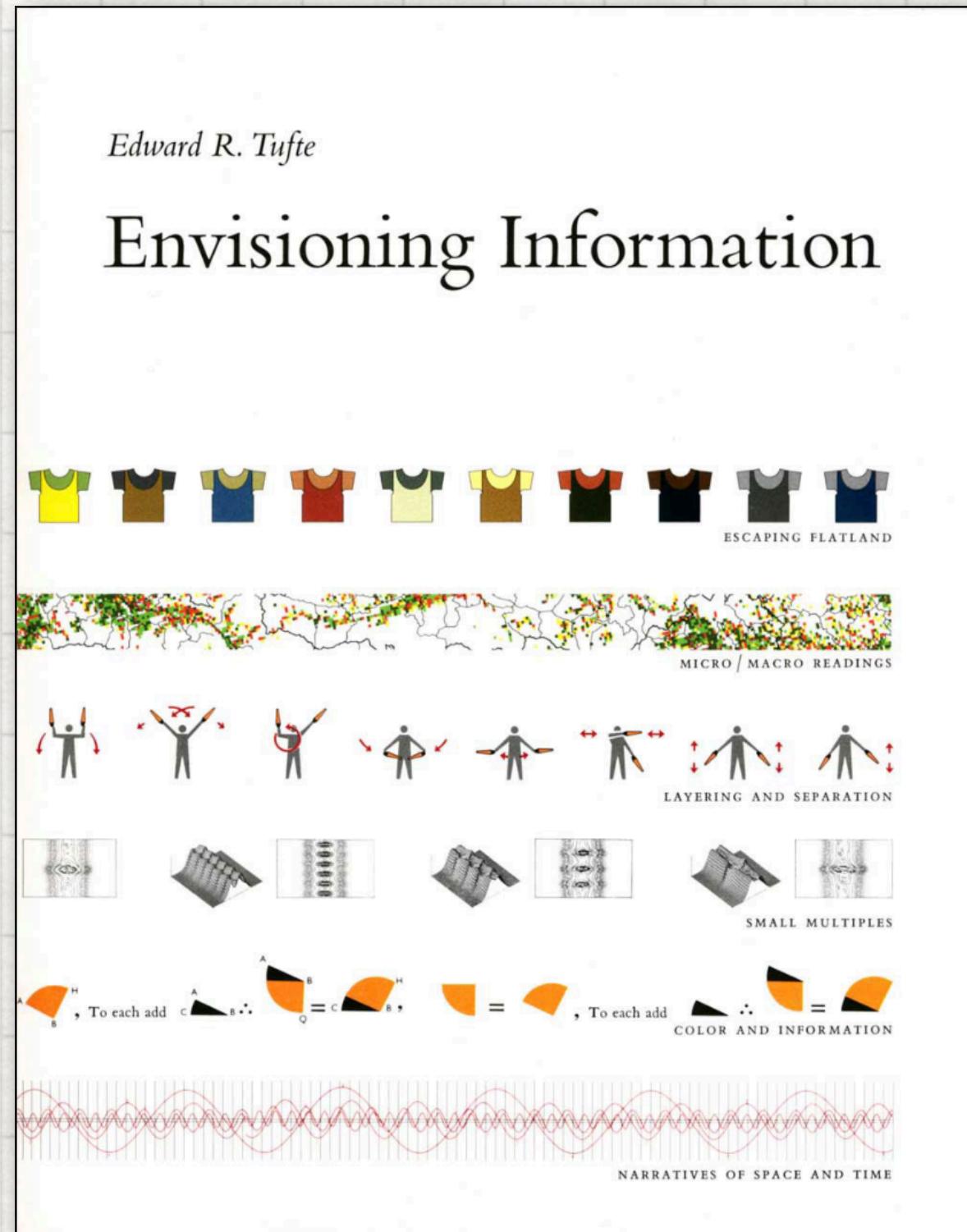
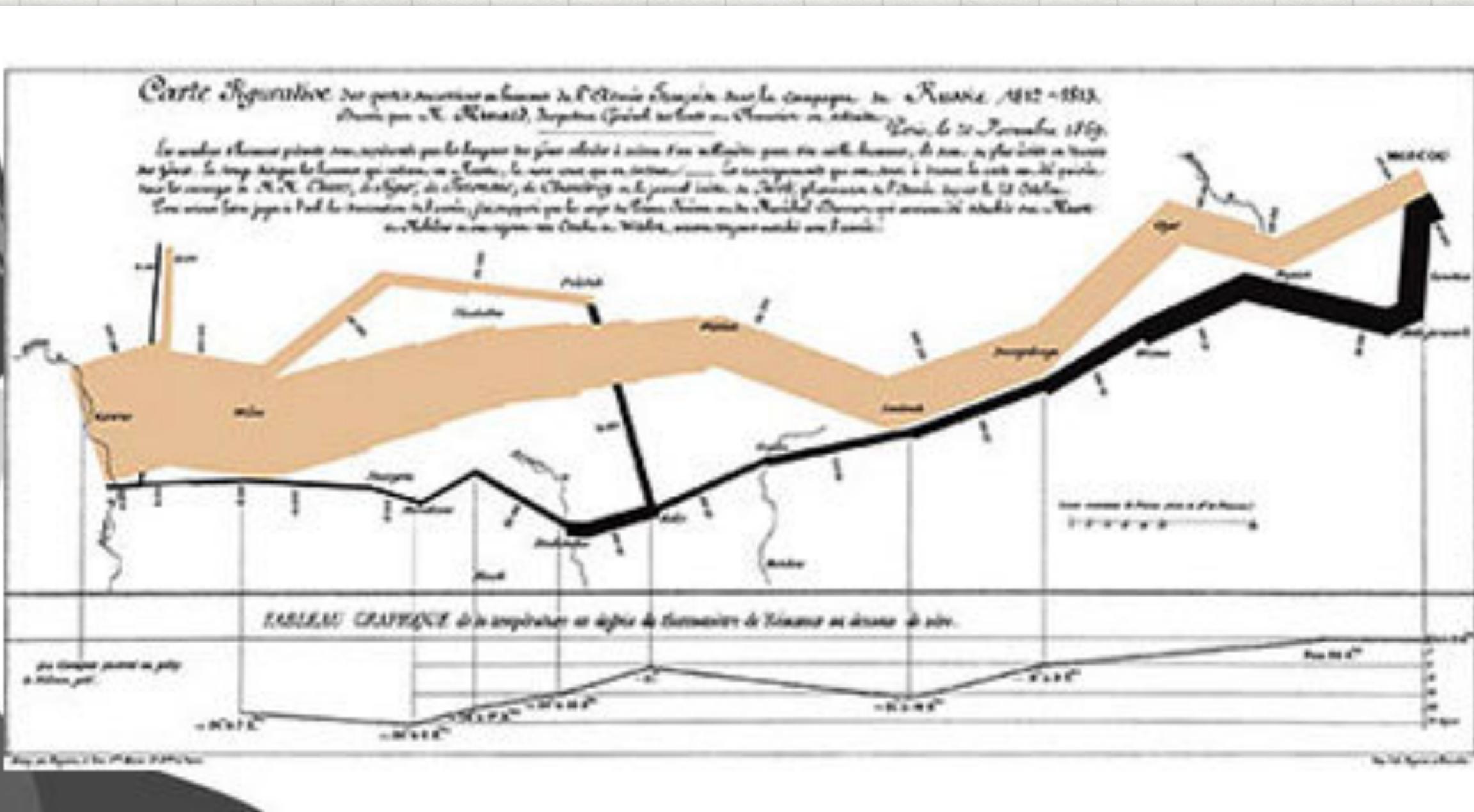
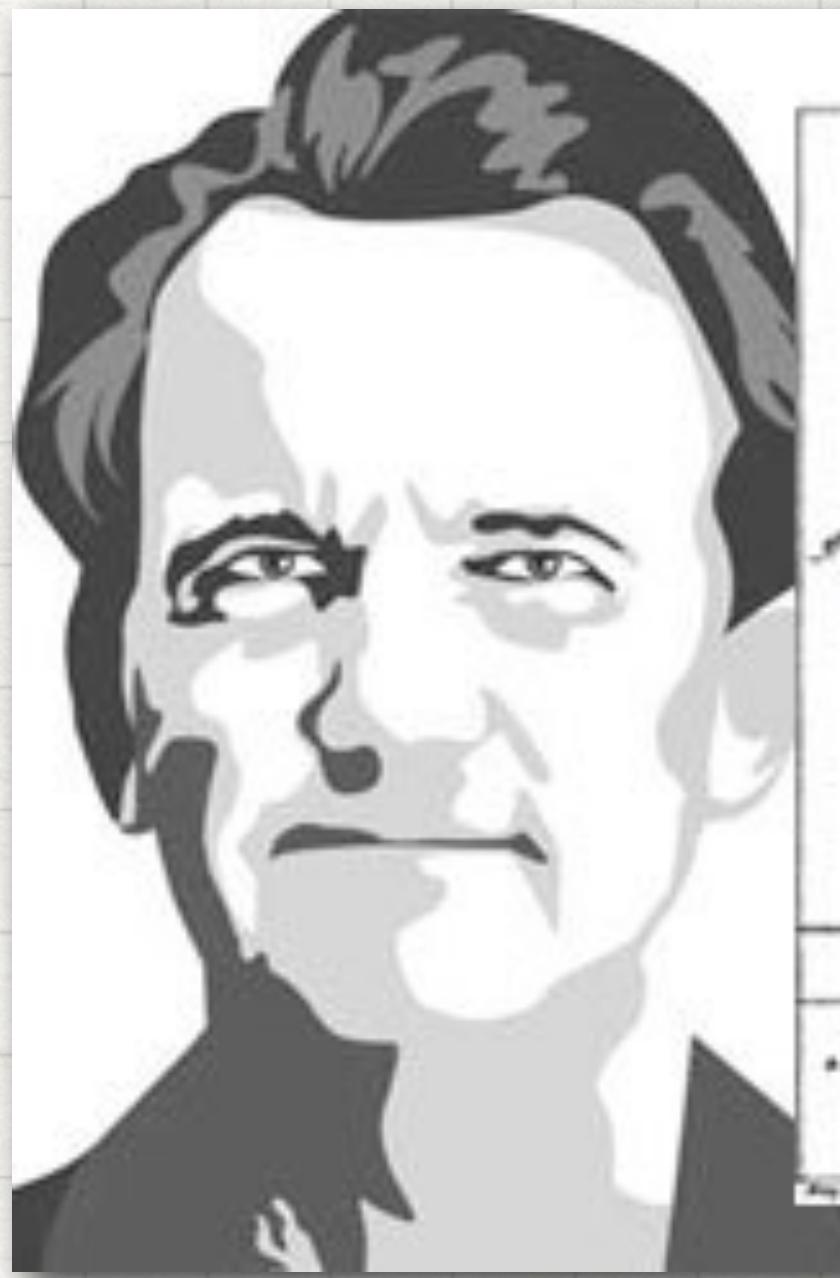


Envisioning Information

Edward Tufte



D'hana Perry
DVIA 2018



Edward Tufte is a statistician and artist, and Professor Emeritus of Political Science, Statistics, and Computer Science at Yale University. He wrote, designed, and self-published 4 classic books on data visualization. The New York Times described ET as the "**Leonardo da Vinci of data,**" and Bloomberg as the "**Galileo of graphics.**" He is now writing a book/film The Thinking Eye and constructing a 234-acre tree farm and sculpture park in northwest Connecticut, which will show his artworks and remain open space in perpetuity. He founded Graphics Press, ET Modern gallery/studio, and Hogpen Hill Farms LLC.

“LURKING BEHIND CHARTJUNK IS
CONTEMPT BOTH FOR INFORMATION
AND FOR THE AUDIENCE”

-Edward Tufte

ENVISIONING INFORMATION

ESCAPING FLATLAND



"Escaping Flatland is the essential task in envisioning information – for all the interesting worlds (physical, biological, imaginary, human) that we seek to understand are inevitably and happily multivariate in nature. **Not flatlands.**"

We understand how complex we are and are comfortable with that reality. He wants us to find ways to break free from the limits of 2D planes and screens.

This chapter provides methods to increase:

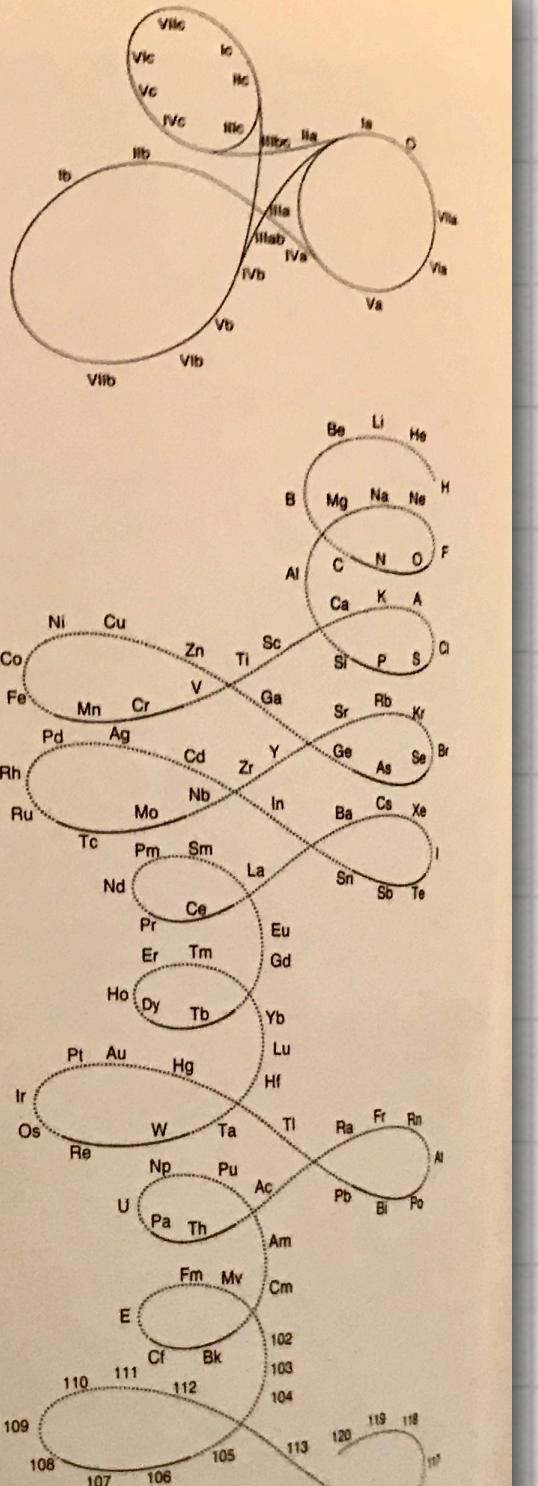
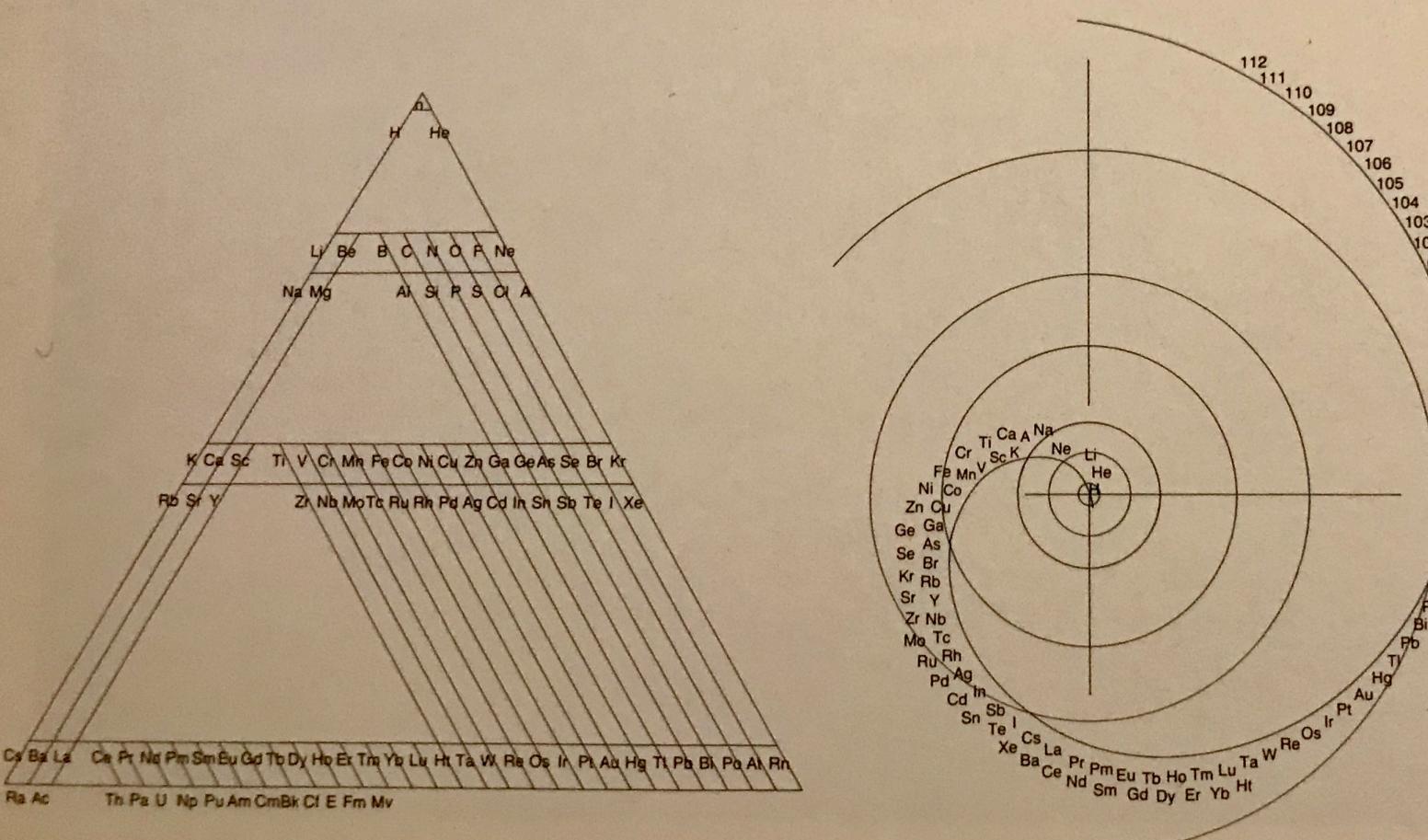
- ✓ Number of dimensions that can be represented on plane surfaces
- ✓ The data density (amount of information/unit area)

Take aways:

- ✓ We are, and our world is multivariate (intersectionality?)
- ✓ The limits of paper and screen when we live in a 3D world
- ✓ Communicating dimensional complexity is difficult including in language

ENVISIONING INFORMATION ESCAPING FLATLAND

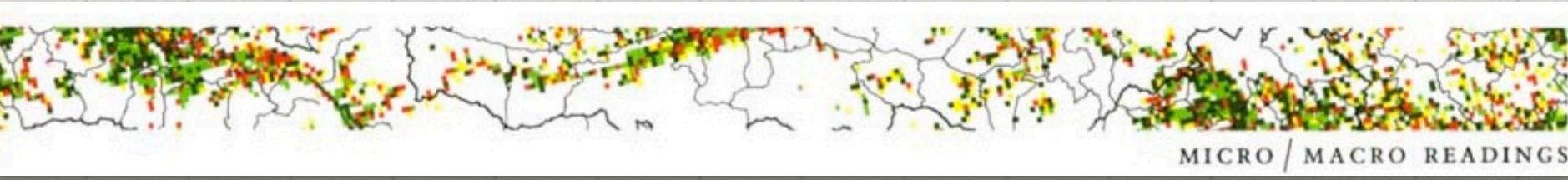
All sorts of techniques for doing better than flattened-out toad suits have evolved during some 500 years of information design.² Since the 15th-century Italian Renaissance, when Florentine architects perfected the necessary geometry, conventional perspective drawing has enriched representations of physical objects. And, for more abstract multivariate information not residing in our three-space reality, several enterprising methods have evolved—nearly silently, often to be found in workaday diagrams of those confronted with an overwhelming quantity of data. A few such techniques are well documented; for example, the elaborate structuring of the periodic table of chemical elements³ (with several



Flat Image, many dimensions of data!

ENVISIONING INFORMATION

MICRO/MACRO READINGS



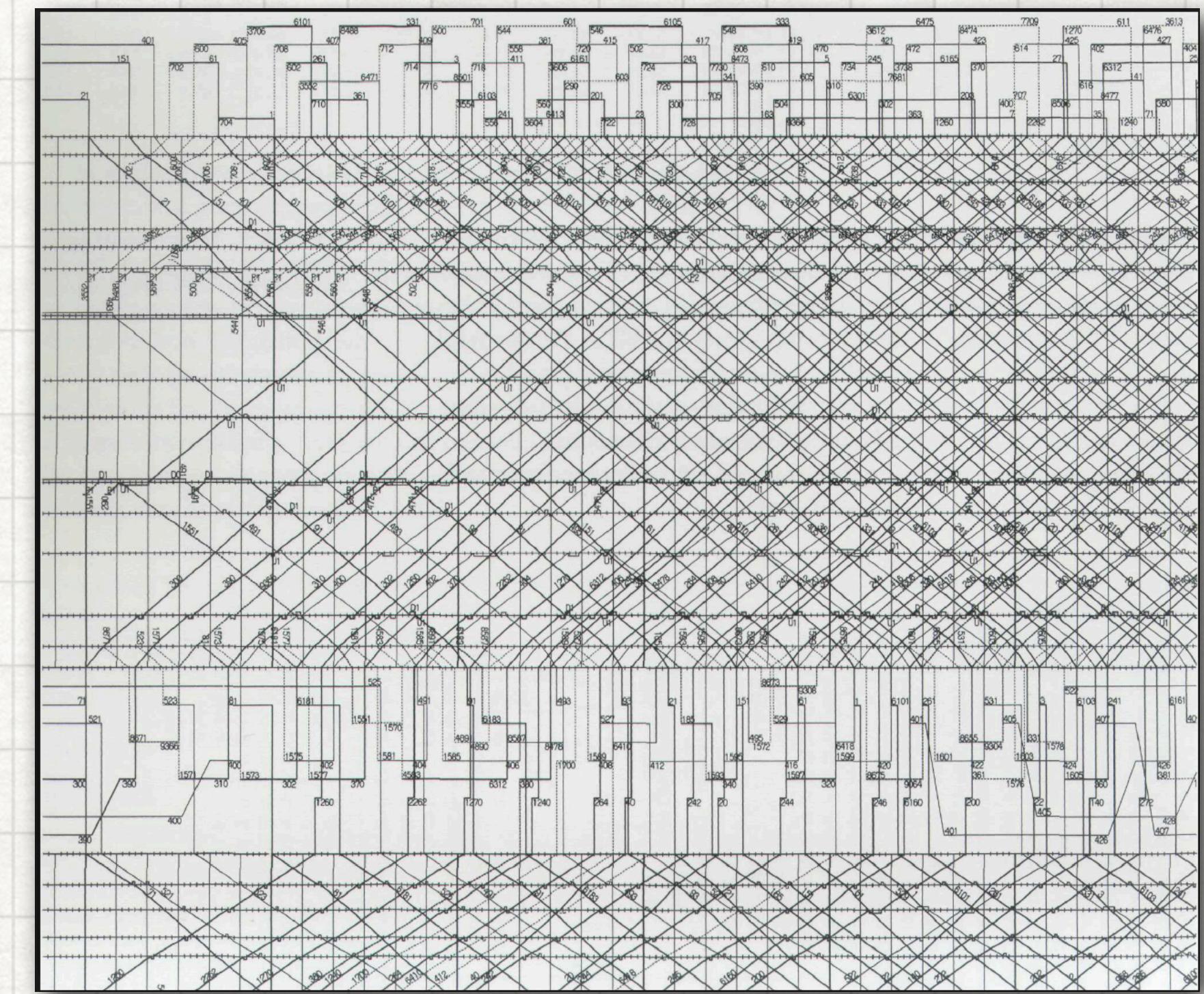
Micro/macro readings refers to the use of different scales of information in one map to show (1) large trends or patterns relative to the overall behavior of the thing being mapped; and (2) the exquisite texture of the detailed information.

Nearly all macro/micro designs portray large quantities of information at high density allowing the reader to switch back and forth from seeing the whole and interrogating specifics.

"We thrive in information-thick worlds because of our marvelous and every day capacities to select, edit, single out, structure, highlight, group, focus, classify, abstract, (etc)..."

Visual displays rich with data are not only an appropriate and proper complement to human capabilities, but also such designs are frequently optimal. If the visual task is contrast, comparison, and choice – as so often it is – then the more relevant information within eyespan, the better.

Micro/macro designs enforce both local and global comparisons and, at the same time, avoid the disruption of context switching" (Tufte, p. 50)



Operation diagram for the Japanese Tokaido & Sanyo bullet trains for 12 noon July 25, 1985

ENVISIONING INFORMATION

LAYERING AND SEPARATION



Layering and separation refers to visually stratifying various aspects of the data. One layer carries one set of data; a second layer a second set of data; and so on.

Often one layer sits as a reference layer against which the other information or sets of information are mapped.

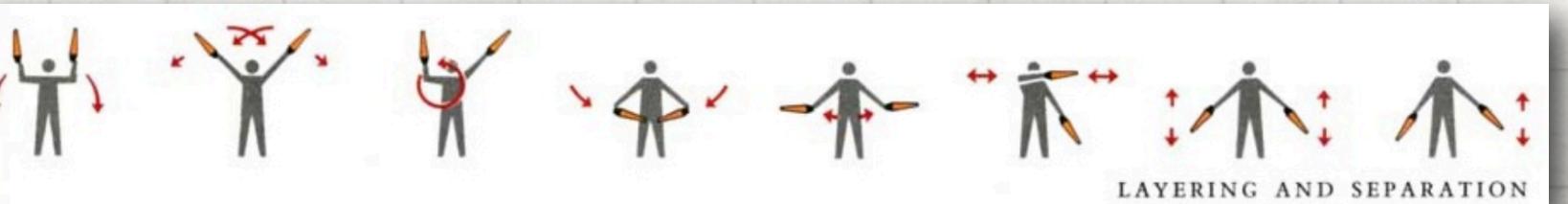
“Confusion and clutter are failures of design, not attributes of information. And so the point is to find design strategies that reveal detail and complexity. Effective layering of information is one of the most powerful devices for reducing noise and enriching the content of displays.

What matters – inevitably, unrelentingly – is the proper relationship among information layers. These visual relationships must be in relevant proportion and in harmony to the substance of the ideas, evidence, and data conveyed. Color effortlessly differentiates between annotation and annotated”

(Tufte, pp. 53–54)

ENVISIONING INFORMATION

LAYERING AND SEPARATION



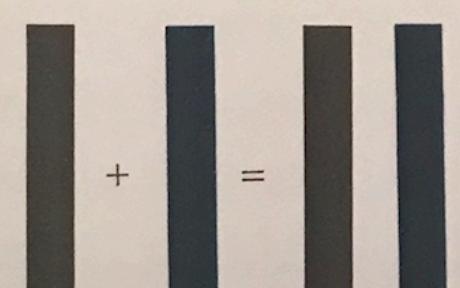
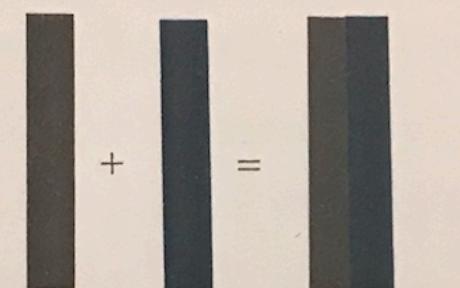
LAYERING AND SEPARATION

Here I have 2 equal strips of cardboard (1" x 6")

Here is one (vertical), here another (also vertical).
Seeing one strip plus one strip, we count 2 strips:
 $1 + 1 = 2$.

We recognize the equal width of the strips.
Now, 1 width + 1 width (strips touching)
equals 2 widths: $1 + 1 = 2$.

But now, separating them (both remain vertical)
by 1 width — we count 3 widths
(one of them negative) : $1 + 1 = 3$.

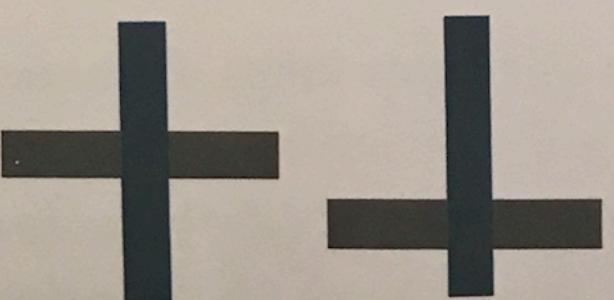


Of the 2 vertical strips,
one crosses the other horizontally
in their centers.

Result: 2 lines form a crossing
thus producing 4 arms, as 4 extensions,
to be read inward as well as outward.

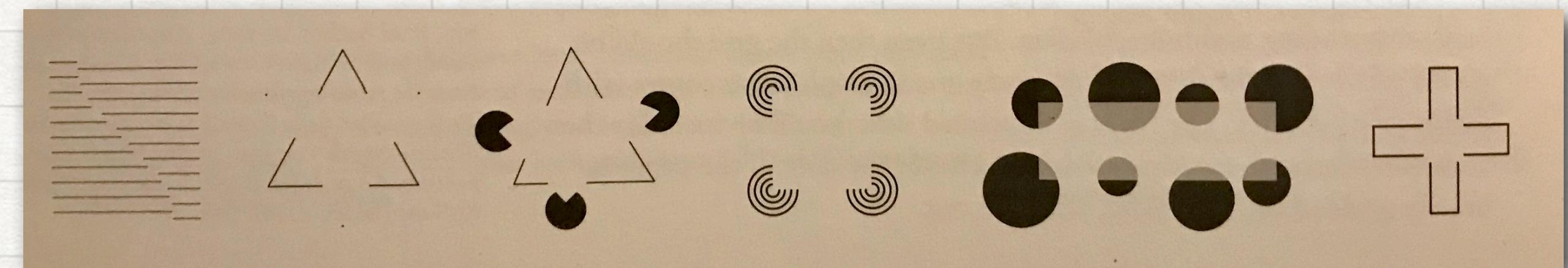
We also see 4 rectangles, and with some imagination,
4 triangles, 4 squares.

By shifting centers and angles,
arms and the in-between figures become unequal.



All together: one line plus one line
results in many meanings — *Quod erat demonstrandum*.

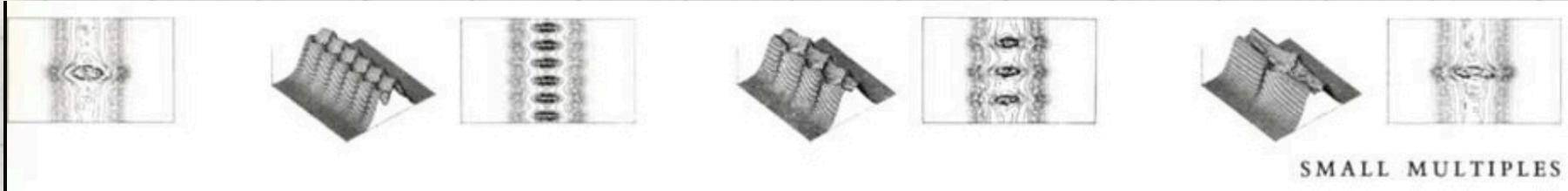
$$1 + 1 = 3$$



Negative White Space

ENVISIONING INFORMATION

SMALL MULTIPLES



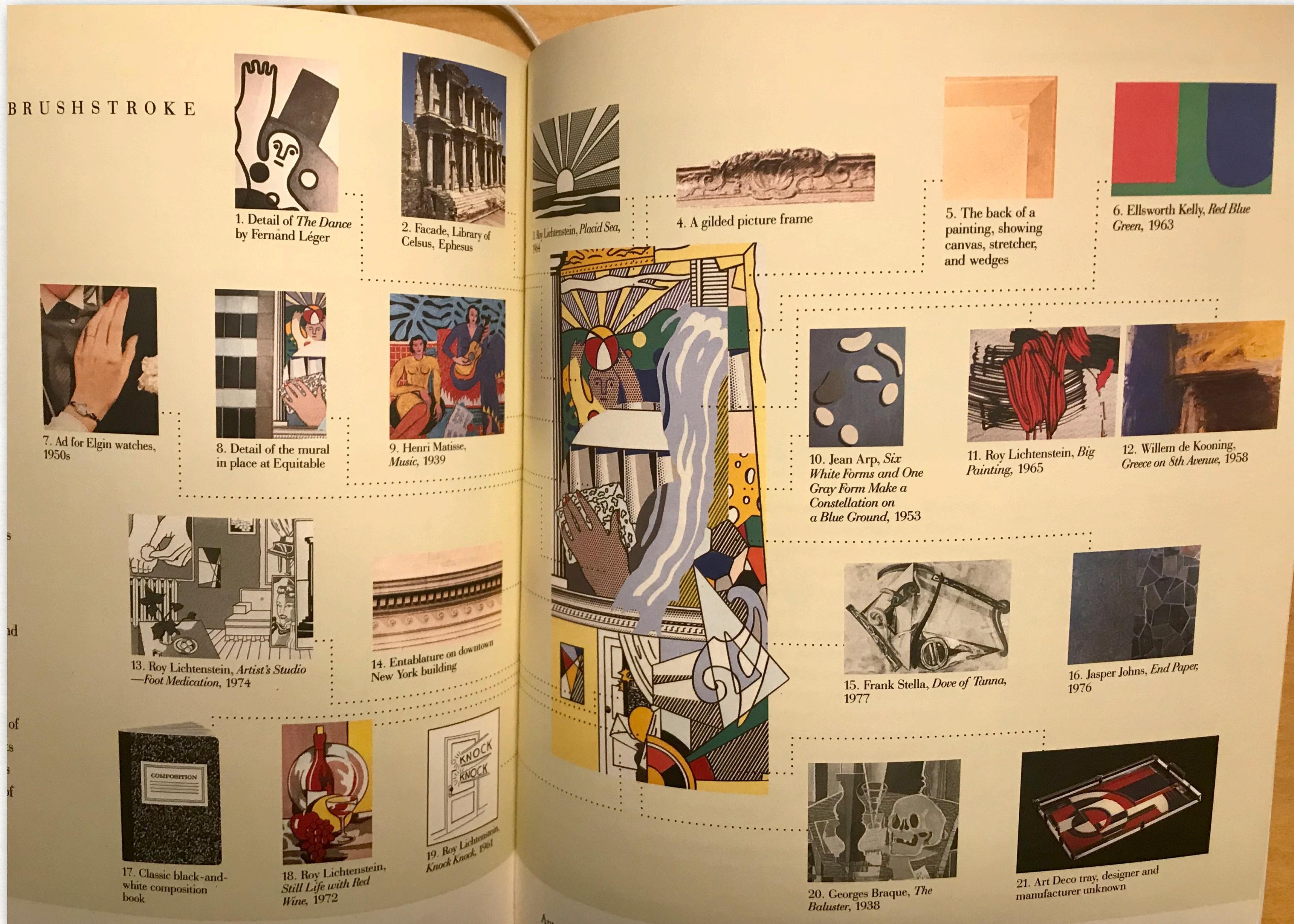
SMALL MULTIPLES

Small multiples refers to the use of repetition to show comparisons of change over time, or differences between like objects, or different states of an object, etc. It is about variations on a theme often only slightly different.

Often a grid, matrix or line is used to organize the elements. Layering and separation can be used within each small multiple to enrich the information content that is being compared.

"At the heart of quantitative reasoning is a single question: Compared to what? Small multiple designs, multivariate and data bountiful, answer directly by visually enforcing comparisons of changes, of the differences among objects, of the scope of alternatives. For a wide range of problems in data presentation, small multiples are the best solution. Information slices are positioned within the eyespan so that viewers make comparisons at a glance – uninterrupted visual reasoning. Constancy of design puts the emphasis on changes in data" (Tufte, p. 67)

Mural with a Blue Brush Stroke by Roy Lichtenstein



ENVISIONING INFORMATION

SMALL MULTIPLES

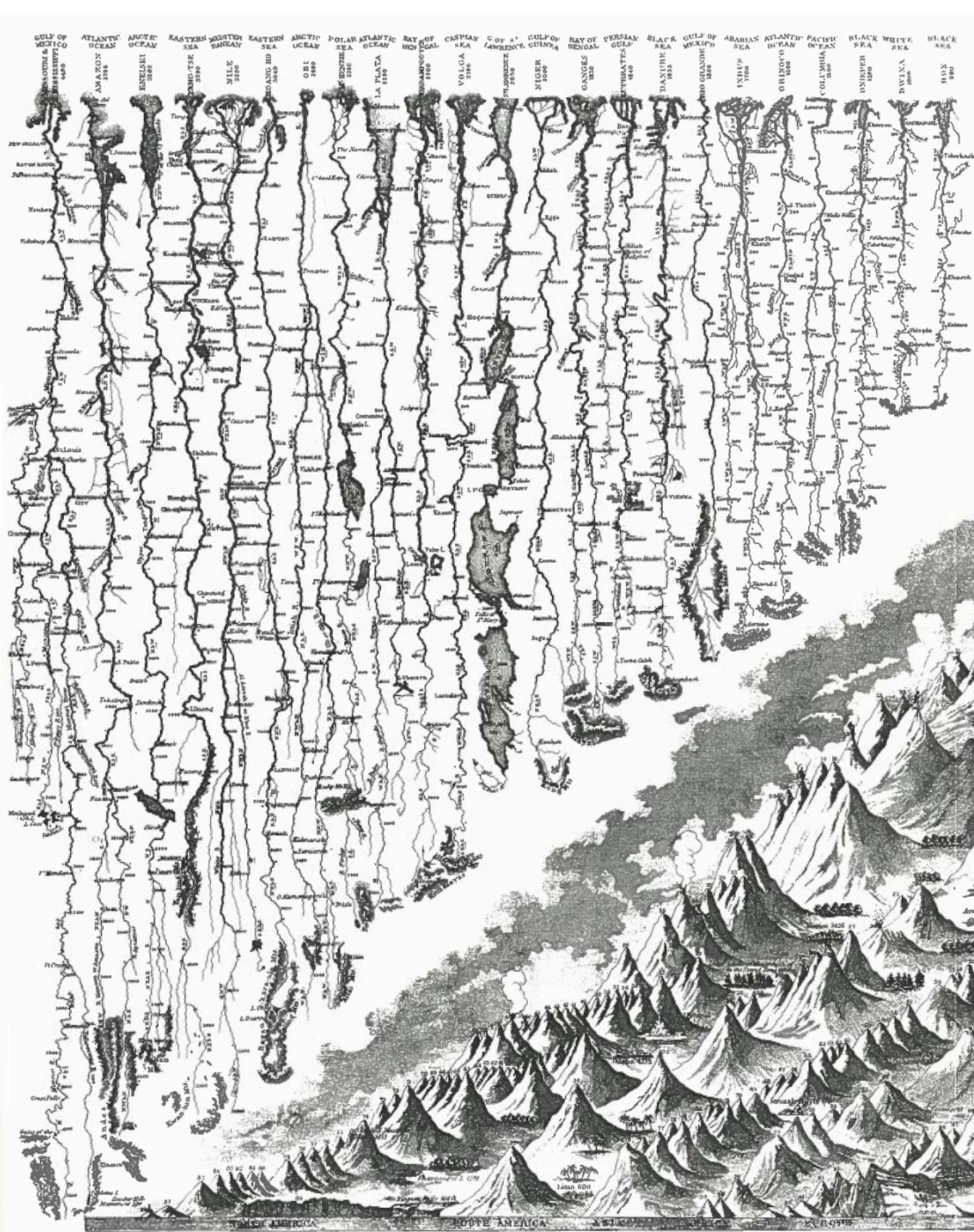


HUTCHINS COLTON, JOHNSON'S NEW ILLUSTRATED FAMILY ATLAS WITH PHYSICAL GEOGRAPHY (1864)

A topographic diagram that shows the lengths of the world's great rivers by straightening them (mostly) out and hanging them from the top in parallel for comparison. Specifics of names and places (major lakes, branches, places) are located along each river.

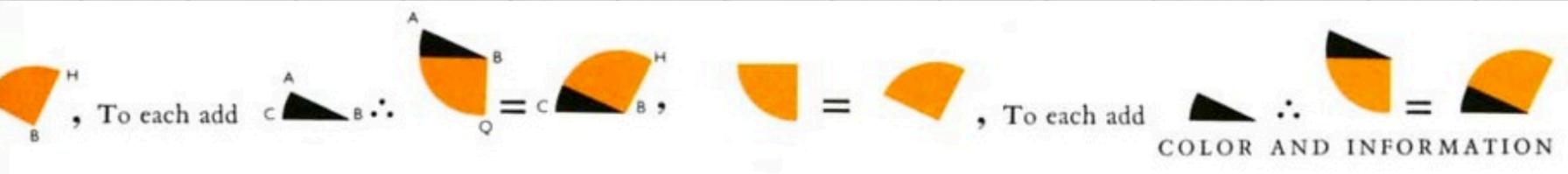
The oceans into which they flow are placed at the top in a whimsical wavy fashion. The great mountains of the world are arranged at the bottom along an 'X' and 'Y' axis. The horizontal has the names of five continents and the vertical represents the height of each mountain. They do not always correspond. Again, the names of the mountains and their heights are given in text.

Multiple rivers and mountains laid out not by location on a map but by other criteria allows one to make comparisons among the multiples. This map is also an excellent example of using macro/micro techniques.

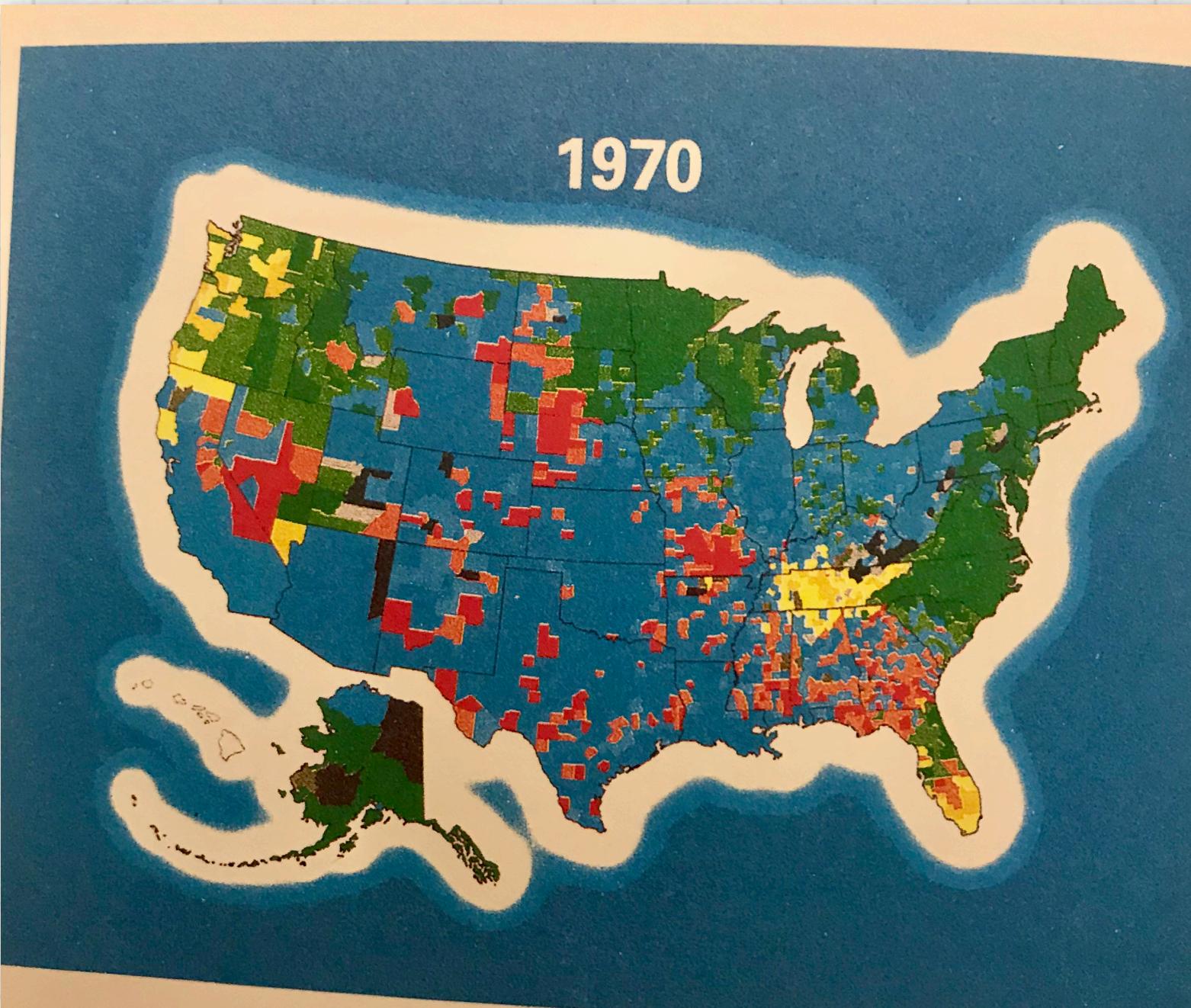


ENVISIONING INFORMATION

COLOR AND INFORMATION



- “The often scant benefits derived from coloring data indicate that even putting a good color in a good place is a complex matter. Indeed, so difficult and subtle that avoiding catastrophe becomes the first principle in bringing color in to information: **Above all, do no harm.**”



Harm

Primary Home Heating Fuel by Counties of the United States,
1970 Bureau of the Census

ENVISIONING INFORMATION

COLOR AND INFORMATION



First Rule:

Do not use pure, bright, or loud colors. If you must, do it sparingly. "Noise"

Second Rule:

The placing of light, bright colors mixed with white next to it leads to "unpleasant results"

Third Rule:

Large area backgrounds should do most of their work "quietly" to allow more vivid colors to stand out.

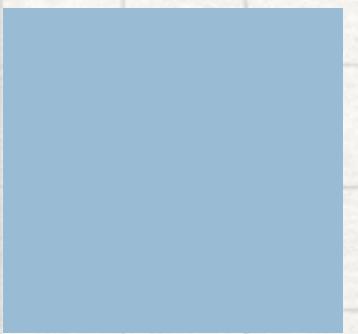
Forth Rule:

If a picture is composed of 2 or more large, enclosed areas in different colors, then the picture falls apart.

Use Colors Found in Nature

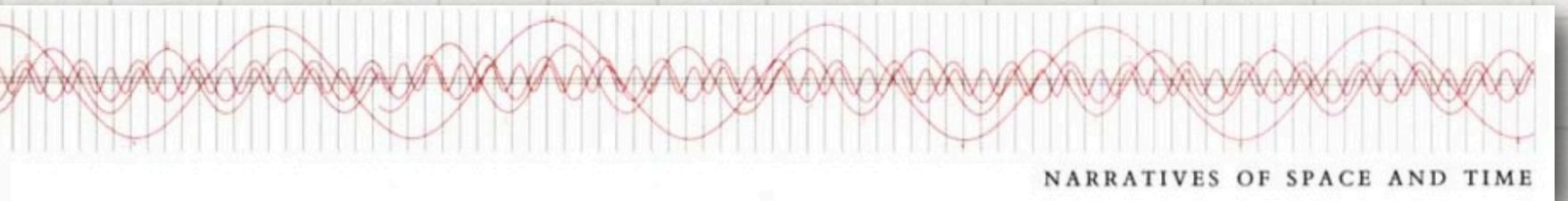


Lighter side of blues, yellows, and "grays of sky and shadow"



ENVISIONING INFORMATION

NARRATIVES OF SPACE AND TIME

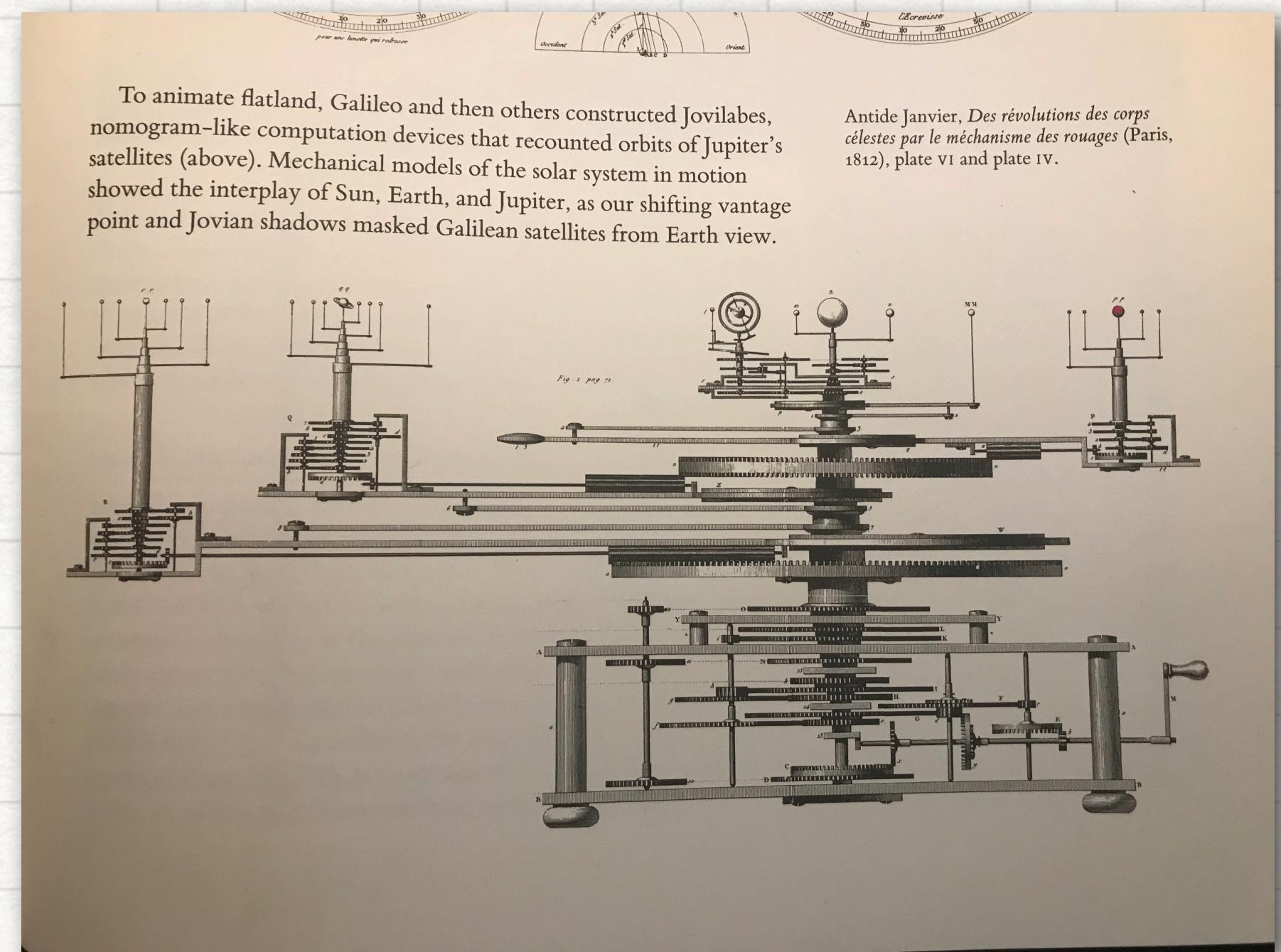


Narratives of space and time refers to visually arranging data and images so that we understand change across time.

This is often done as serial images as if one were presenting stills of different moments in time. You can imagine how any of the previous examples might be repeated (as several stills) holding constant the referent frames and the things that remain the same and then varying that which changes. Other methods map data across a timeline.

Interactive examples allow one screen to actually change in time either in real time – as it is unfolding – or time sped up.

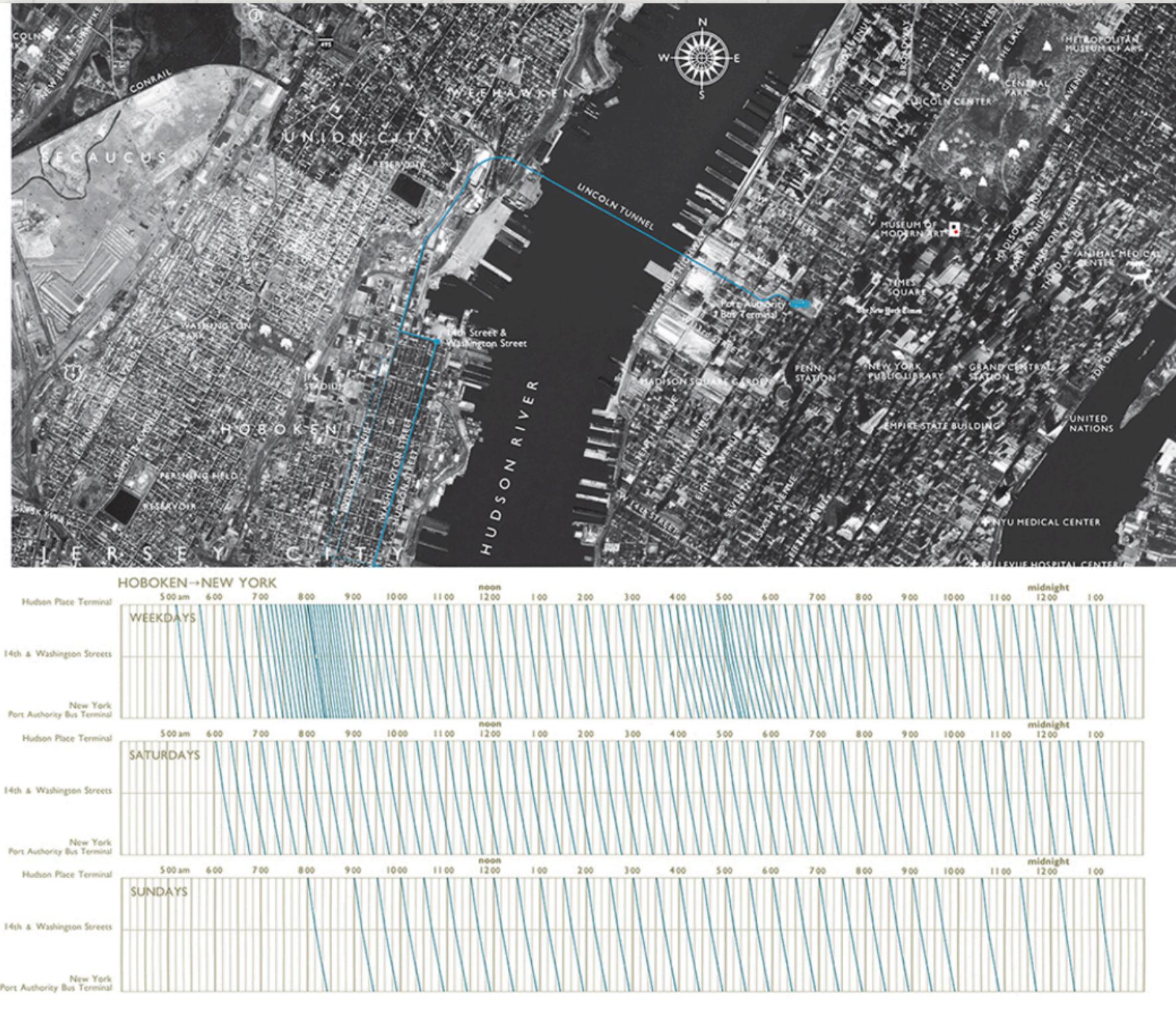
“Many information displays report on the world’s workaday reality of three-dimensional space and time. Painting four-variable narrations of space-time onto flatland combines two familiar designs, the map and the time-series. Our strategy for understanding these narrative graphics is to hold constant the underlying information and then to watch how various designs and designers cope with the common data.” (Tufte, p. 97)



Galileo's constructed "Jovilabes" to animate Jupiter's satellite movements

ENVISIONING INFORMATION

NARRATIVES OF SPACE AND TIME



"My design of a bus schedule and route combines a graphical timetable with a route map overlaid on a precisely detailed aerial photograph, so much richer than the typical schematic diagram of bus routes. Hourly, daily, and weekly rhythms of the buses are clearly revealed, as well as details of each journey. During rush hours, lines densely crowd into spaghetti—but then service is so frequent that the jumble of lines informs the rider simply to show up, for there will be virtually no wait for whatever bus it is that arrives."

The gray grid is set at ten-minute intervals in order to ease visual interpolation of the times of arrival. The aerial photograph unveils the area mostly at the level of *house resolution*, that is, with sufficiently fine details to show individual buildings. Indeed, the reaction of those who live in the area is to explore the photograph, personalizing the data, seeking to discover their own residence, school, or workplace. **Same picture, but many stories.**"

- Edward Tufte

Discussion Questions

- **What is the style/use/purpose of your subject?**
Deep influence on modern and essential techniques to visualizing data
- **What does this subject do well? What do they do poorly? What do you like/dislike?**
Beautiful! Great for your coffee table & collection of art books.
Incredible depth of research
Important takeaways to make beautiful AND accurate work
Style snob
- **How does this subject connect to other readings and discussions within the course?**
Graphesis, Johanna Drucker
Gestalt Principles & Perception 1 + 1 = 3
Avoid distorting data