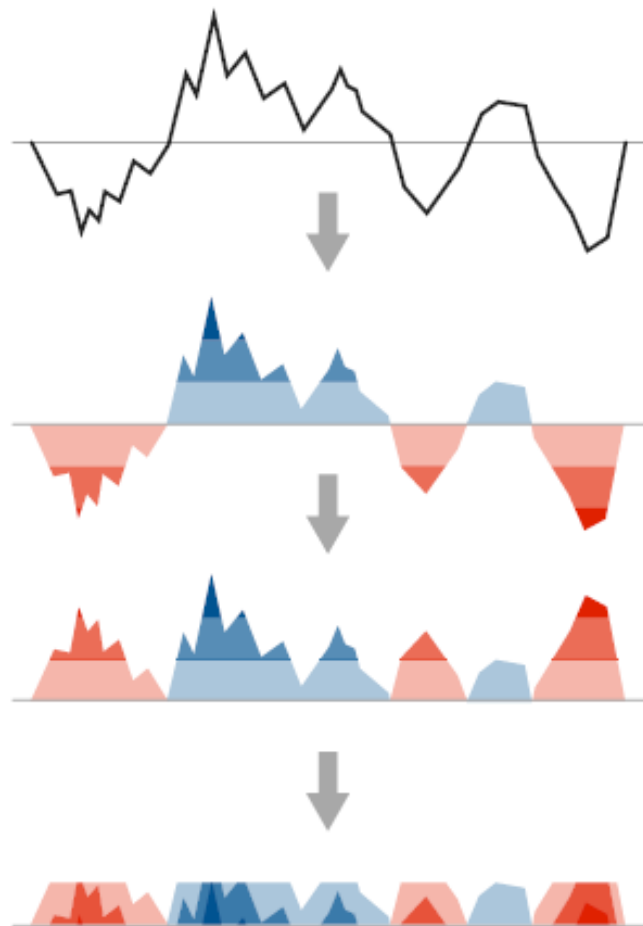
Color Encoding - FFT Spectrum



[\(image source\)](#)

Other Charts

Horizon Graphs



Other

Rank Chart

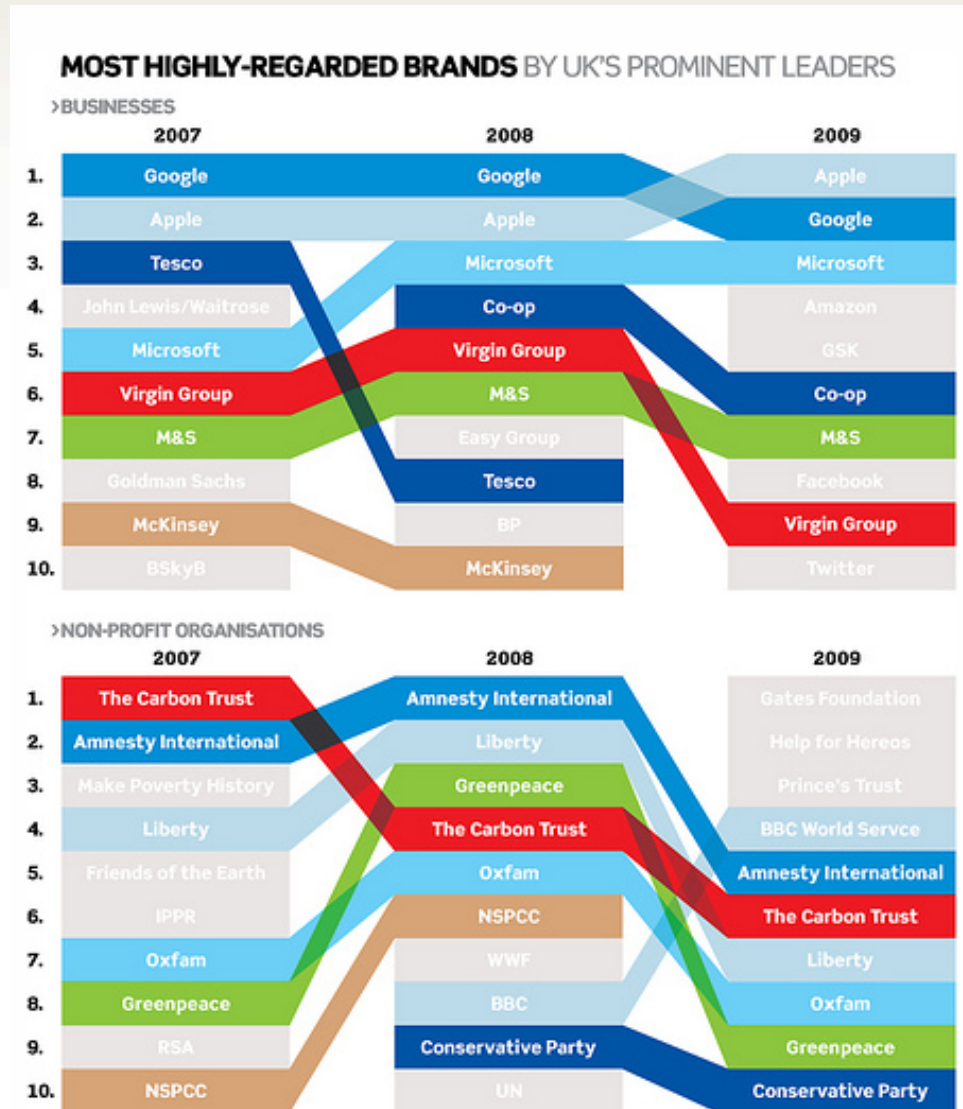
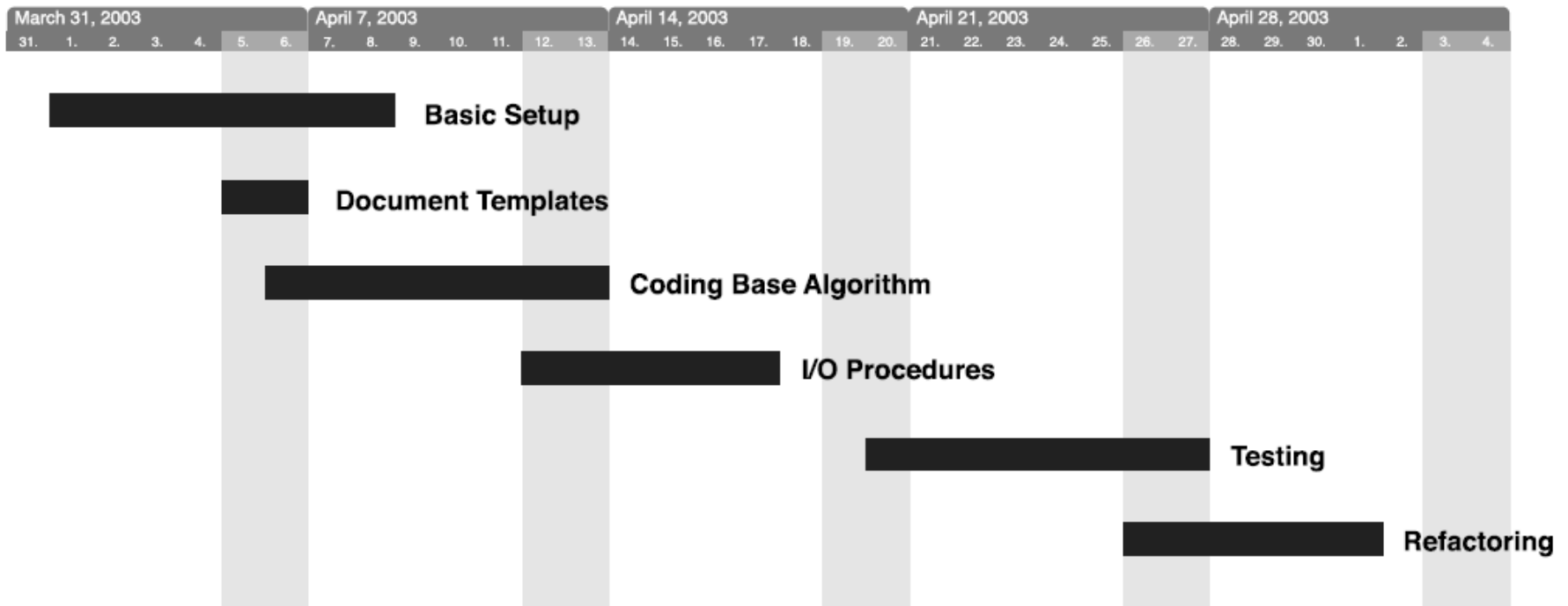


Chart showing the top ten brands' standing over the last three years

Timelines

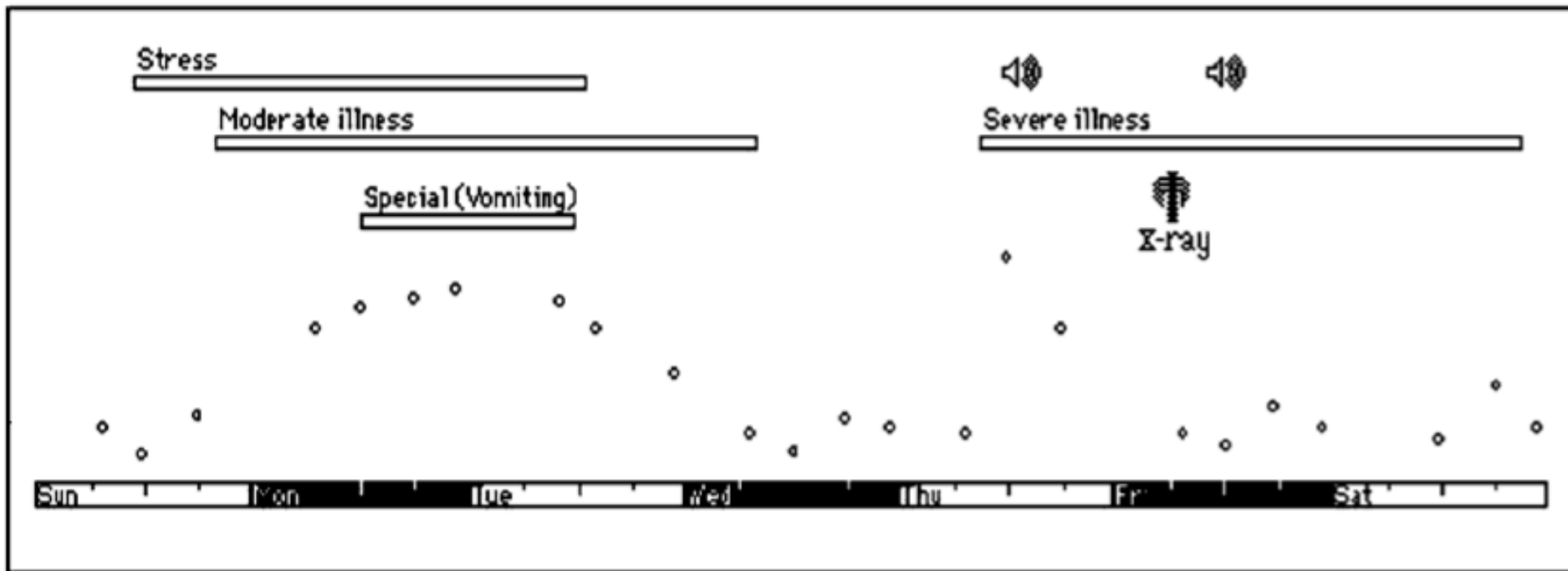
Project Timeline



Timelines

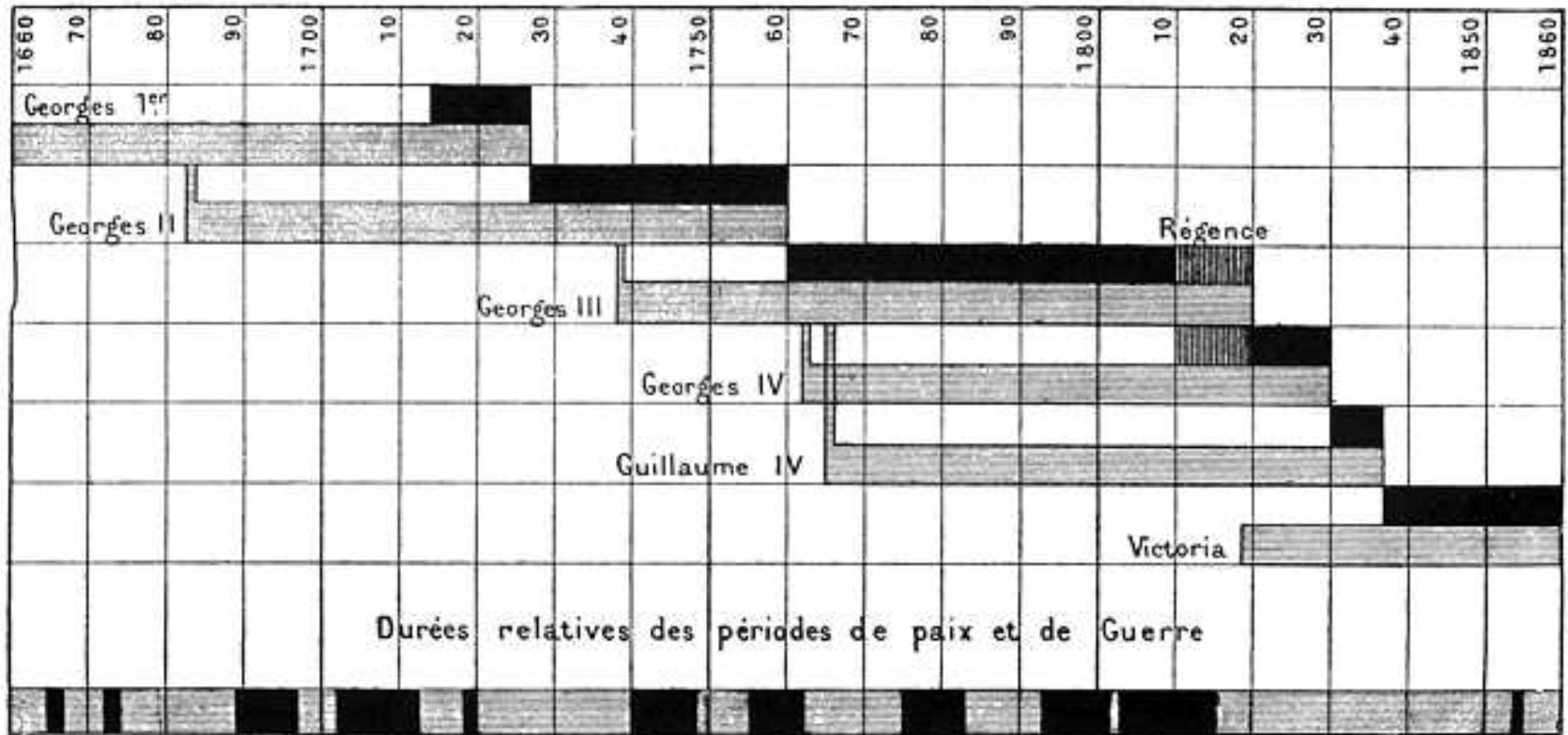
Patient Data

Patient: Joe Patient



Timelines

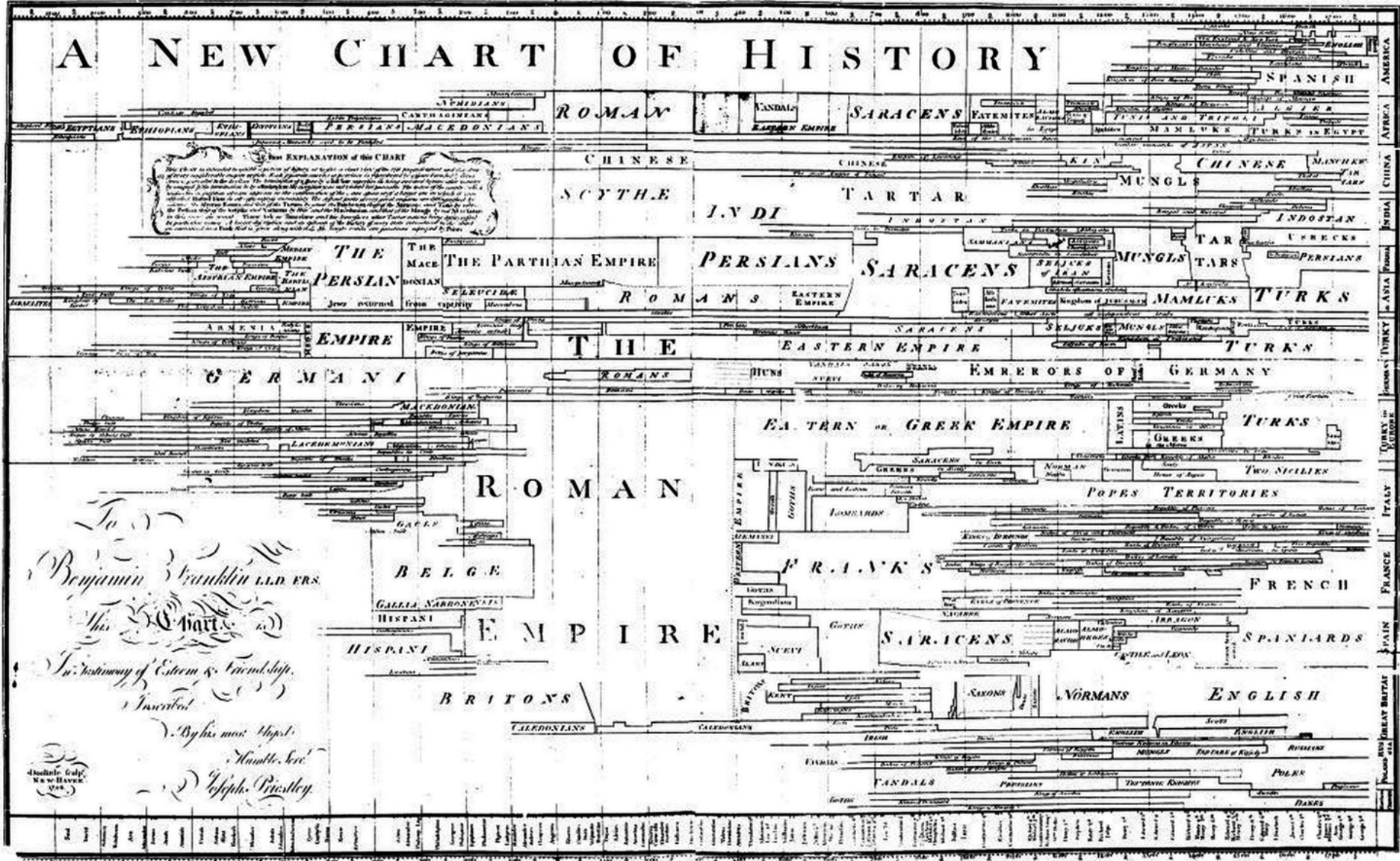
Reigns of English Monarchs



Timelines

a

Illustration in business and language, excerpt
 A Historical Atlas



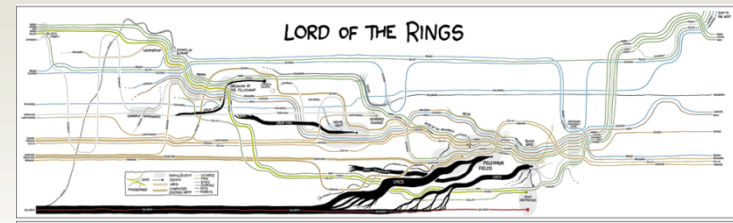
Benjamin Franklin LL.D. FRS.
The Chart
The Continuity of Eastern & Western History
Invented
By his most Obedt. Servt.
Joseph Priestley

London, 1769

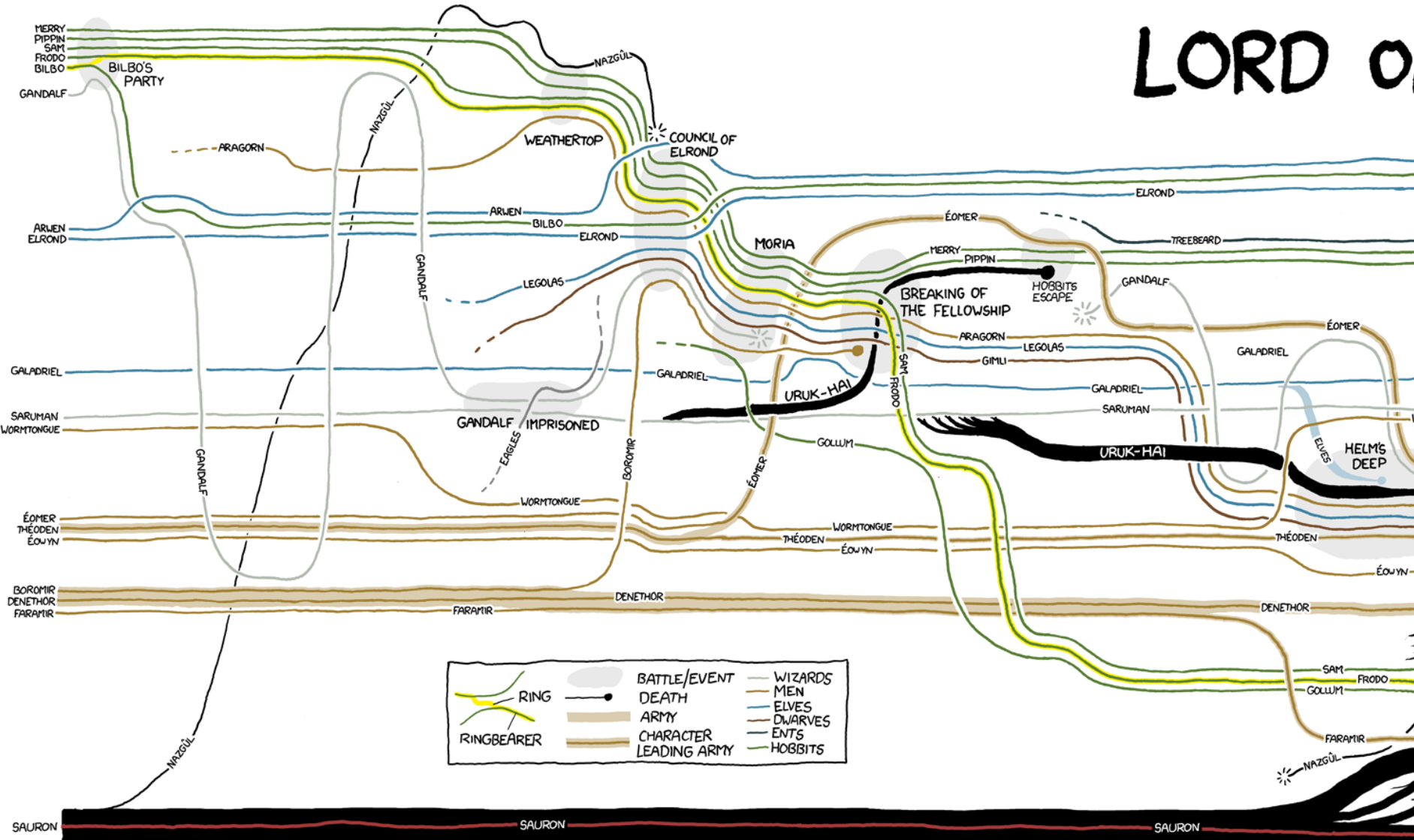
Timelines

Movie Narratives

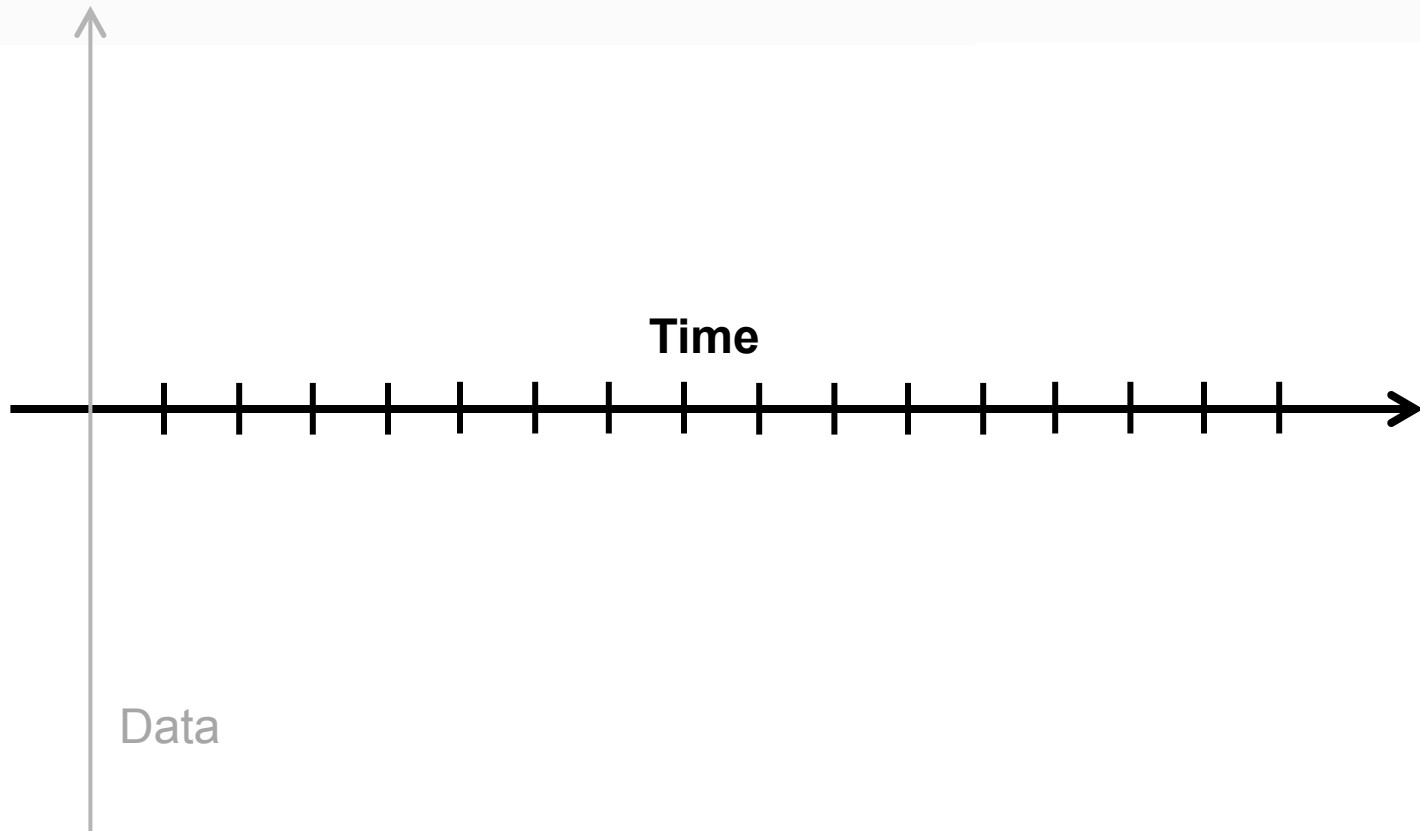
xkcd.com, 2009



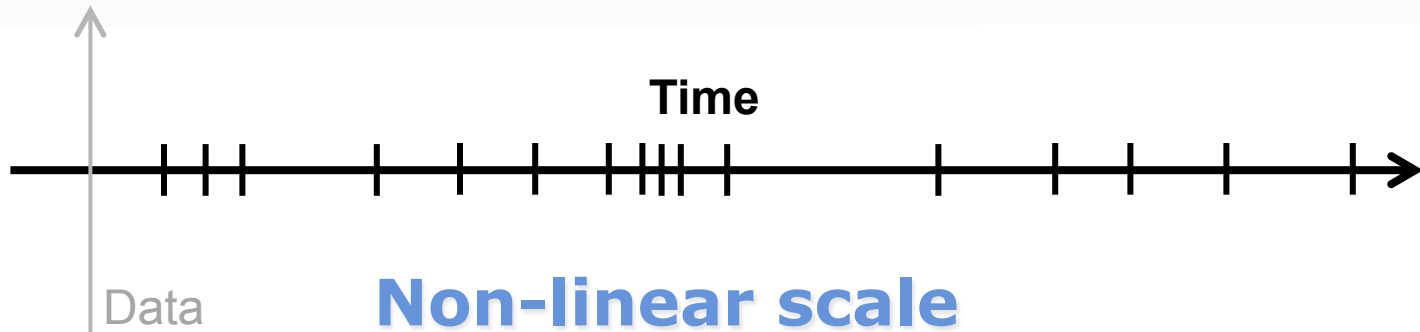
LORD OF THE RINGS



Mapping Time to an Axis

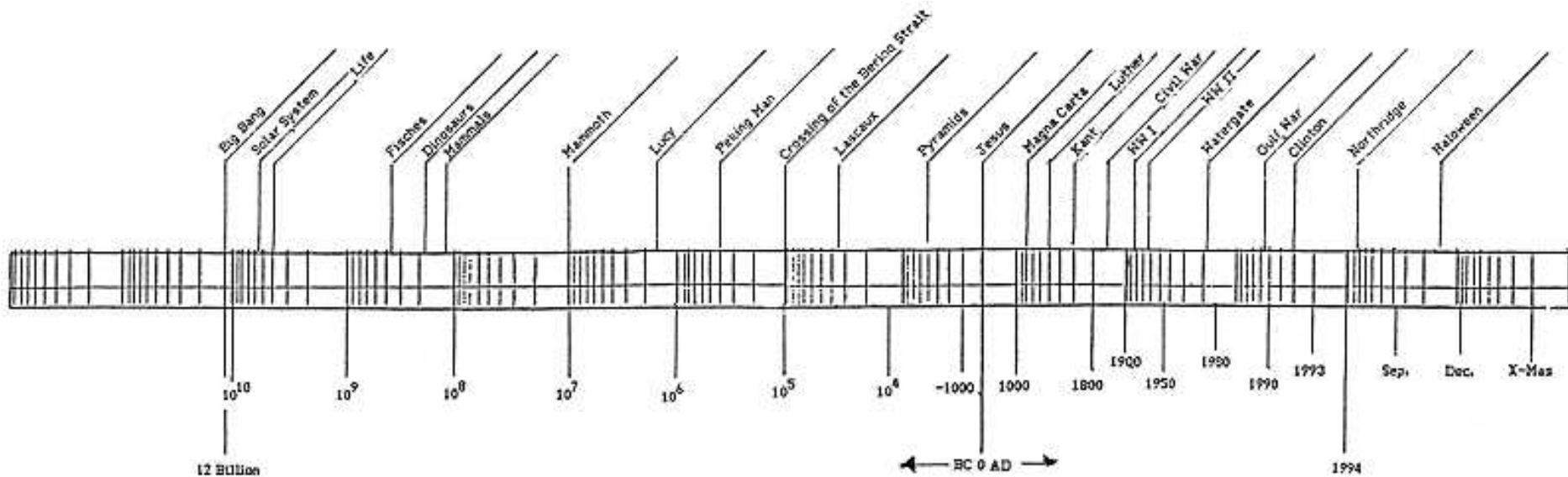


Non-Linear Time Axes



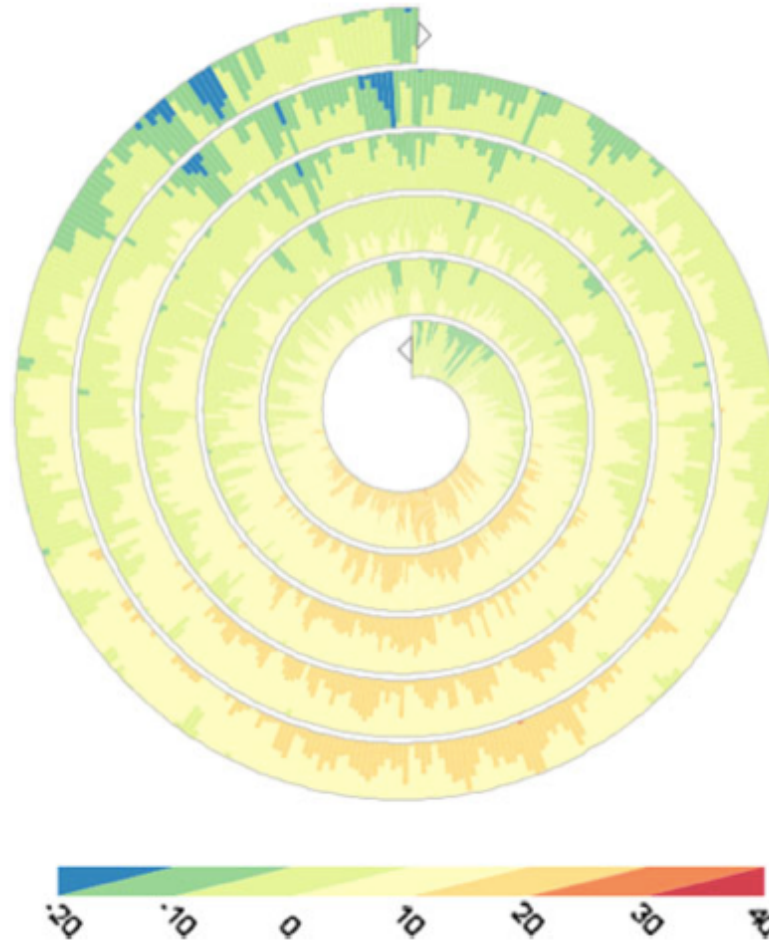
Non-Linear Time Axes

Logarithmic scale



Non-Linear Time Axes

Spiral



Non-Linear Time Axes

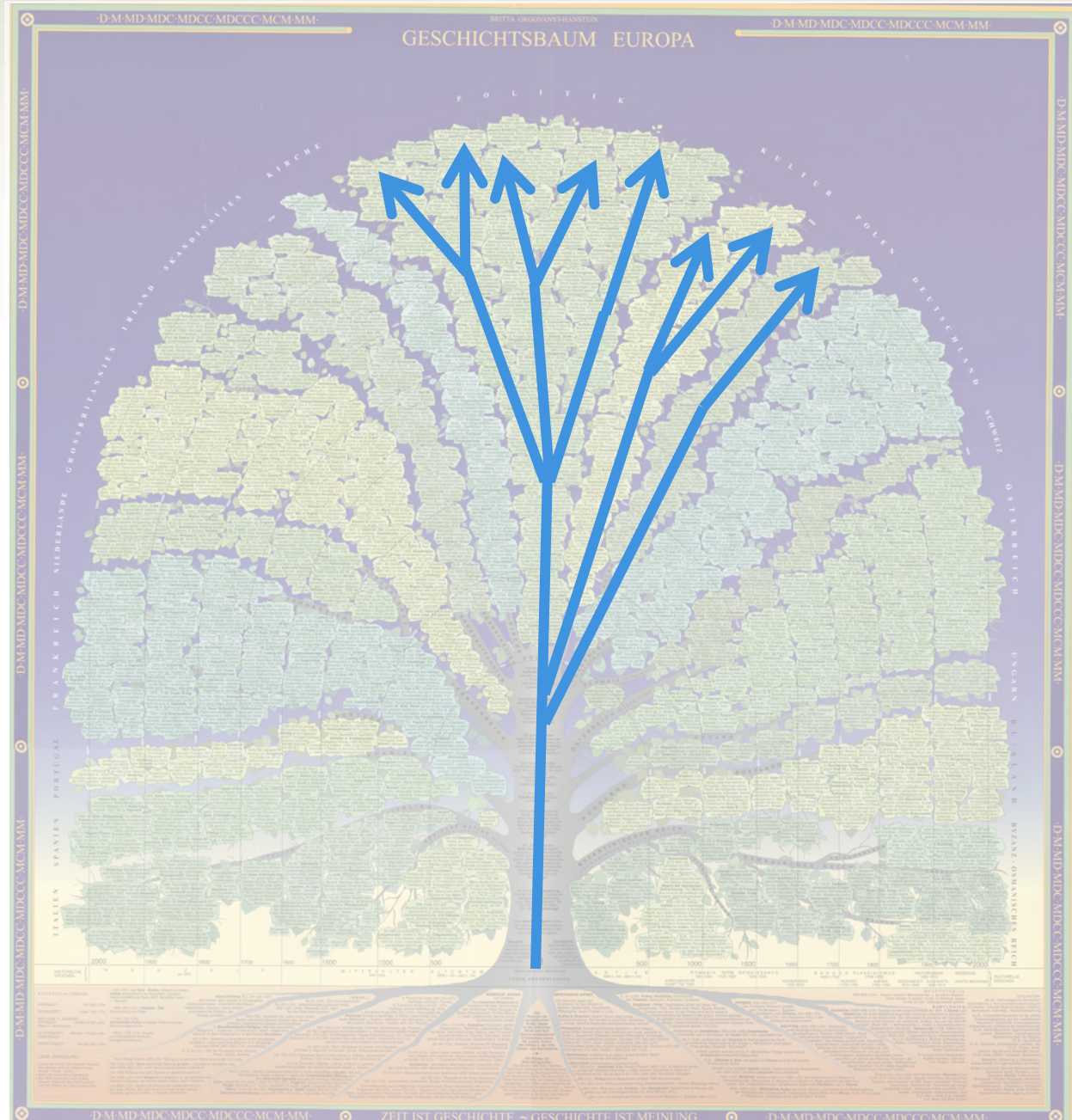
Grid - Calendar



Trees

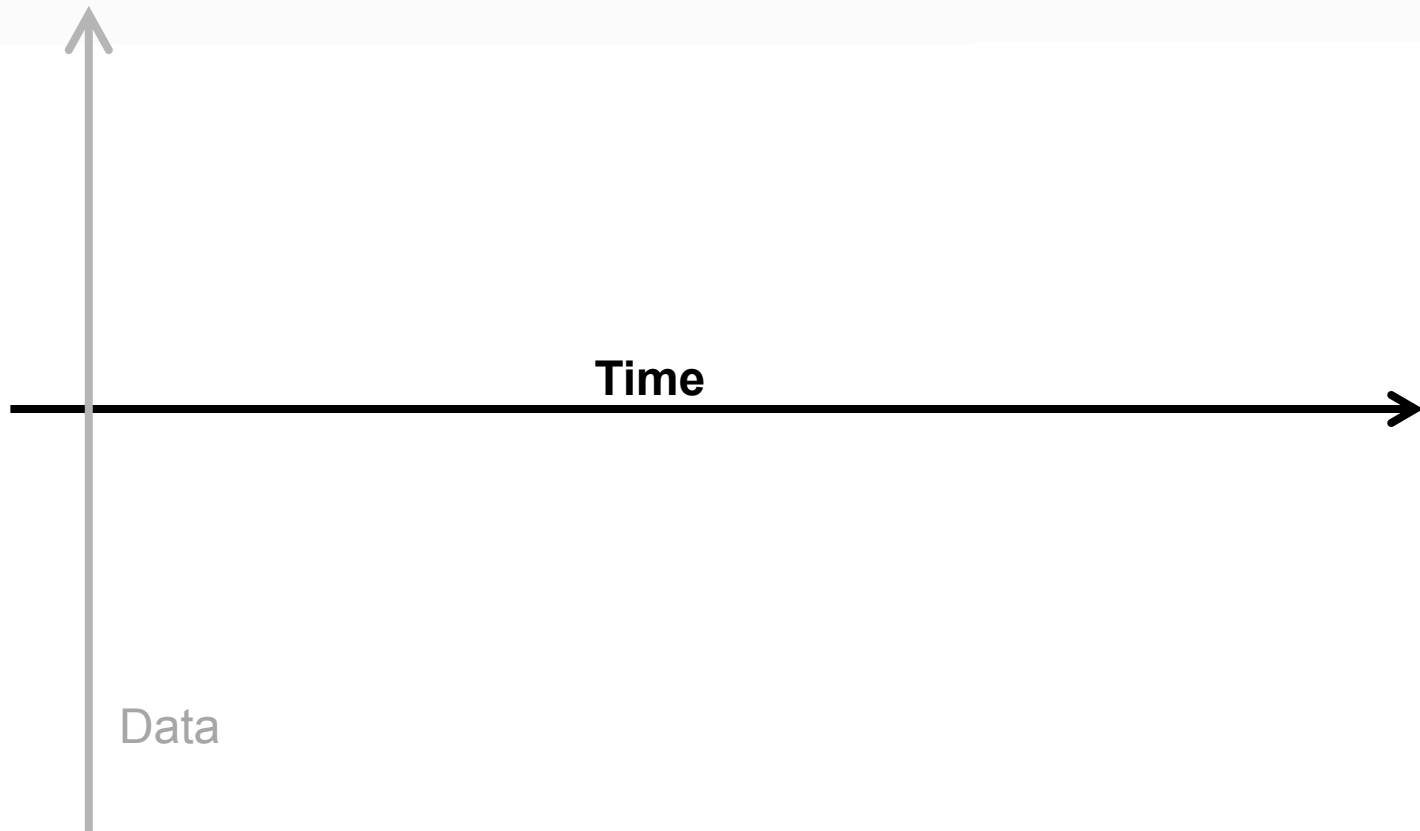


geschichtsbaum.de

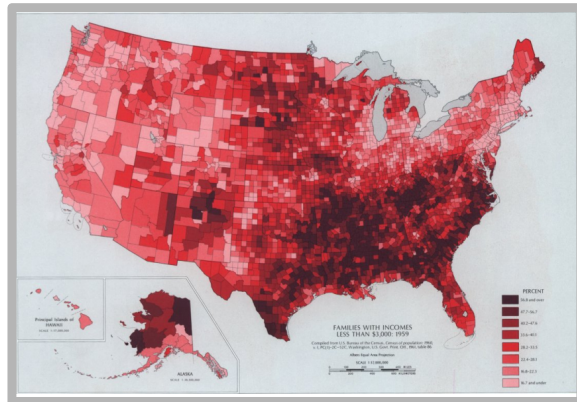


Mapping Time to Space

Mapping Time to an Axis



Mapping Time to an Axis



Data

Time



2D + Time

A Review of Temporal Data Visualizations Based on Space-Time Cube Operations

B. Bach¹, P. Dragicevic¹, D. Archambault², C. Hurter³ and S. Carpendale⁴

¹INRIA, France

²Swansea University, UK

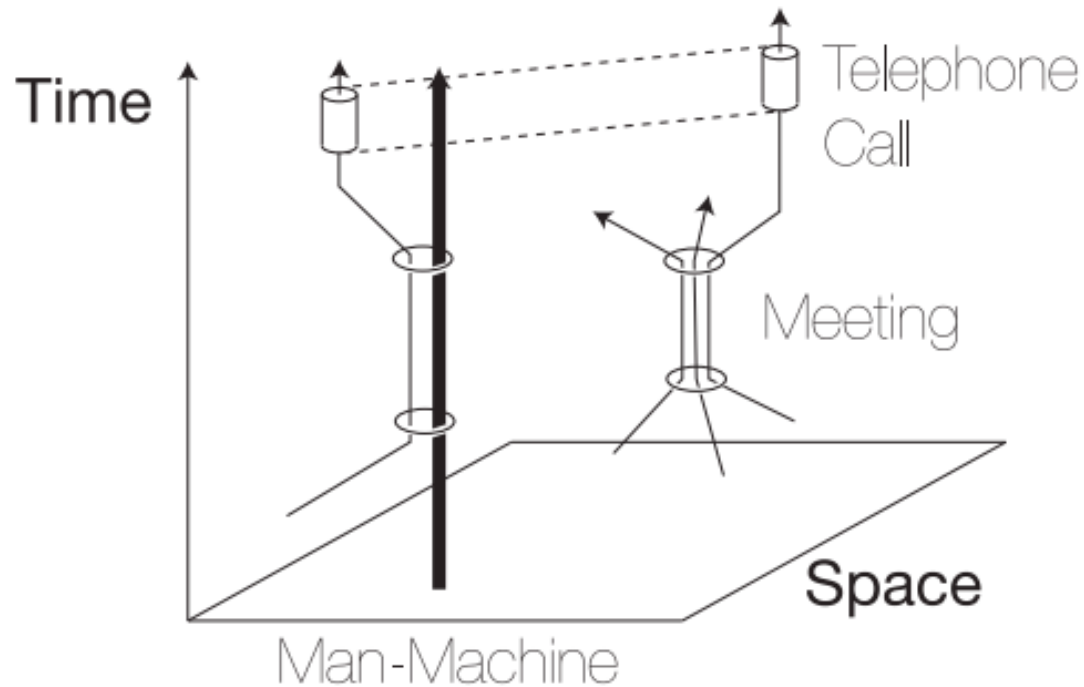
³ENAC, France

⁴University of Calgary, Canada

tinyurl.com/spacetime-bach

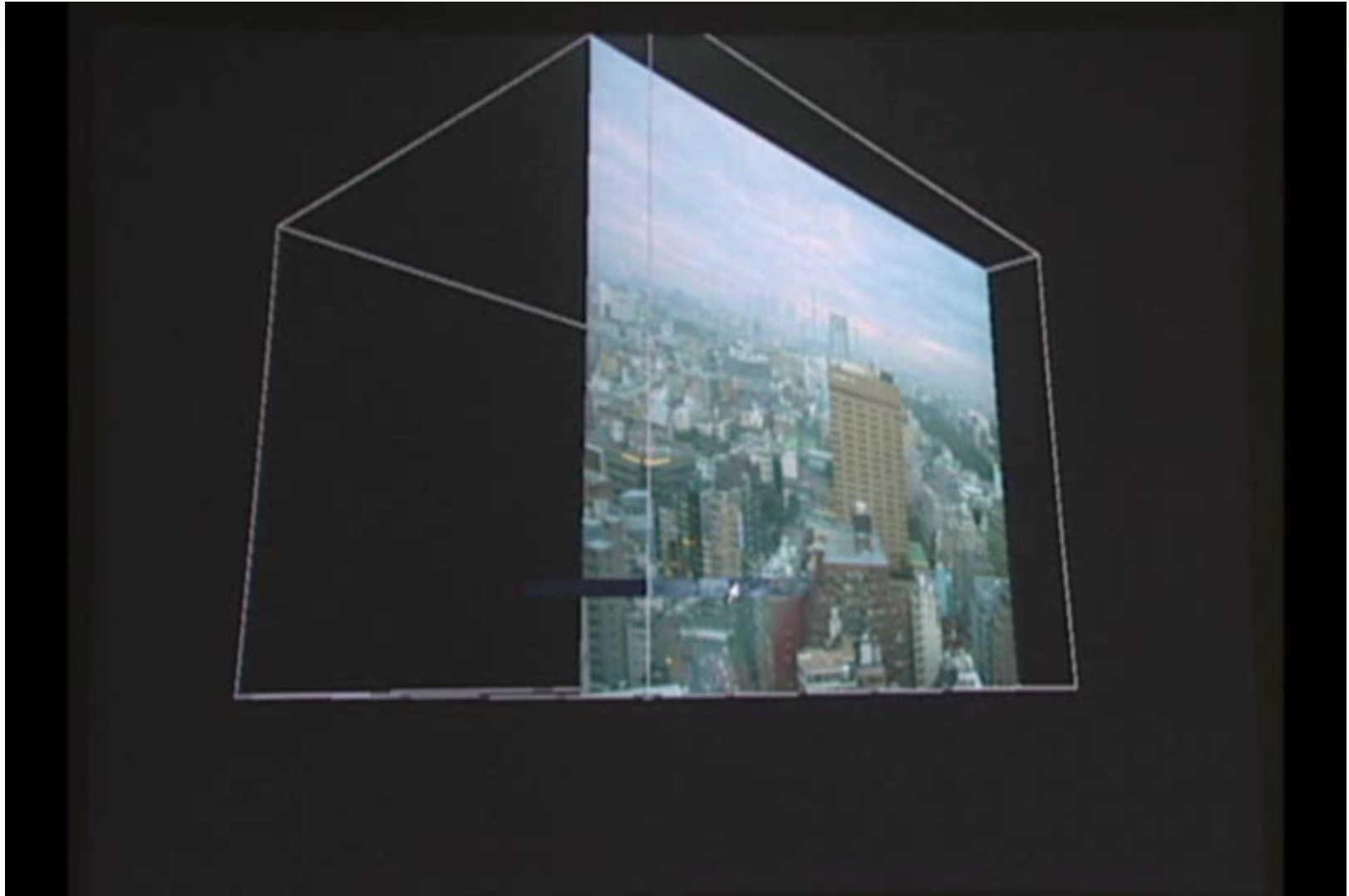
2D + Time

Space-Time Cube



[Hägerstrand, 1970]

2D + Time

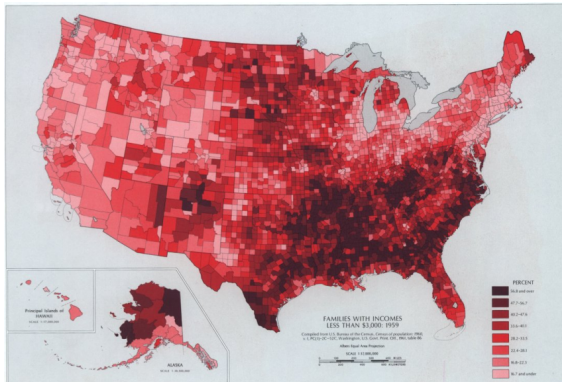


2D + Time



2D + Time

Space-Time Cube Model



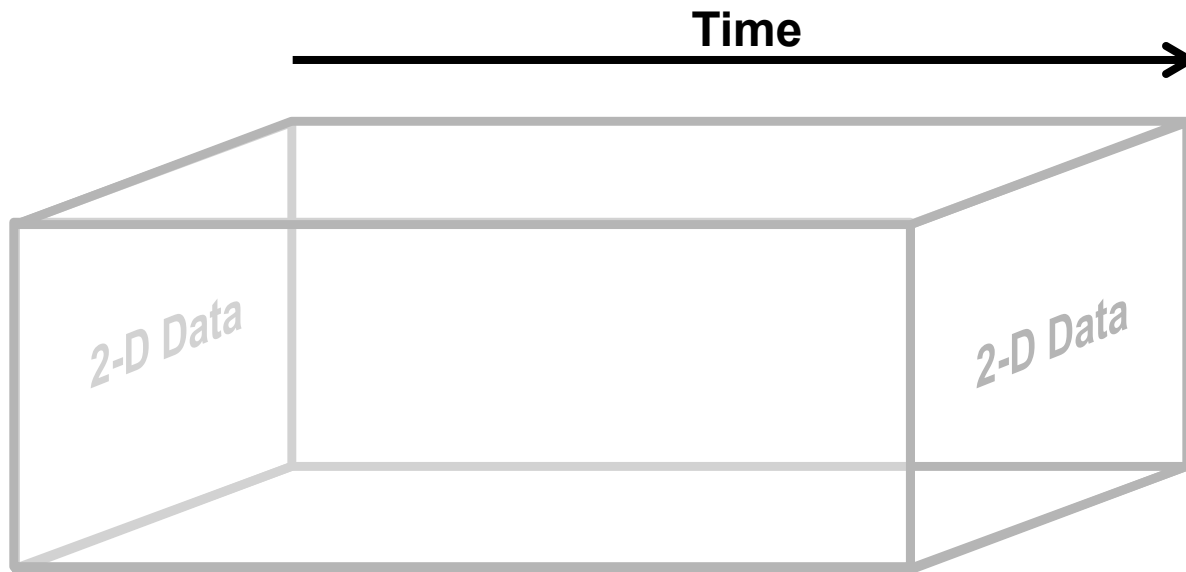
Time



2D Data

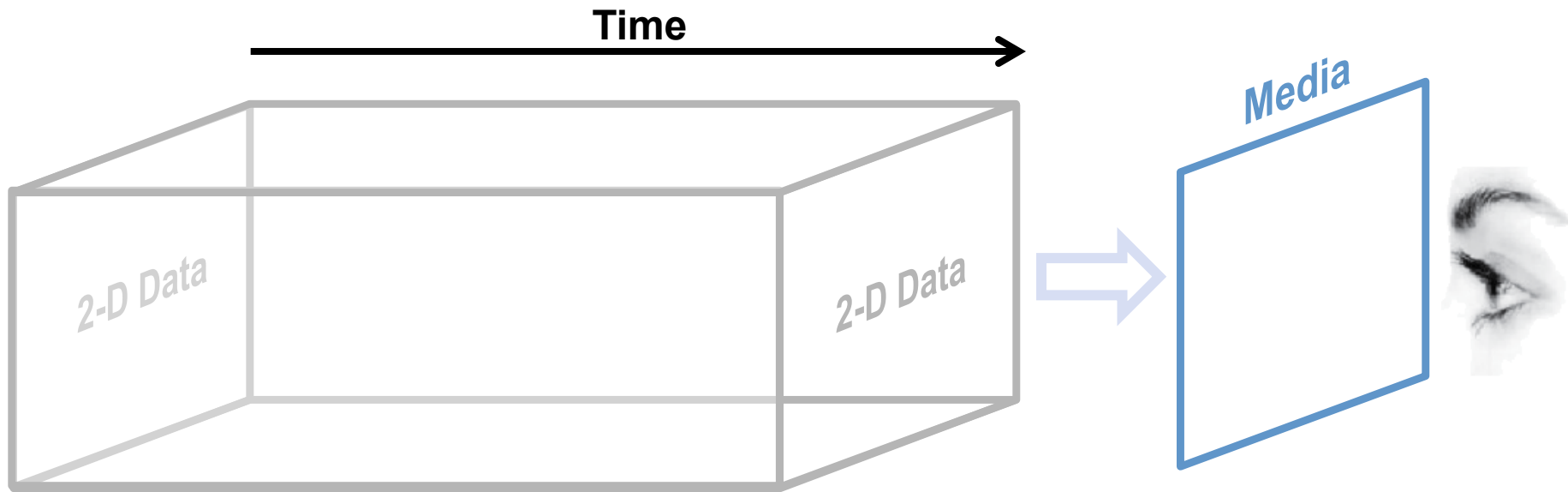
2D + Time

Space-Time Cube Model



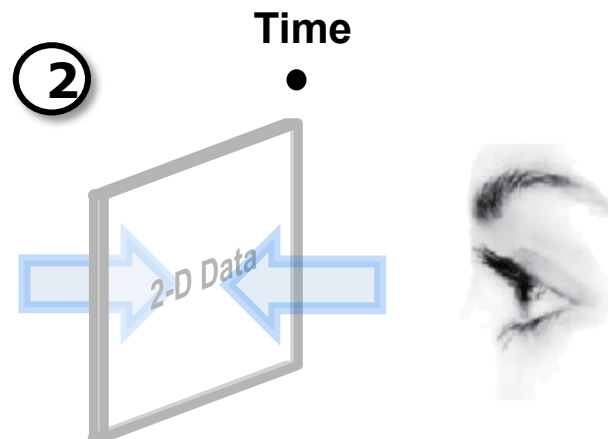
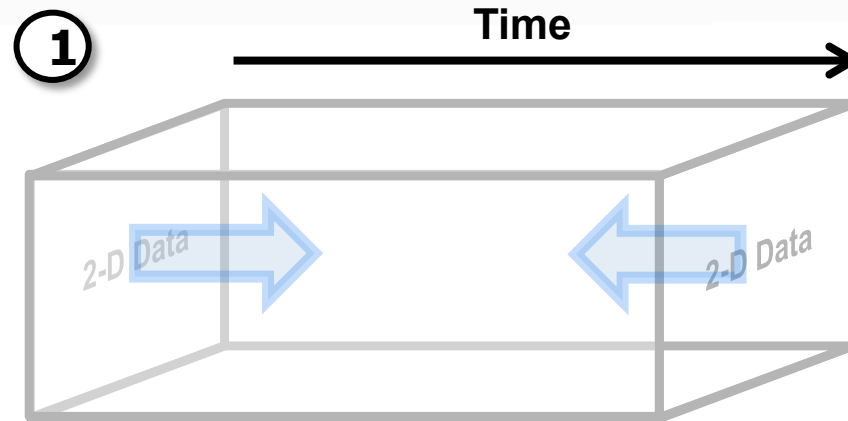
2D + Time

Space-Time Cube Model



2D + Time

Time Flattening



2D + Time

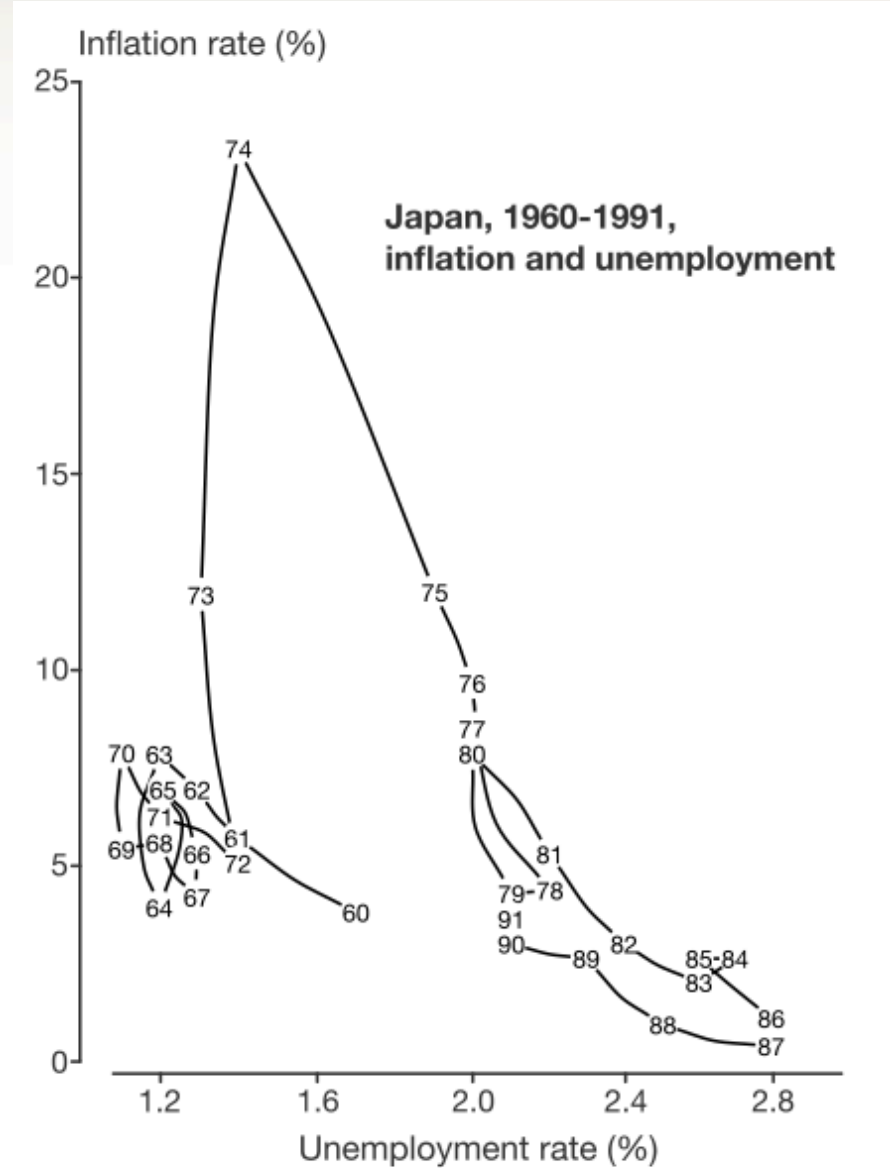
Long exposure photography



www.dlrmen.com

2D + Time

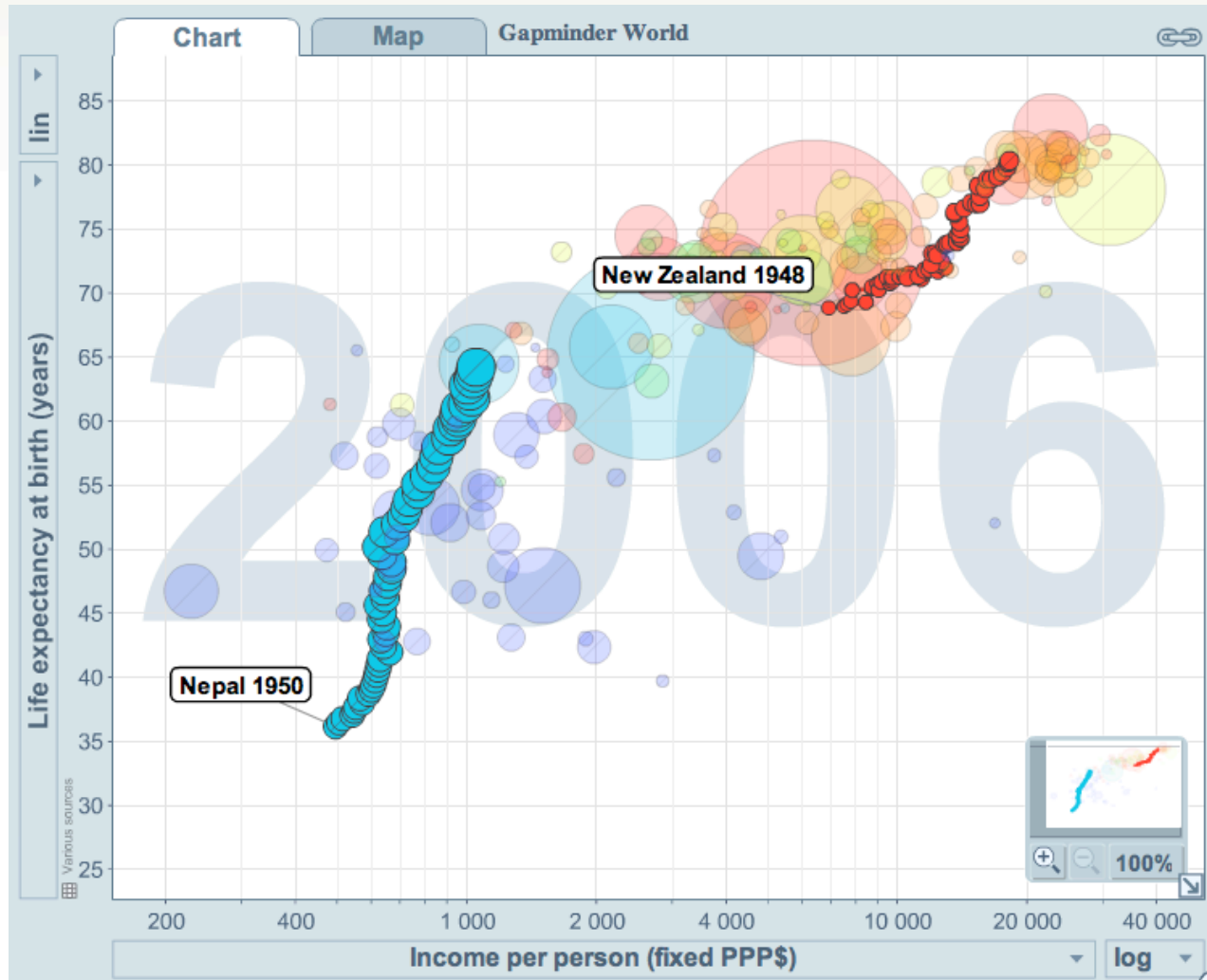
Phillips Curve



Tufte, 1997. Cited in [Aigner et al, 2001](#)

2D + Time

Trails



2D + Time

Napoleon's Russian Campaign of 1812

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

Dressée 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 dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont été en Russie, le noir ceux qui en sont sortis. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de L'égur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 23 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 qui rejoignent vers Orscha et Witebsk, avaient toujours marché avec l'armée.

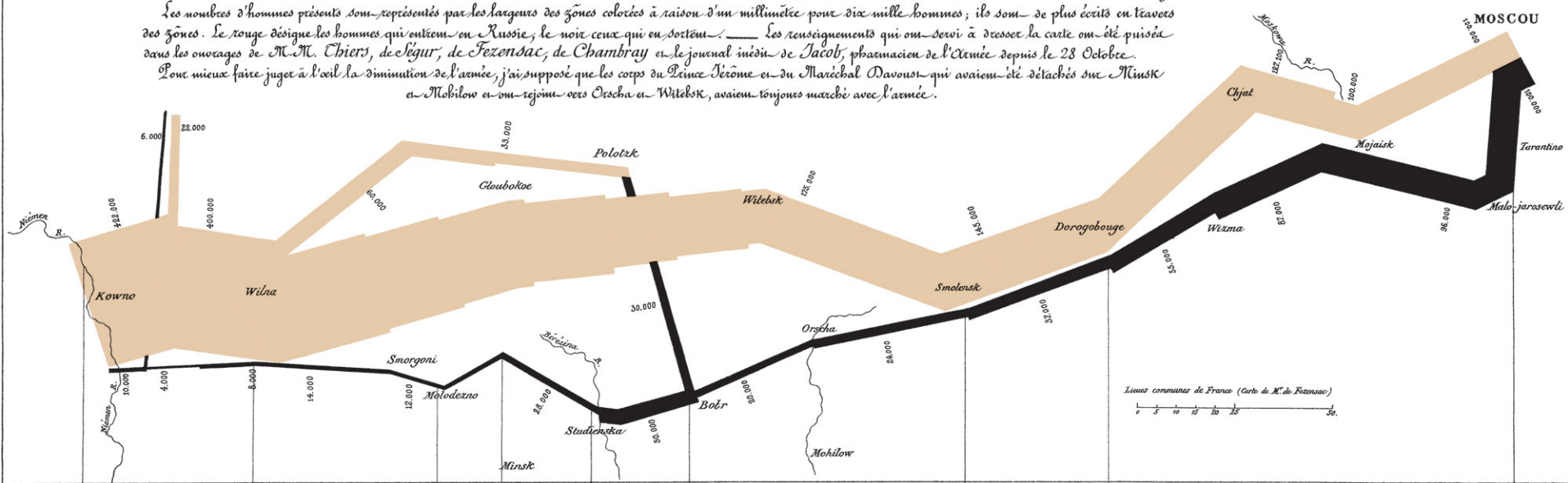
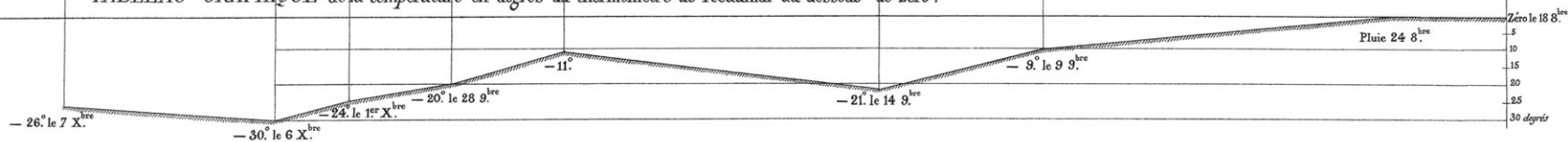


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



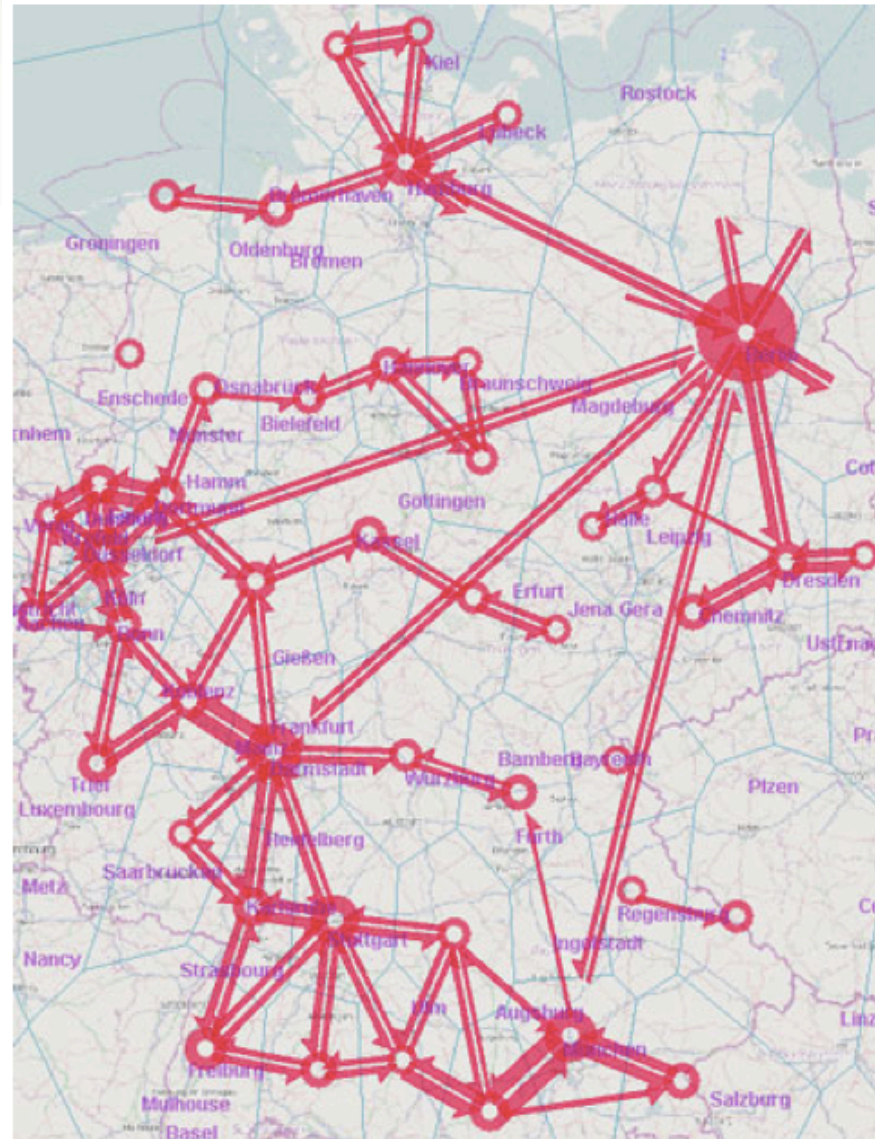
Les Cosaques passent au galop le Niémen gelé.

Autog. par Regnier, 8. Par. S¹⁶ Marie S¹⁶ G¹⁶ à Paris.

Imp. Lith. Regnier et Doucet.

2D + Time

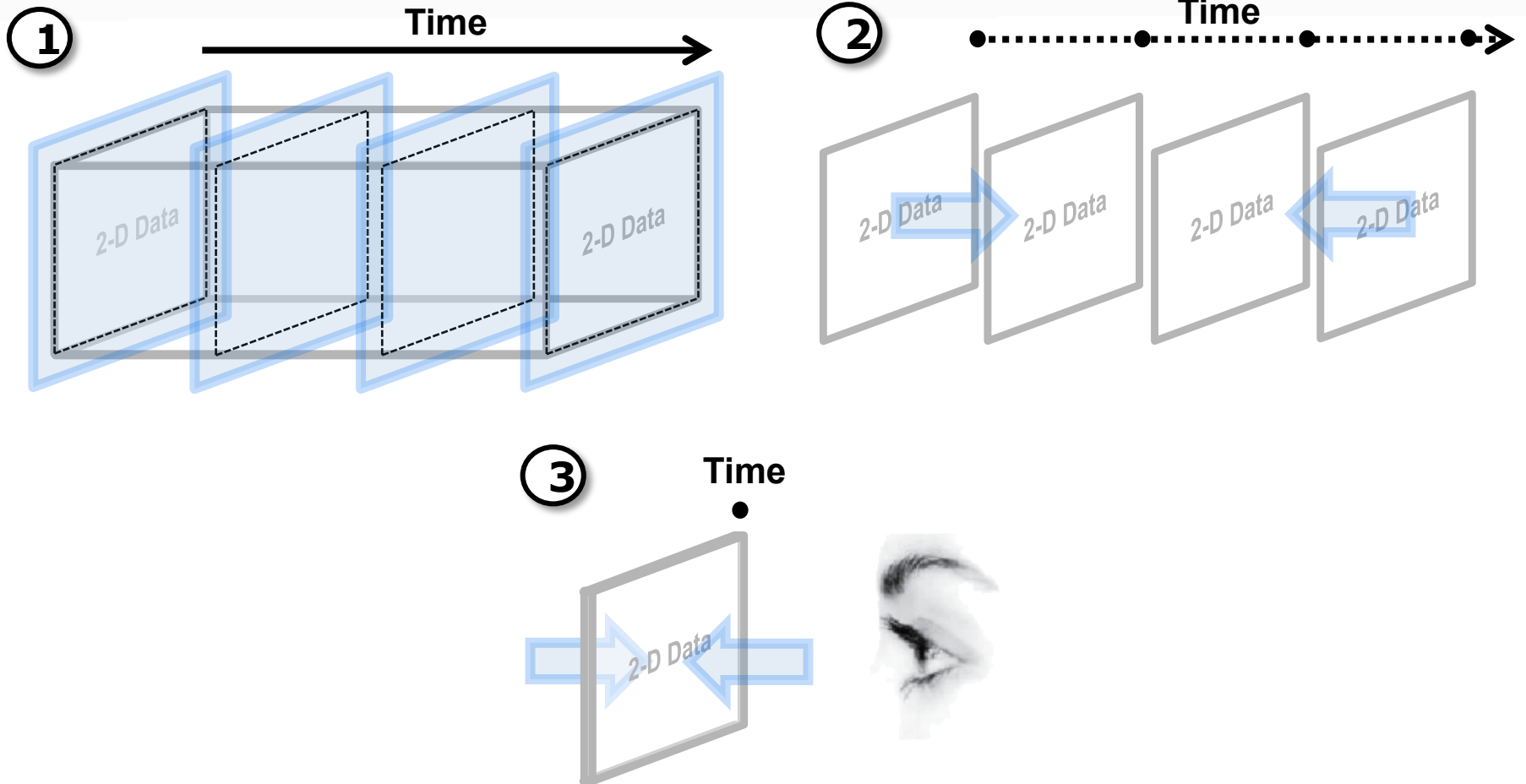
Flow Maps



Tobler, 1987
Adrienko, 2011

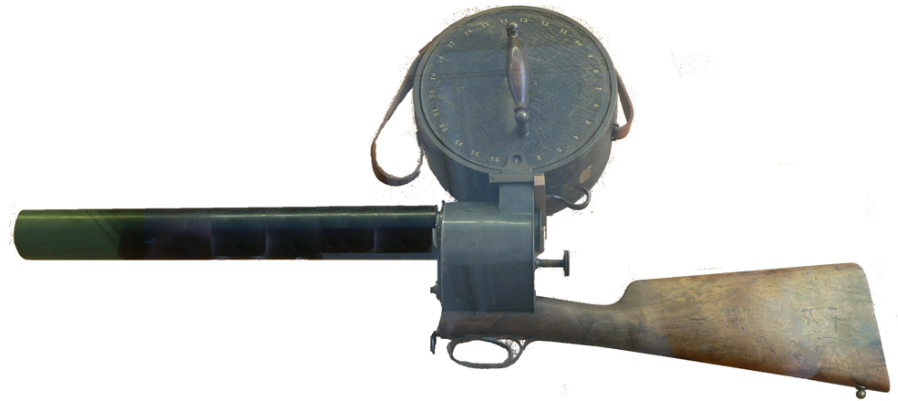
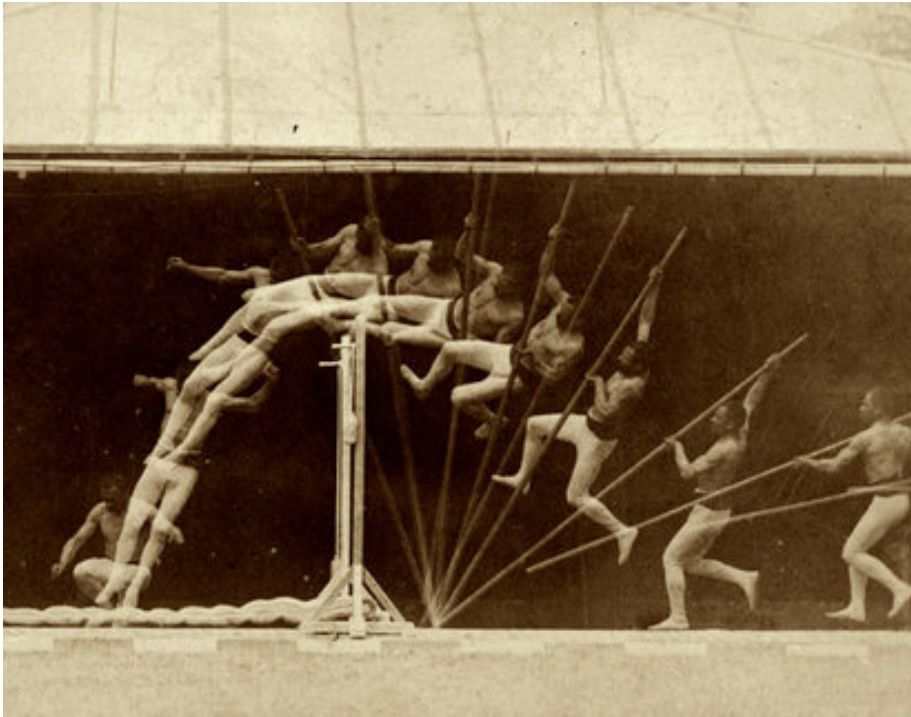
2D + Time

Discrete Time Flattening



2D + Time

Marey's Chronophotography Technique

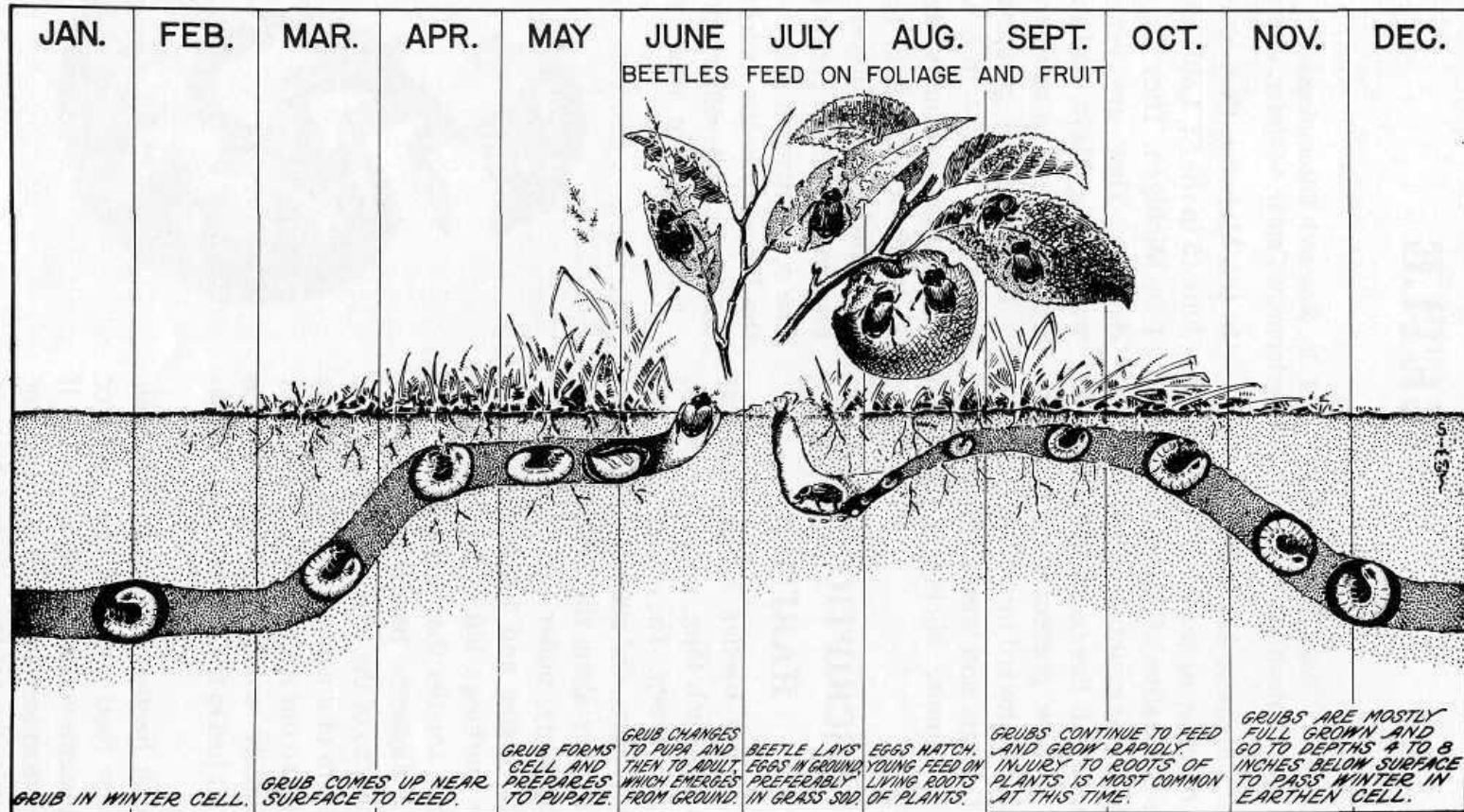


[\(image source\)](#)

Étienne-Jules Marey, 1880s ([source](#))

2D + Time

Sequences



Seasonal life cycle of the Japanese beetle in the vicinity of Philadelphia.

FR.1.2789

2D + Time

Sequences

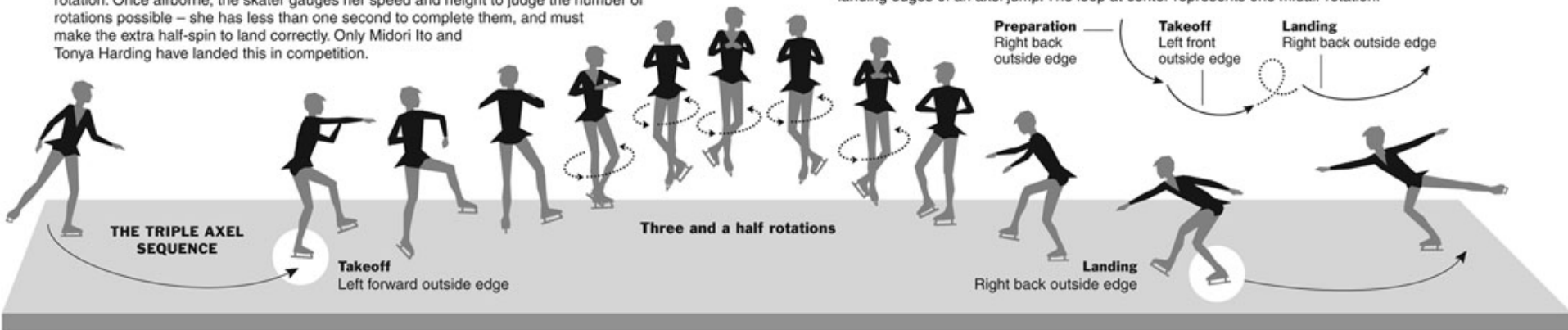
The Jumping Off Points: Moves That Will Be Made in the Free Skating Programs

TRIPLE AXEL: Add an extra half-spin

The axel's forward takeoff and backward landing positions add an extra half-rotation to the jump, so skaters need maximum power on takeoff, and precise upper body control during rotation. Once airborne, the skater gauges her speed and height to judge the number of rotations possible – she has less than one second to complete them, and must make the extra half-spin to land correctly. Only Midori Ito and Tonya Harding have landed this in competition.

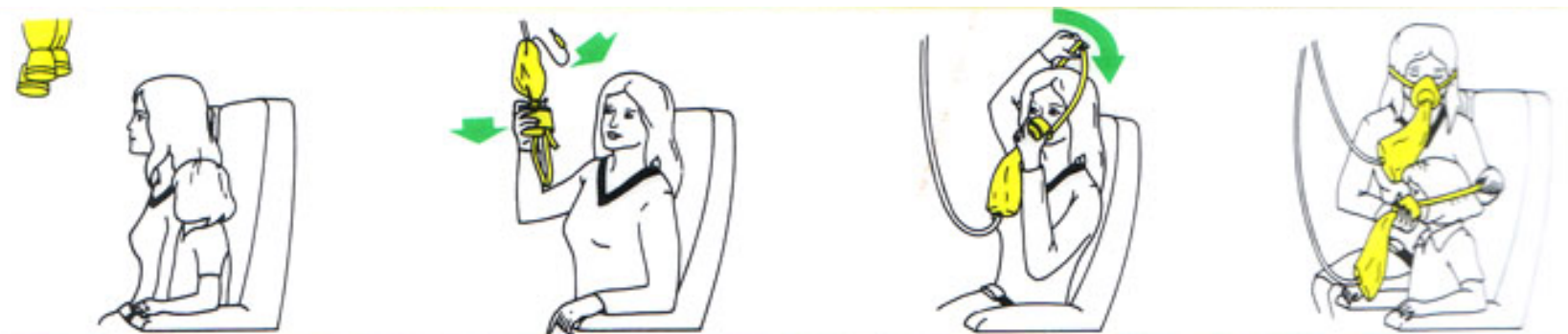
SKATING THE EDGES: An overhead view of the axel

In skating terminology, the path of a jump is described as a series of edges – semicircular arcs that follow the path of the skate blade. The diagram shows the preparatory, takeoff and landing edges of an axel jump. The loop at center represents one midair rotation.



Megan Jaegerman. Cited in [Tufte, 2007](#)

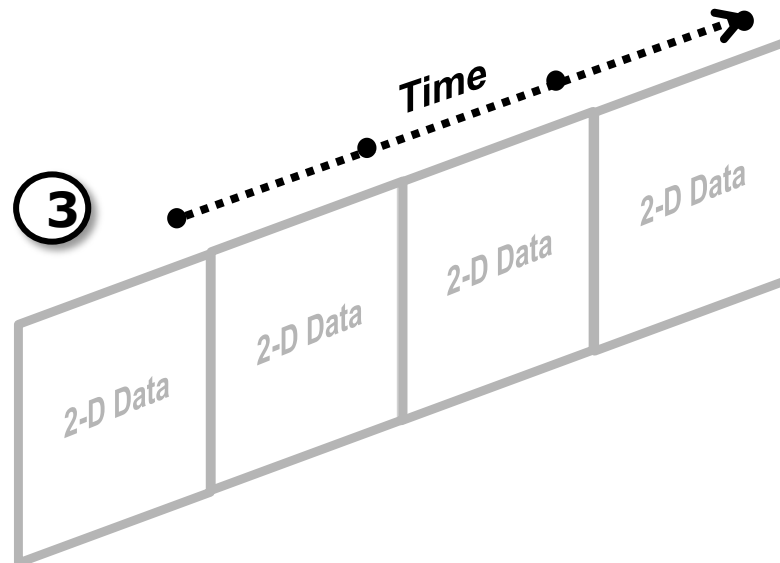
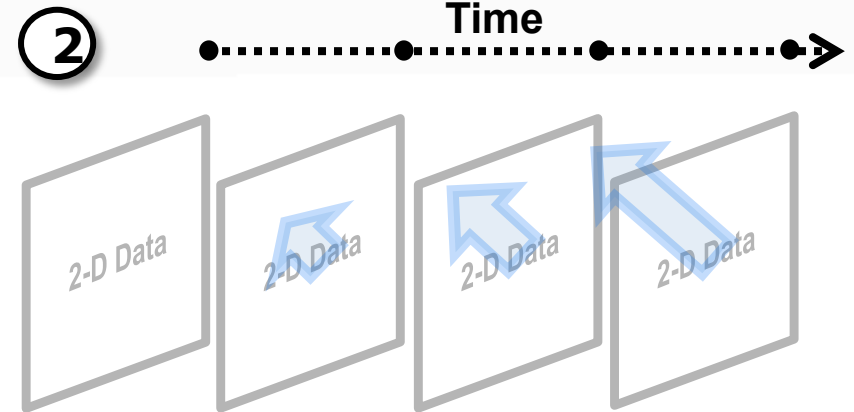
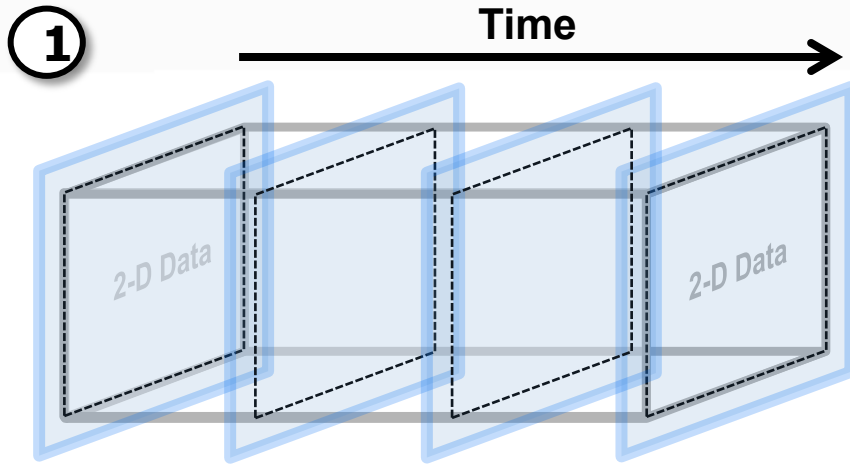
2D + Time



[\(image source\)](#)

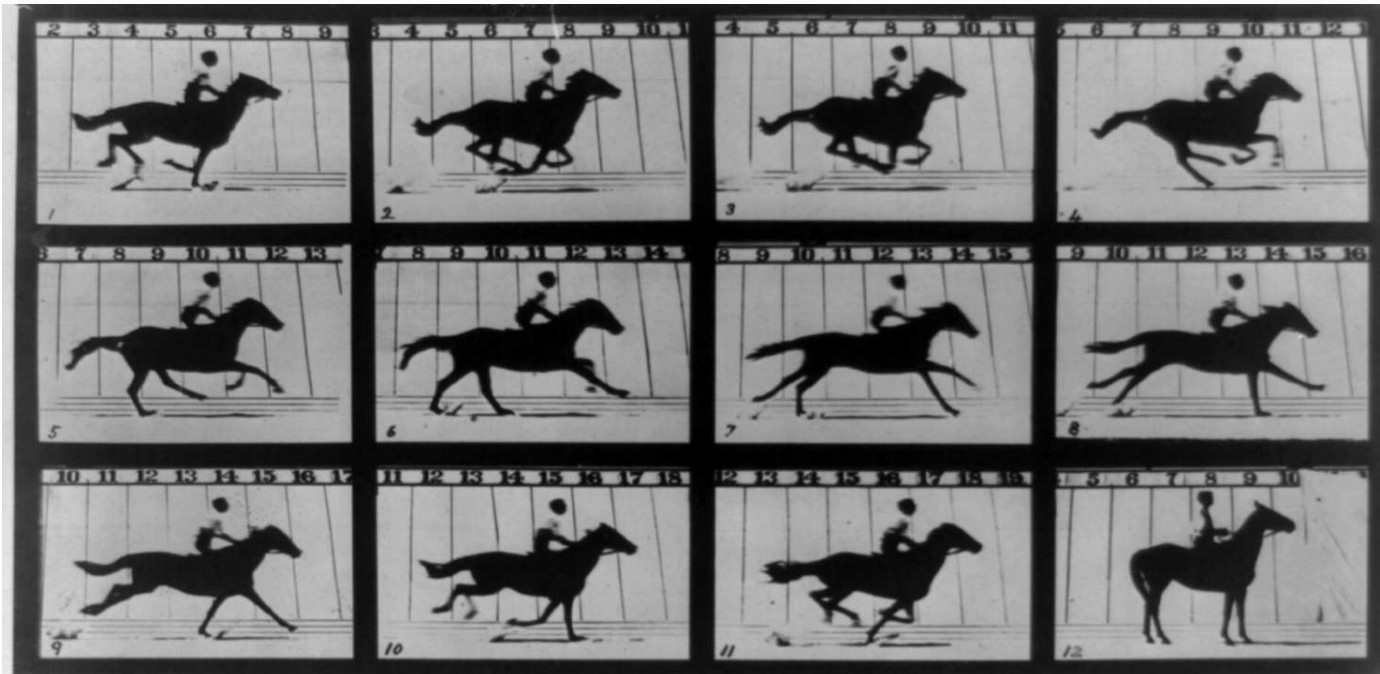
2D + Time

Time Juxtaposing



2D + Time

Muybridge's Chronophotography Technique



Copyright, 1878, by MUYBRIDGE.

MORSE'S Gallery, 417 Montgomery St., San Francisco

THE HORSE IN MOTION.

Illustrated by
MUYBRIDGE.

AUTOMATIC ELECTRO-PHOTOGRAPH.

Patent for apparatus applied for.
"SALLIE GARDNER," owned by LELAND STANFORD; ridden by G. DOMM, running at a 1.40 gait over the Palo Alto track, 19th June, 1878.

The negatives of these photographs were made at intervals of twenty-seven inches of distance, and about the twenty-fifth part of a second of time; they illustrate consecutive positions assumed during a single stride of the mare. The vertical lines were twenty-seven inches apart; the horizontal lines represent elevations of four inches each.

The negatives were each exposed during the two-thousandth part of a second, and are absolutely "untouched."

Eadweard J. Muybridge, 1878 ([source](#))

2D + Time

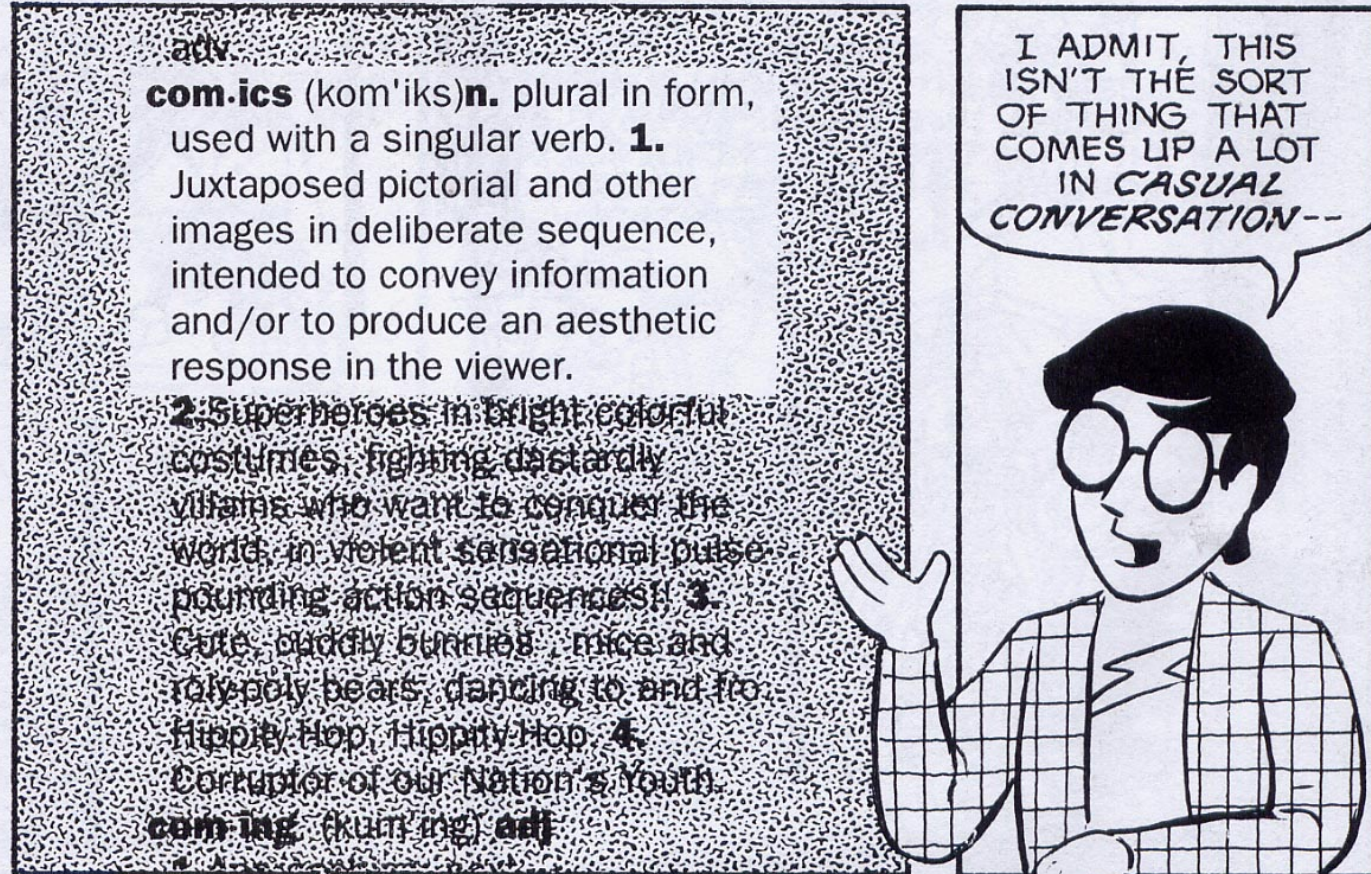
Comics



Understanding Comics: The invisible Art
[Scott McCloud, 1993](#)

2D + Time

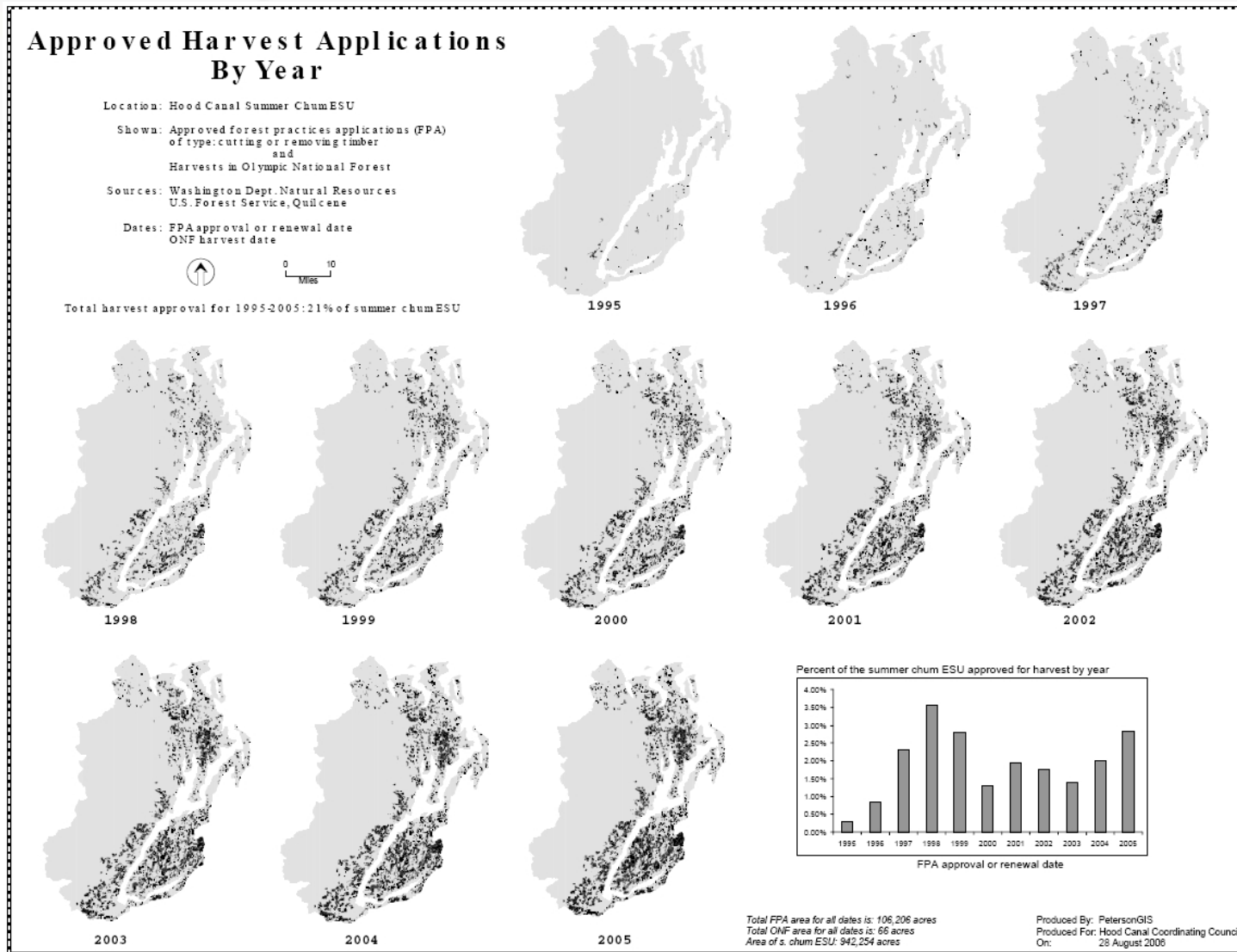
Comics



Understanding Comics: The invisible Art
[Scott McCloud, 1993](#)

2D + Time

Small Multiples

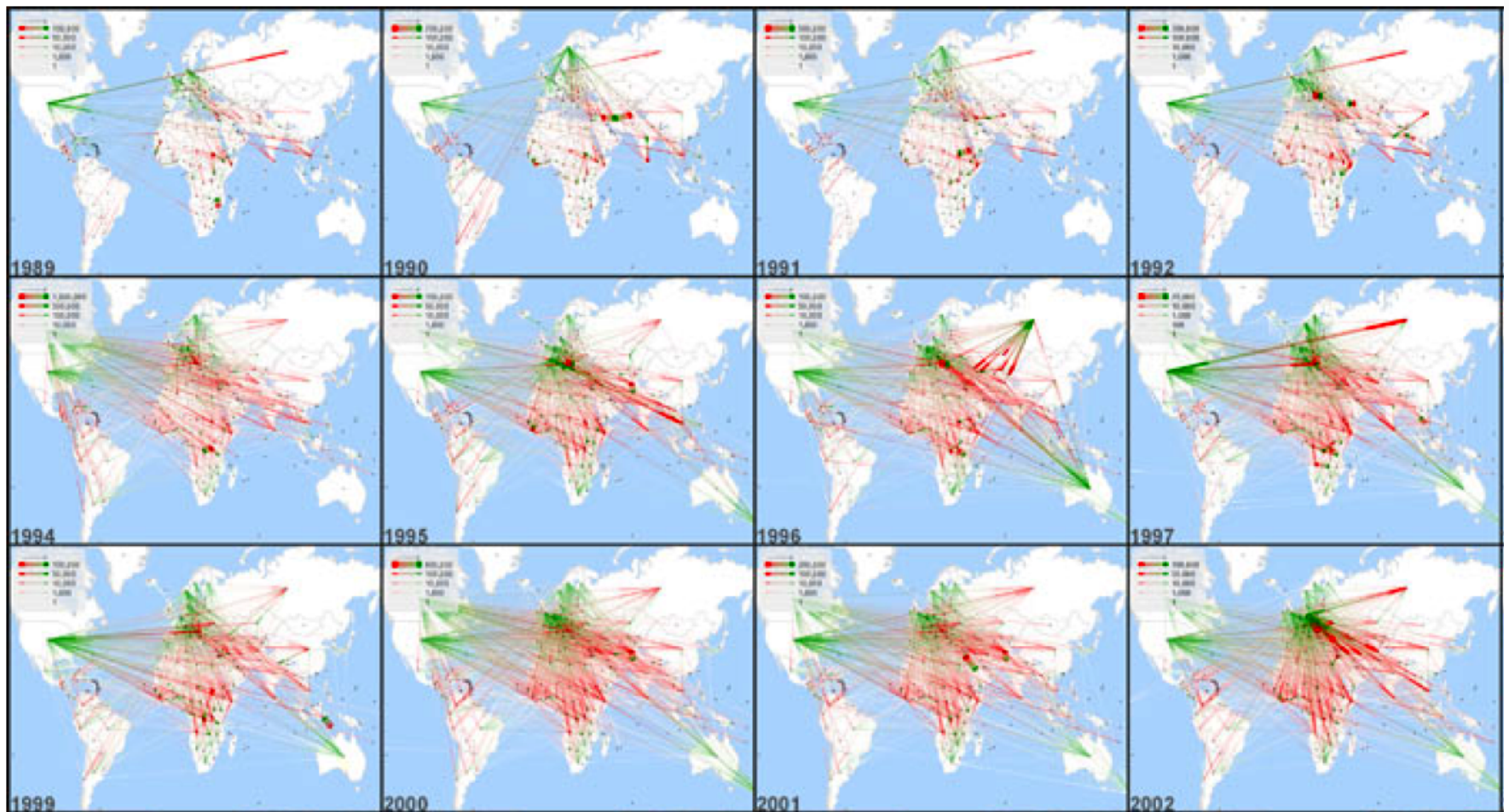


[Tuftes,](#)
[1983](#)

[\(image source\)](#)

2D + Time

Small Multiples



2D + Time

Side-By-Side Views

FE / trunk
build.xml

Activity Revisions Users Reports Source

107905 107905 Changeset Raw Annotation Highlighting Columns Reviews

Line	Original Code	Modified Code
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2D + Time

Side-By-Side Views

