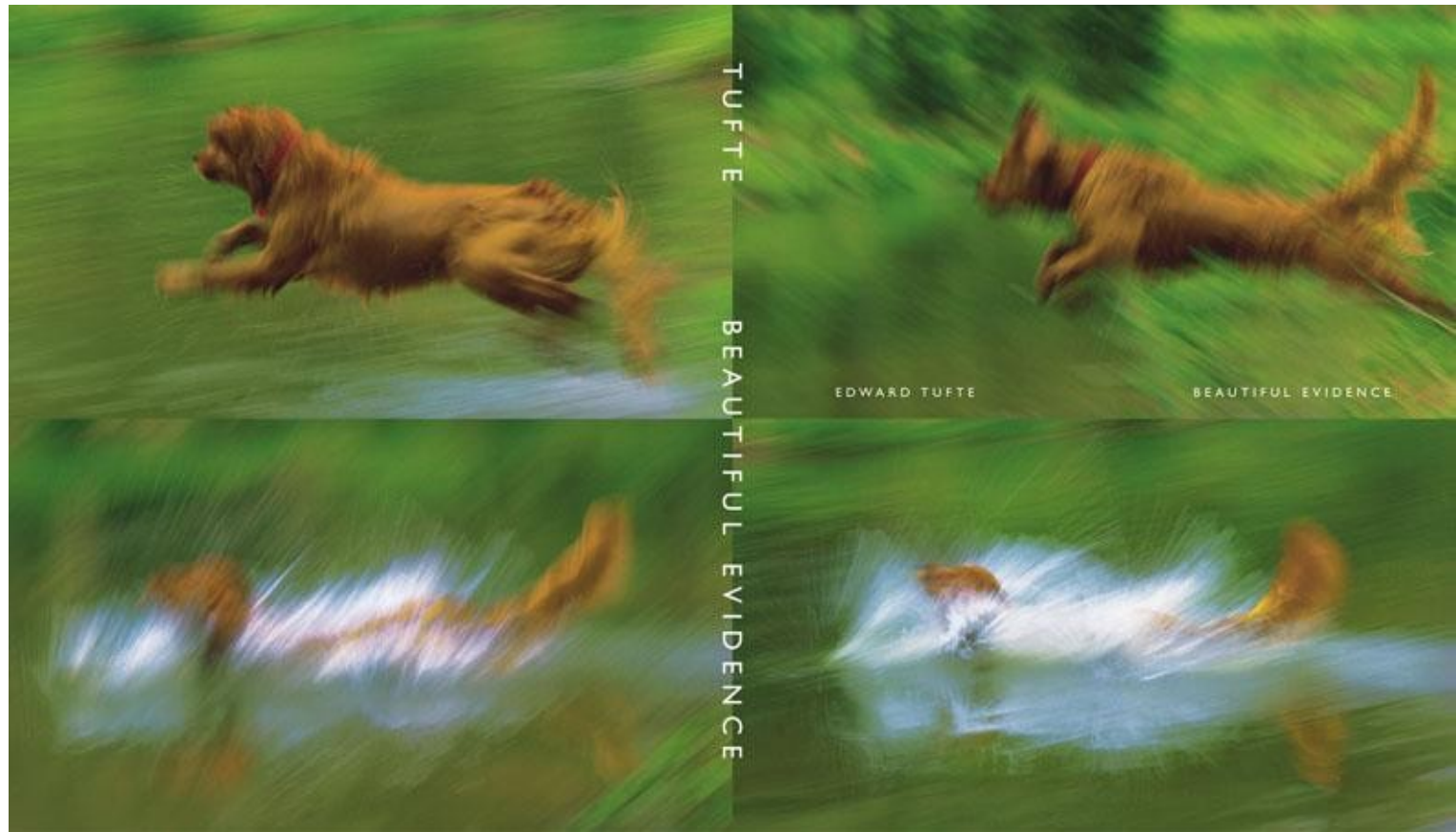
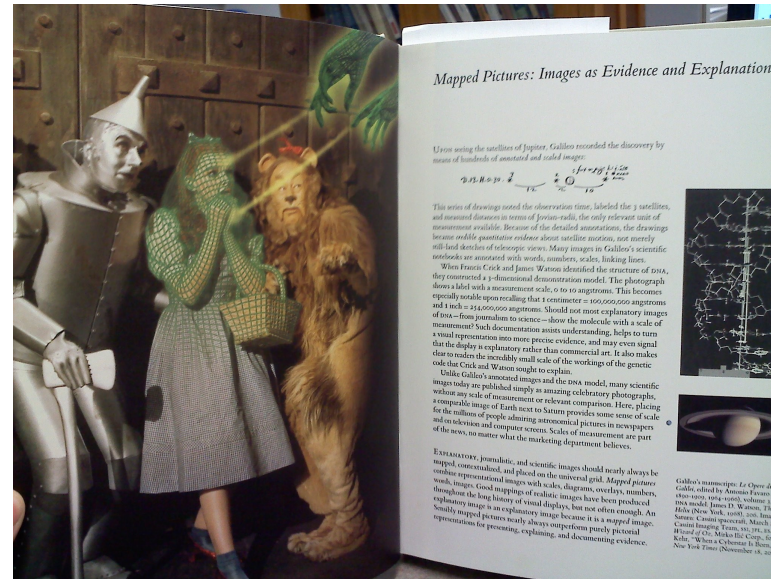


Beautiful Evidence

by Edward Tufte



Harriet King, CS 5090: Data Visualization (November 11, 2010)



[Chapter One] Mapped Pictures: Images as Evidence and Explanation

Presentation Outline

- Brief Biography
- About the Book
- About the Chapter: Mapped Pictures
- Examples of Mapped Pictures
- Conclusion
- Sources

Edward R. Tufte

- Born 1942 in Missouri
- Beverly Hills High School
- Stanford BS and MS in Statistics
- Yale PhD Political Science (1968)
- Yale Professor Emeritus of Political Science, Statistics, and Computer Science
- Landscape Sculptor



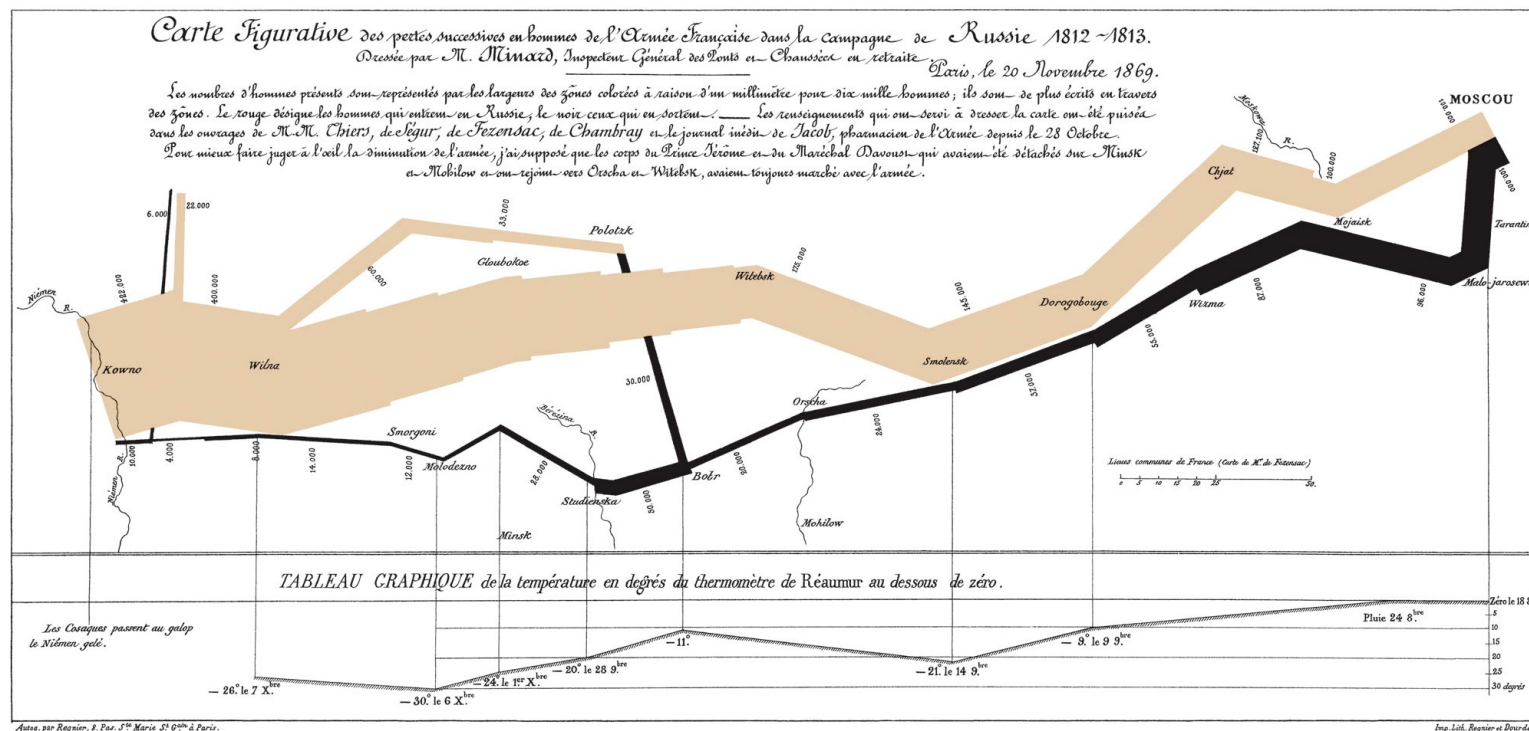
Analytical Design Theorist



- "Leonardo da Vinci of Data" (NY Times)
- "Galileo of graphics" (Business Week)
- 1975 Princeton seminars on statistics to journalists
- Self Published 1983 gave him freedom
- Statistical evidence and scientific visualization

Seeing & Thinking Intensified

“A big intellectual move in my work and my teaching came together in [1990 book]... It essentially opened the entire world of visual evidence up so evidence was *no longer statistical graphics* – it was the whole world of seeing and thinking, bringing together how seeing and therefore thinking could be intensified.” (Tufte)



Auget, par Regnier, 3. Par. 5^{me} Marie 51 9^{me} à Paris.

Imp. Lit. Regnier et Doucet.

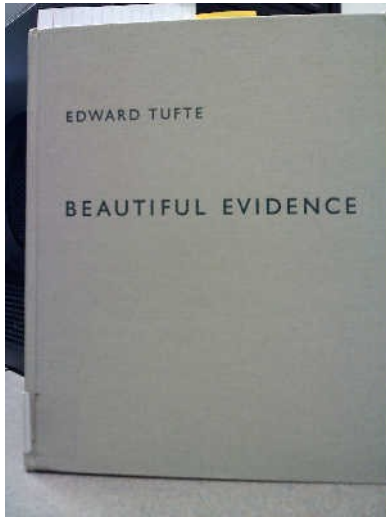
Example of Book's Variety



Edward Tufte, "Dear Leader I" and "Millstones 5 and 6", 2003-2004
(mild steel, diameter 13'8" or 4.2 meters)

Beautiful Evidence's Contents

- 1) Mapped Pictures: Images as Evidence and Explanation
- 2) Sparklines: Intense, Simple, Word-Sized Graphics
- 3) Links and Causal Arrows: Ambiguity in Action
- 4) Words, Numbers, Images – Together
- 5) The Fundamental Principles of Analytical Design
- 6) Corruption in Evidence Presentations: Effects Without Causes, Cherry Picking, Overreaching, Chartjunk, and the Rage to Conclude
- 7) The Cognitive Style of PowerPoint: Pitching Out Corrupts Within
- 8) Sculptural Pedestals: Meaning, Practice, Depedestalization
- 9) Landscape Sculptures



Book's Themes

Valid data visualizations turn seeing into showing

For both producers and consumers

- Evidence presentation is ethical and intellectual act
- Must understand and reason about evidence

Meaning of “Beautiful Evidence”

- Beautiful beyond being proof
- Used to judge quality, relevance, integrity
- Science and art share intense observing



[chapter 1]

Mapped Pictures: Images as Evidence and Explanation

A Mapped Picture



Edward Tufte, *Spring Arcs* (2004) solid stainless steel, arc diameter 12 feet

What are “Mapped Pictures”?

- Detailed annotations on images
- Credible
- Quantified
- Contextualized
- Clear Scale

Why Mapped Pictures?

Purpose:

- To present, explain, or document
- Mappings tell why an image matters

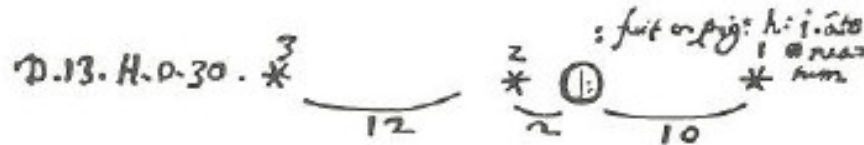


David Hockney, *Nichols Canyon* (1980) acrylic on canvas

Minimal Mapping

- Stop sign
- Street sign
- Basic relative scale

Notations as Evidence



Galileo's drawing (1610)

- Scaled and annotated
- “credible quantitative evidence”

Notations as Evidence

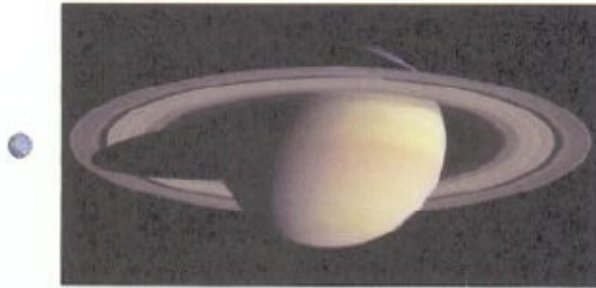


Bayer's sky drawing

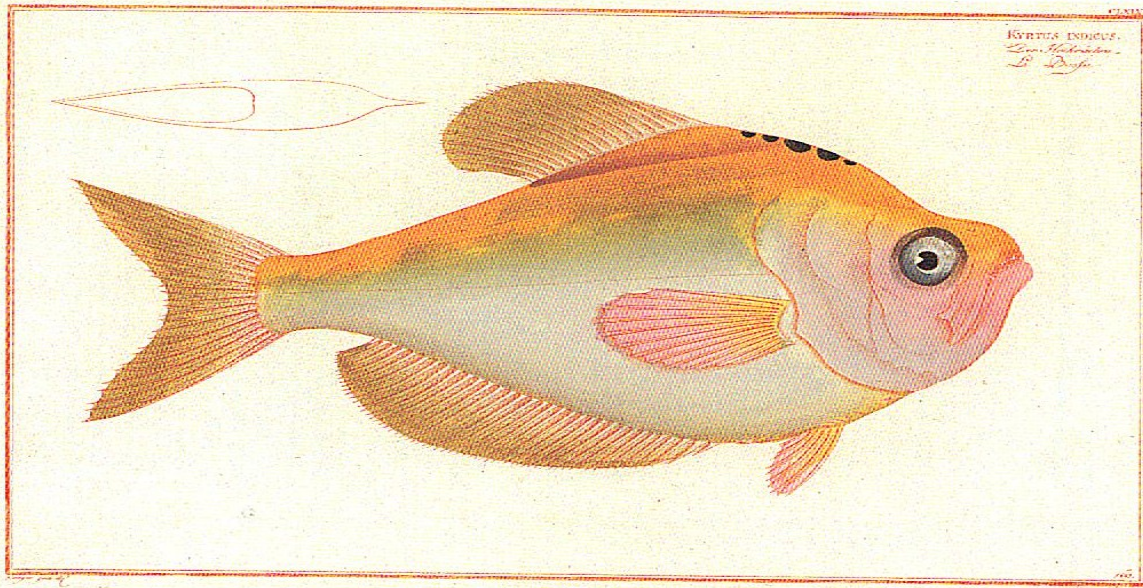
- Measured star strength
- Located on the grid
- Gives context
- Unknown filled with Leo the star myth

“unscaled and dequantified”

Problem with scientific deep space photos of today



Scale and Location

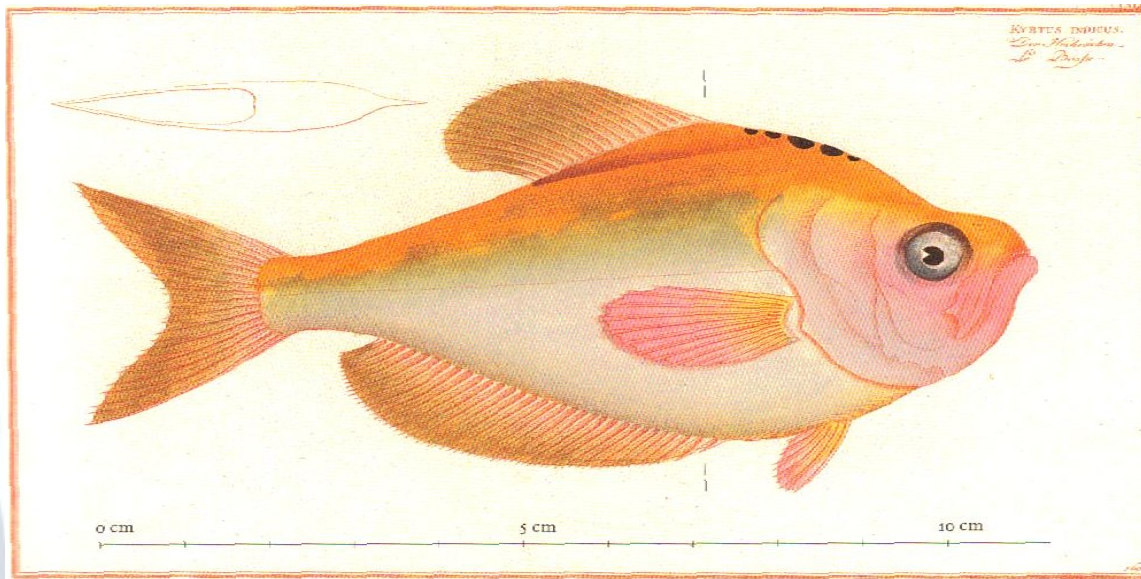
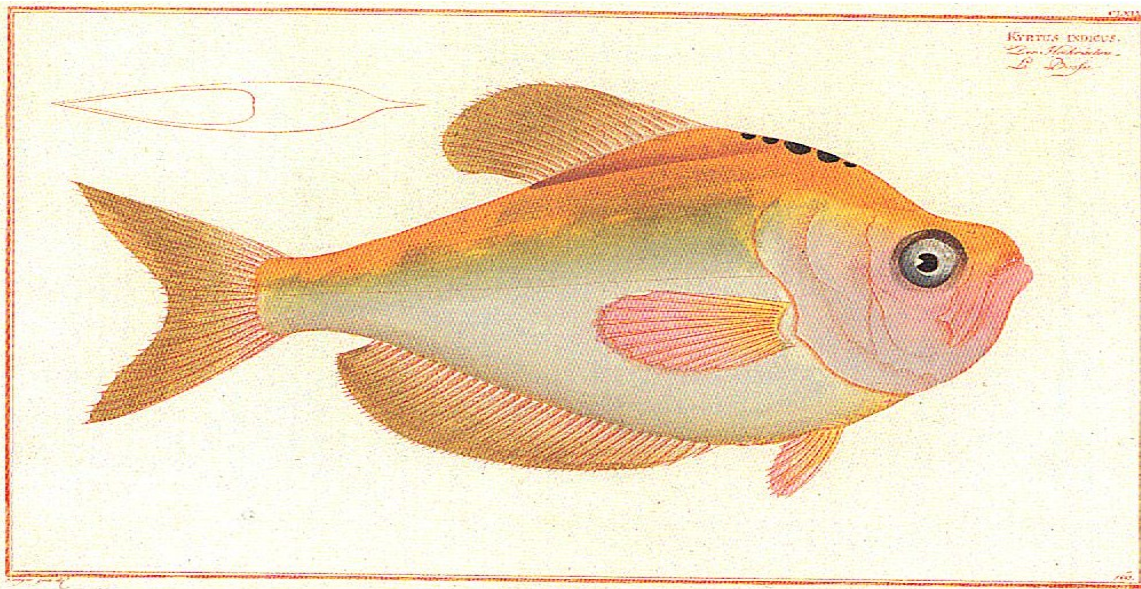


Problem:

- No scale given
- Same size
- Cross section location missing

Figure 1: Marcus Bloch, *Ichthyologie, our Histoire Naturelle Generale et Particuliere des Poissons* (1795)

Problem Solved

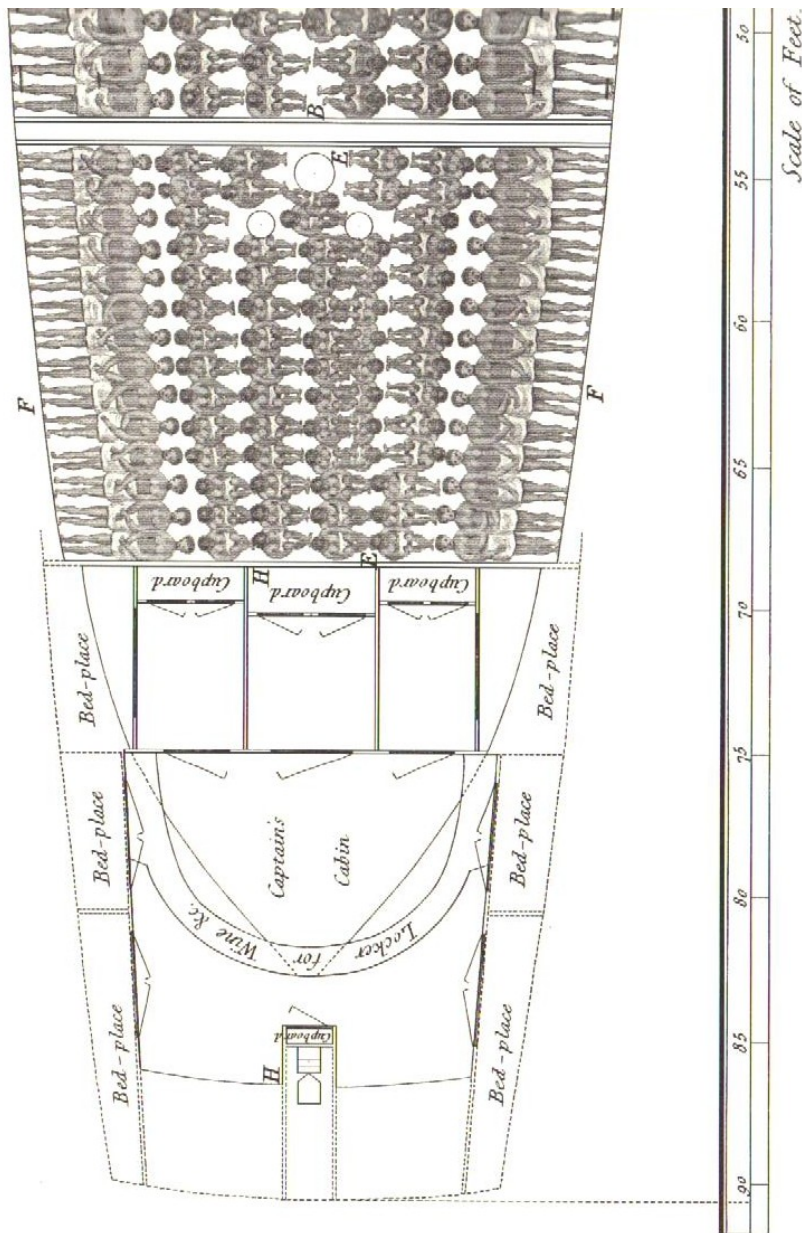


Solution:

- Give scale bar
- Add cross section mark

Figure 1: Marcus Bloch, *Ichthyologie, our Histoire Naturelle Generale et Particuliere des Poissons* (1795)

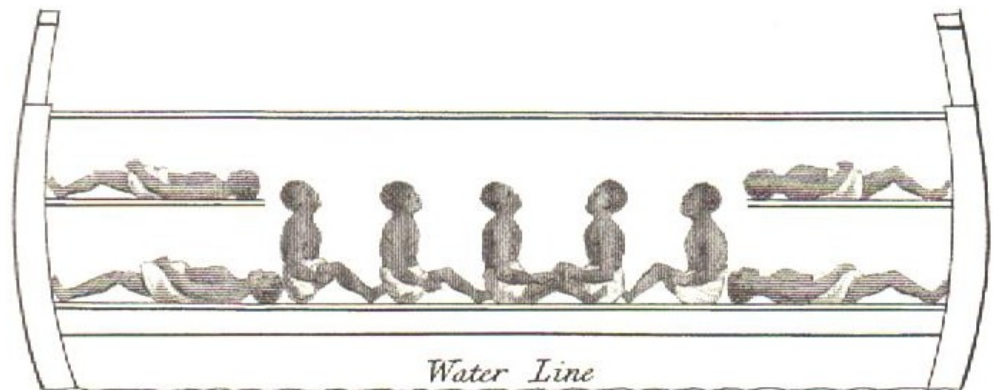
Evidence Because:



- Credible precision
- Engineering diagram

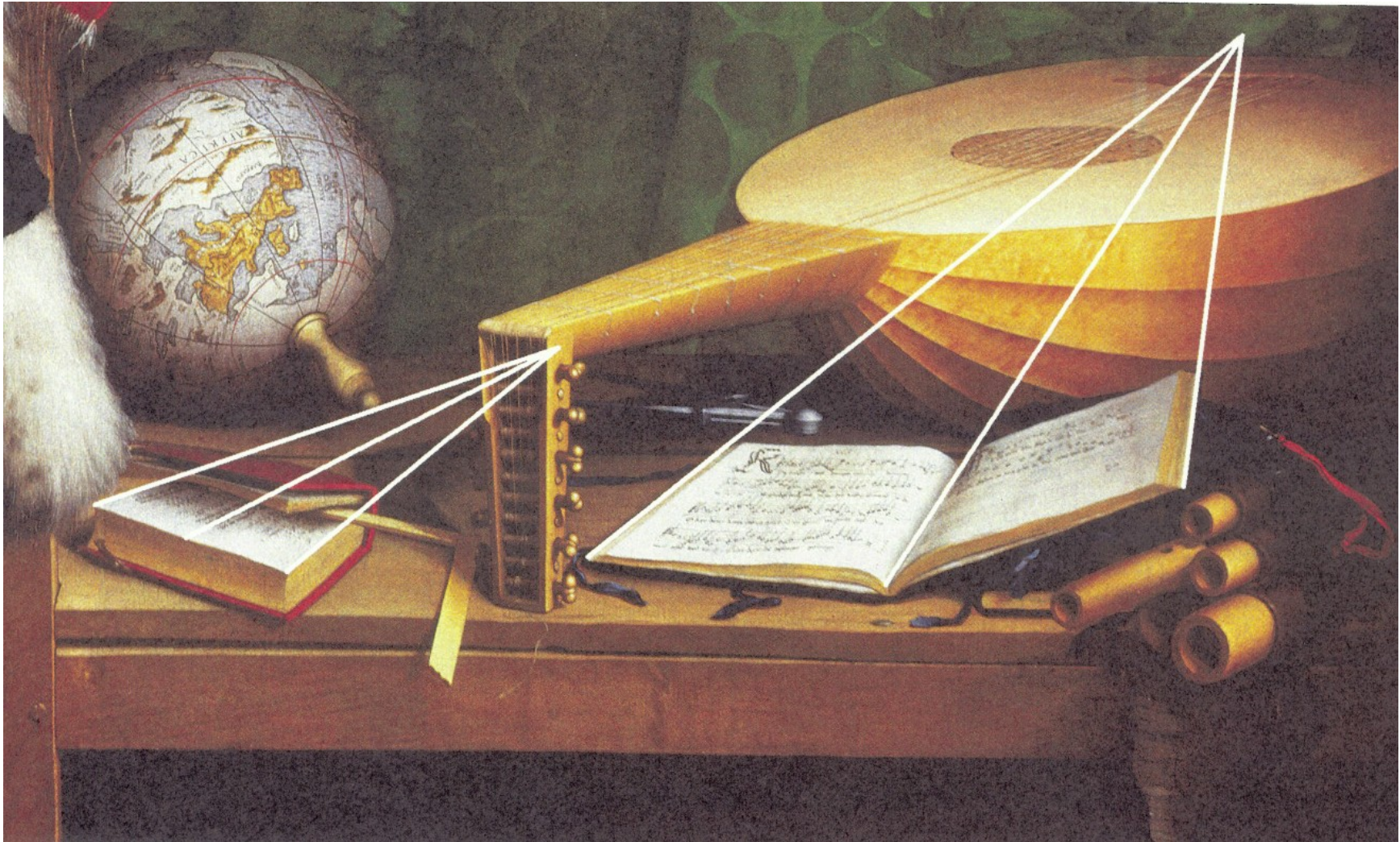
Proves:

Humans as a commodity (347)



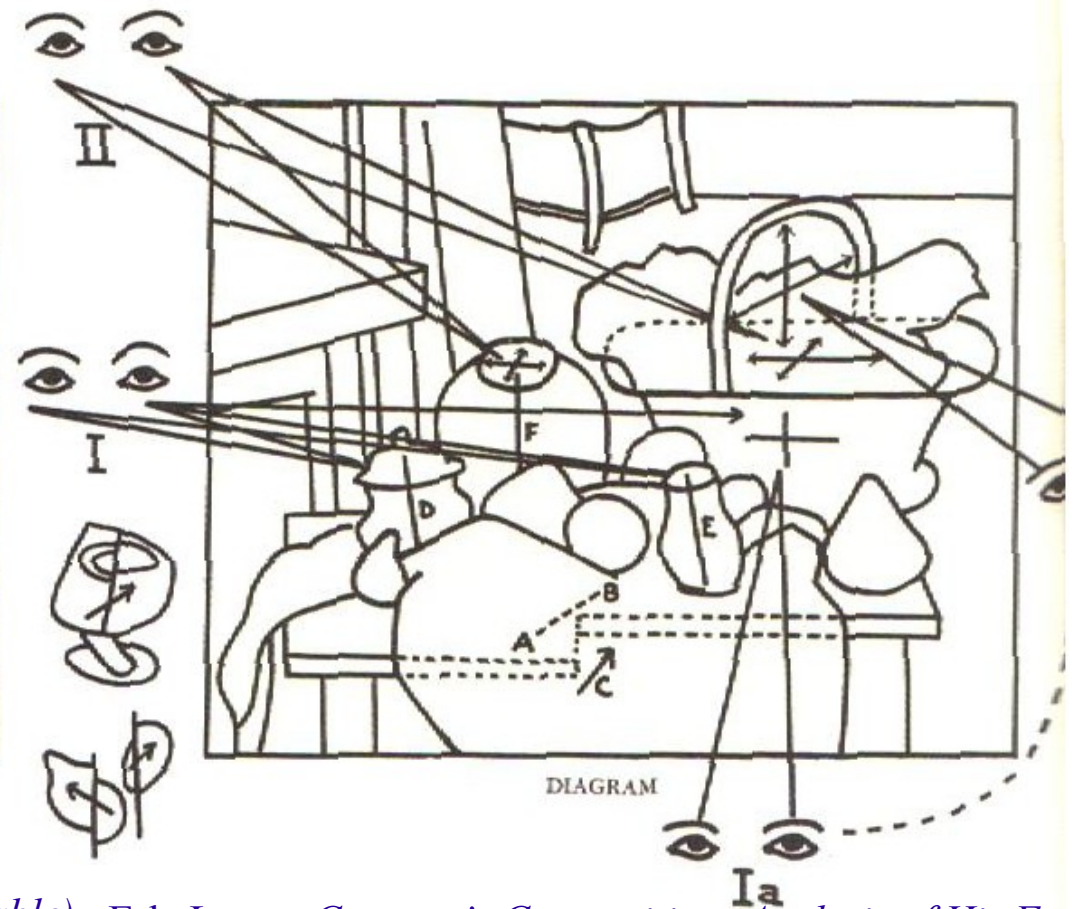
Published for the Religious Society of Friends in London, *Case of The Vigilante, A Ship Employed in the Slave-Trade* (1823)

Explanatory Mappings



Hans Holbein the Younger, *The Ambassadors* (detail, 1533), Mapped by David Hockney, *Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters* (London, 2001)

Explanatory Mappings



Paul Cezanne, *Still Life With a Basket (Kitchen Table)* (1890-95) oil on canvas, Musée d'Orsay, Paris

Erle Loran, *Cezanne's Composition: Analysis of His Form with Diagrams and Photographs of His Motifs* (1943)

- Various points of view
- Side by side vs. overlay

Explanatory Mappings Annoy Artists

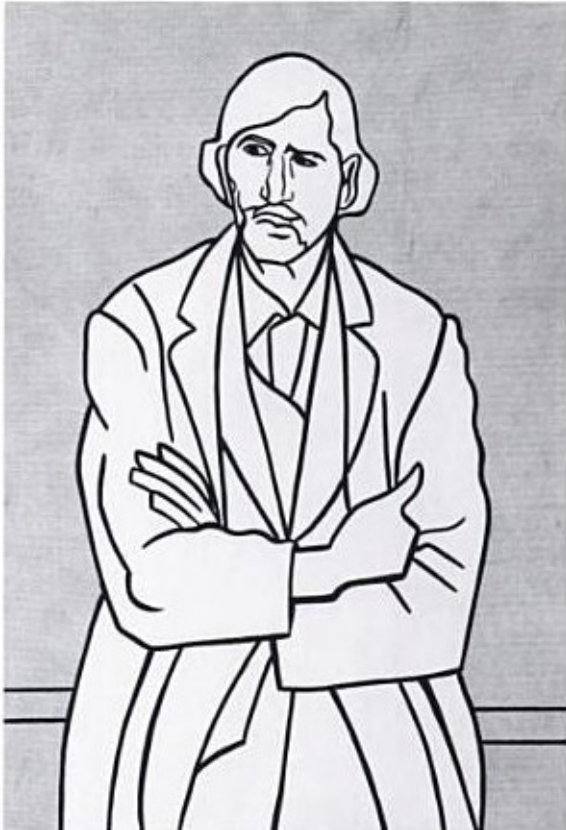
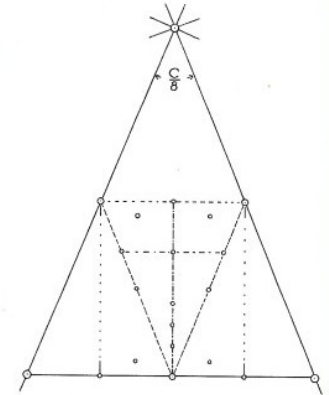
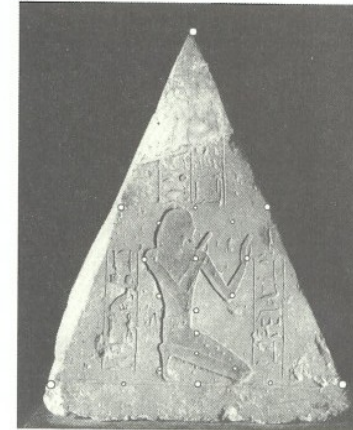
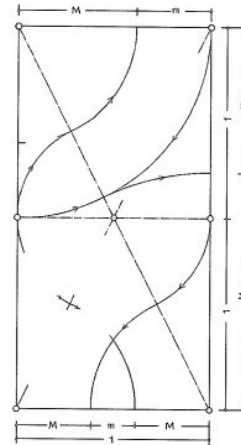
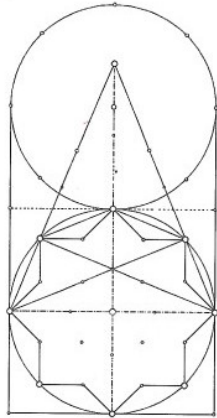
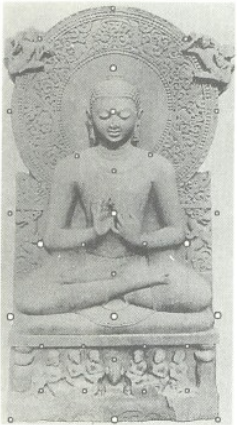
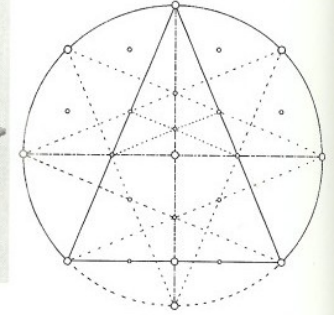
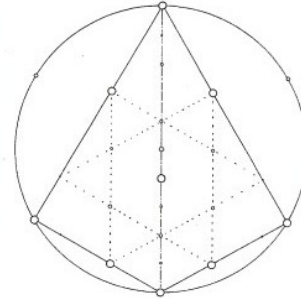
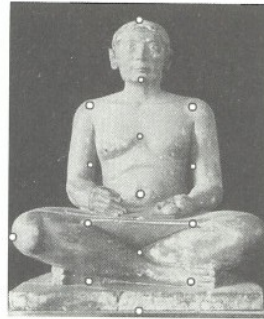
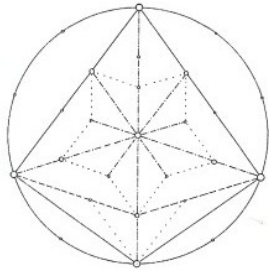


Figure 98. Erle Loran, diagram from
Cézanne's Composition (1943)

- Lichtenstein's response to Loran
- Irony that the satire of the diagrammed analysis ends up museum quality art
- Response: "Pop Artists or Copy Cats"

Roy Lichtenstein, *Man with Folded Arms*, 1962, oil on canvas, Museum of Contemporary Art, Los Angeles

After the fact mappings



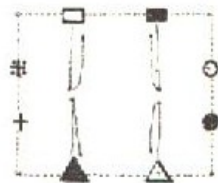
Ernst Mosse, *Vom Geheimnis der Form und der Urform des Seins* (Stuttgart, 1938)

- Claim of universal structure beneath all art
- Not valid as evidence

Capturing Time in 2-d

I^{er} Mouvement.

*Quatre en avant par deux coupés
et Rigaudon en arriere.*



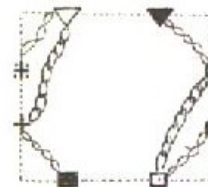
2^e M^t.

*Les mêmes changent de places
avec ceux de vis-à-vis*



3^e M^t.

*La Petite Chaine sur les côtés,
puis les 4 autres figurans font
à leur tour la meme figure que
ceux-cy viennent de faire aux
I^{er}, 2^e et 3^e Mouvem^{ts}.*



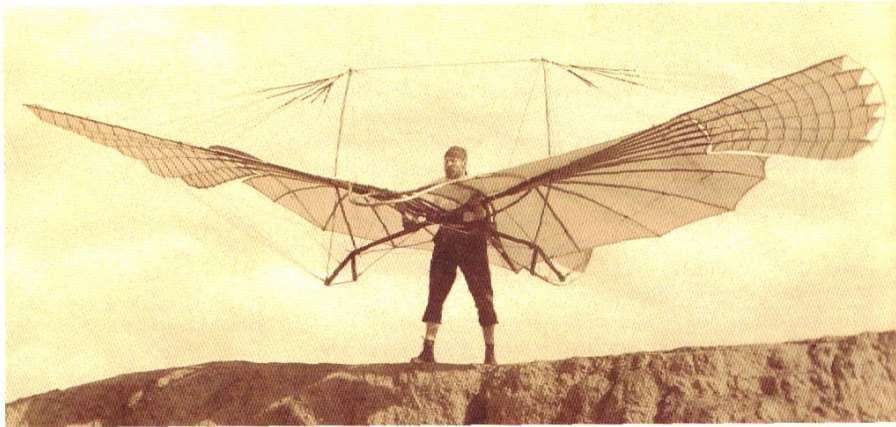
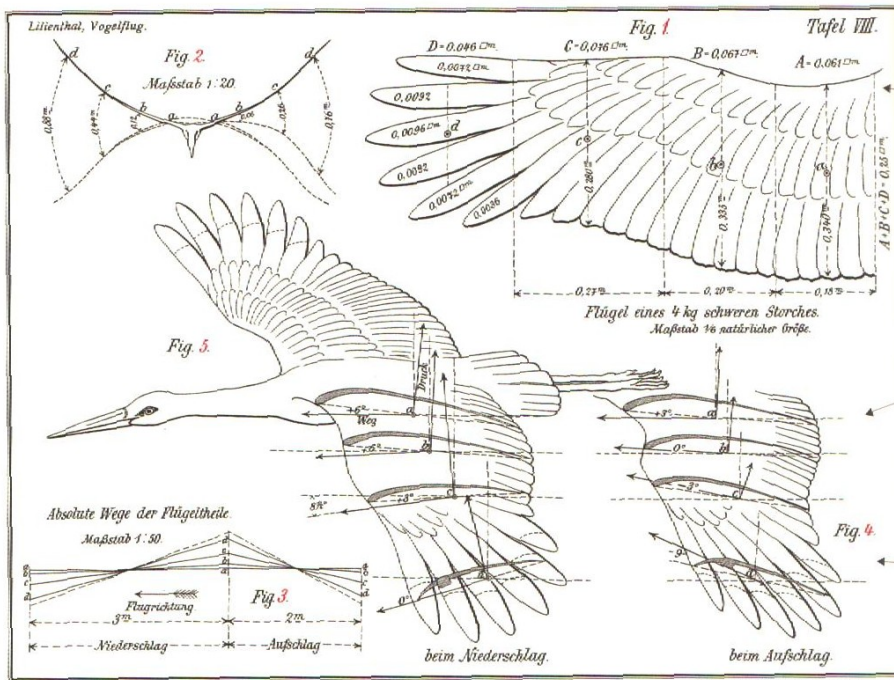
4^e M^t.

*Les 4 qui ont agi les pr
vont figurer vis-a-vis ceux
droite.*



*La Cuisse, Le Repertoire des bals ou theorie-pratique des contredanses decrites d'une maniere aisee avec des
figures demonstratives pour les pouvoir danser facilement (1762, Paris)*

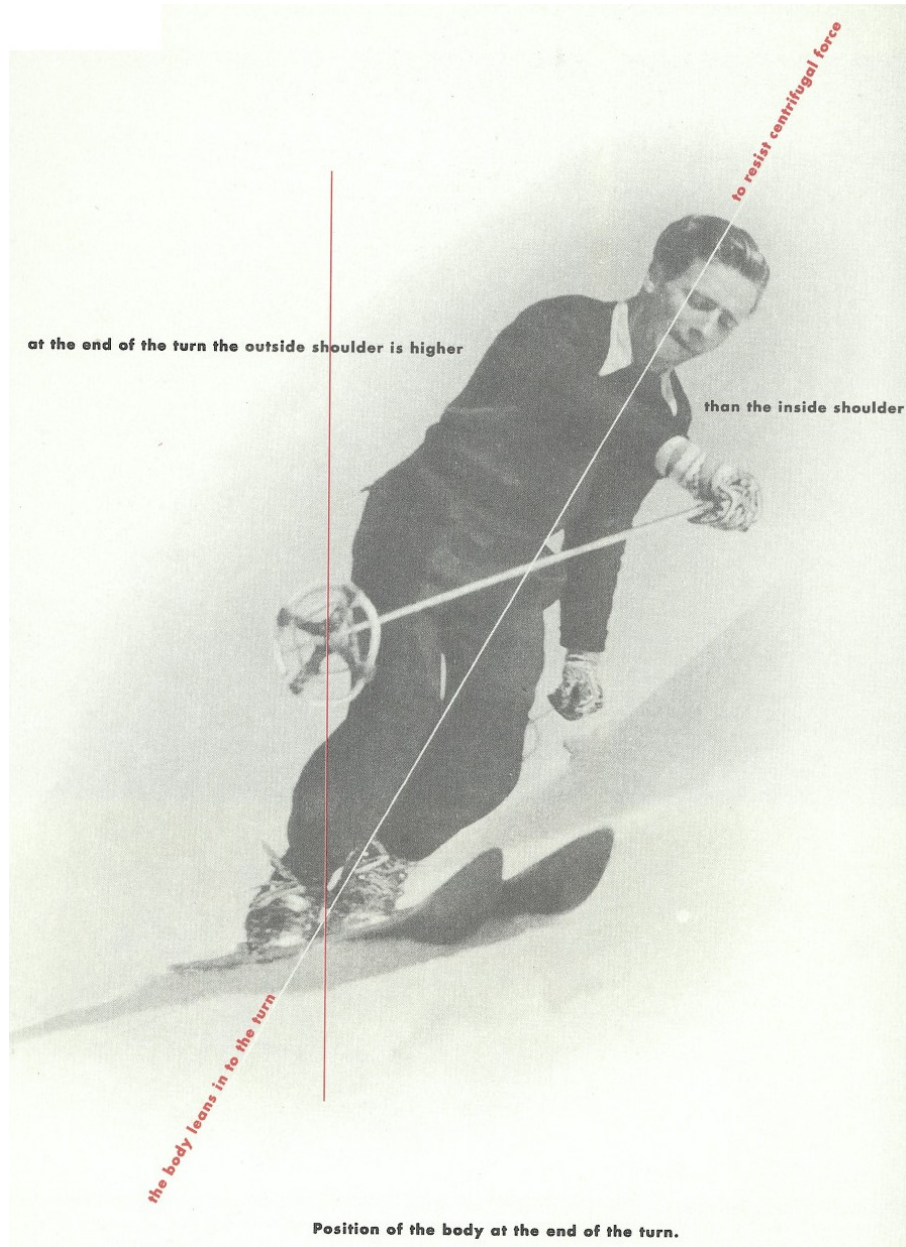
Coherent multiple viewpoint



Otto Lilienthal, *Der Vogelflug als Grundlage der Fliegekunst* (1889, Munich and Berlin)

- Investigation of bird anatomy and flight
- Goal of constructing gliders
- Quantitative scale
- Cambered airfoil cross section
- Shifting angles as flapping wings torque
- Linked and oriented (a,b,c)
- Side view flying left

Instruction



- Diagram & text overlaid on image
- Content documentation and fluent art
- Words double as horizontal line

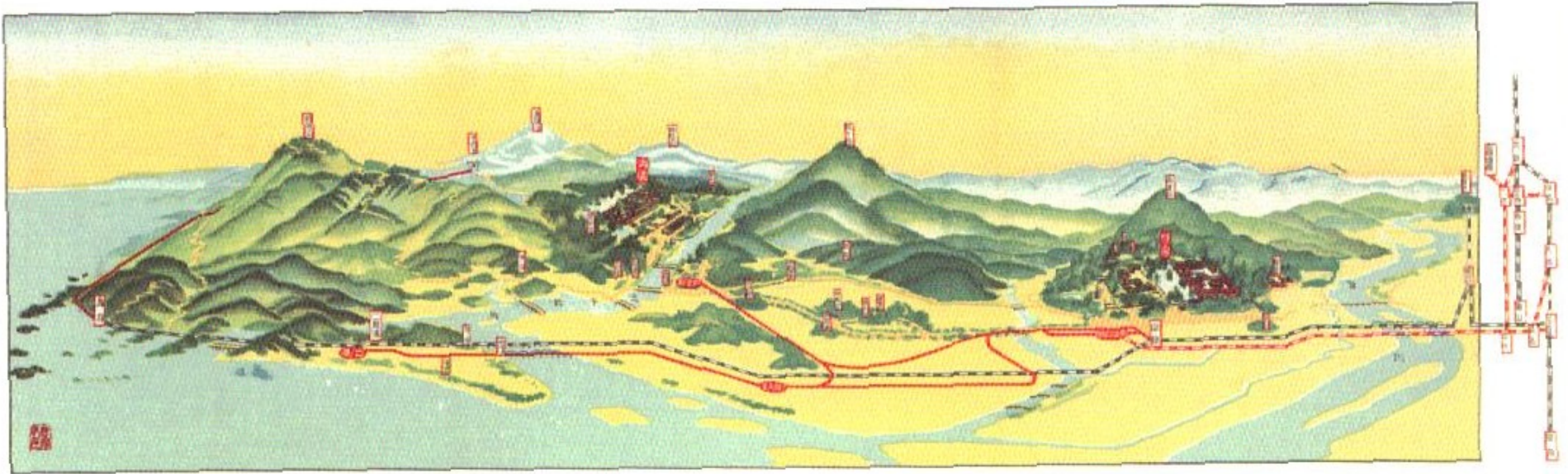
Emile Allais, *How to Ski by the French Method* (Paris, 1947)

Multiple Views



St. Kirill of Belozersk with scenes from his life, silk cloth, early 16th century

Contextualizing



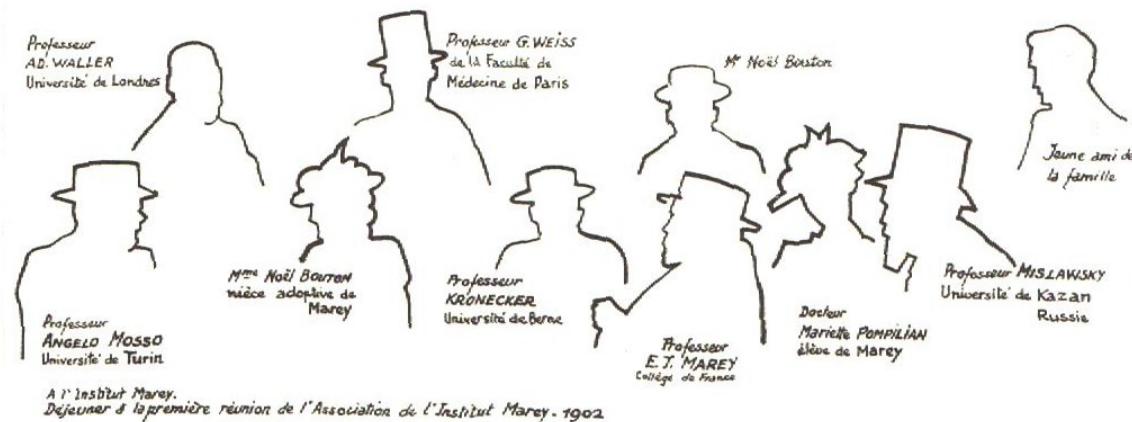
Guide for Visitors to Ise Shrine (Ise, Japan, 1948-1954)

Local detail and whole country in context

Historical Documents

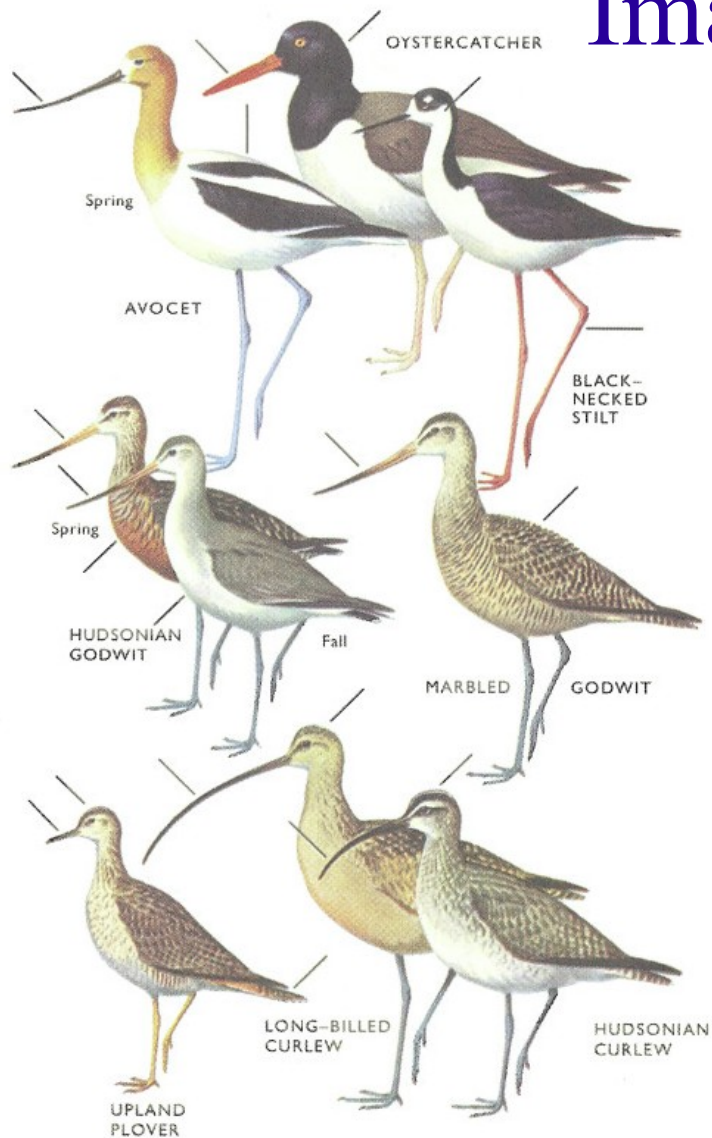


- Detailed diagram in parallel
- Original not disturbed
- Affiliations and names document the history
- Avoid “dreaded letter code”



Marta Braun, “The Photographic Work of E. J. Marey”,
Studies in Visual Communication (1983) photo: 1902

Images can map other images



- Relative scale
- Easy to compare
- Lines directing attention
- Needs a universal grid or measurement scale

Roger Tory Peterson, *A Field Guide to the Birds* (Boston, 1934, 1939, 1947), plate 23, shore-birds.

Conclusion:

Mappings tell why the image matters

Well designed, thoughtfully mapped images combine:

- Direct visual evidence
- Power of diagrams

Most explanatory & evidential images should be mapped

- Including scale and context
- High standards for mappings as any evidence

Sources page 1

Tufte, Edward, *Beautiful Evidence*, Graphics Press LLC, 2006.

Rosenberg, Scott, “*The Data Artist*” *Chart-master Edward Tufte*, March 10, 1997,
<http://www.salon.com/march97/tufte2970310.html>

Few, Stephen, *Beautiful Evidence: A Journey Through the Mind of Edward Tufte*,
<http://www.b-eye-network.com/print/3226>

Lobel, Michael, *Image Duplicator: Roy Lichtenstein and the Emergence of Pop Art*,
Yale University Press, 2002.

Engelhardt, Yuri, *A review of Edward Tufte’s ‘Beautiful Evidence’*,
<http://www.yuriweb.com/tufte/>

Sources page 2

<http://www.edwardtufte.com>

Bissantz, *Ivy League Rock and Roll – A day with Edward Tufte*,
<http://blog.bissantz.com/a-day-with-tufte>

Zachry, Mark and Charlotte Thralls, *An Interview with Edward R. Tufte*, Utah State University, *Technical Communication Quarterly*, 2004, Vol. 13, No. 4, Pages 447-462.

Andrew, *Tufte: More Data*, May 2010,
<http://noisydecentgraphics.typepad.com/design/2010/05/tufte-more-data.html>

www.wikipedia.org/

<http://www.aiga.org/content.cfm/medalist-edwardtufte>

<http://www.yale.edu/polisci/people/etufte.html>

<http://thesaurus.com/>

Questions?
Comments...