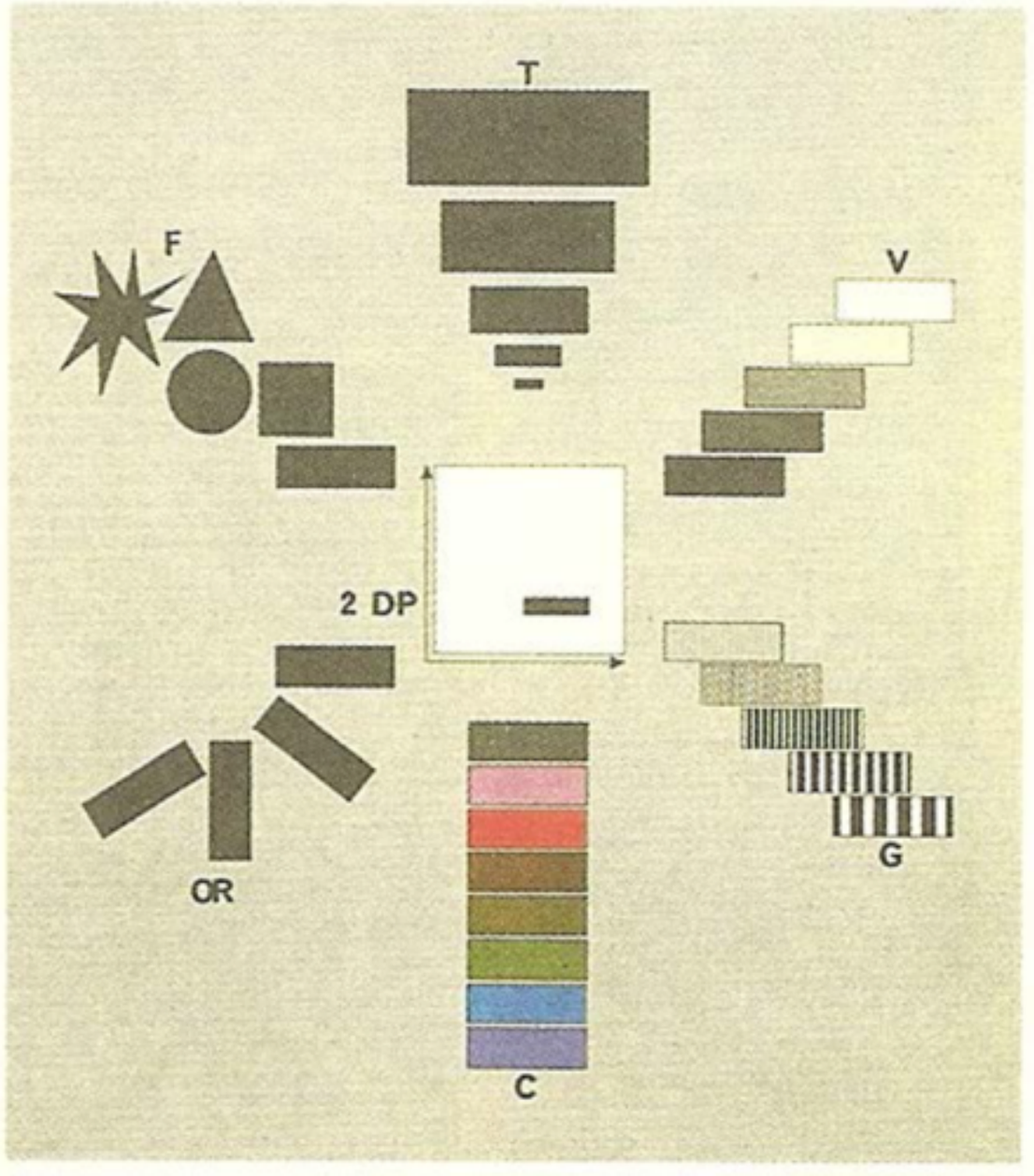
Constants & Variables

via Jacques Bertin

Size

Shape



Value

Orientation

Texture

Color

The Semiology of Graphics: Diagrams, Networks, Maps Jacques Bertin (1967)

Group Distinguish Sort Count

Size

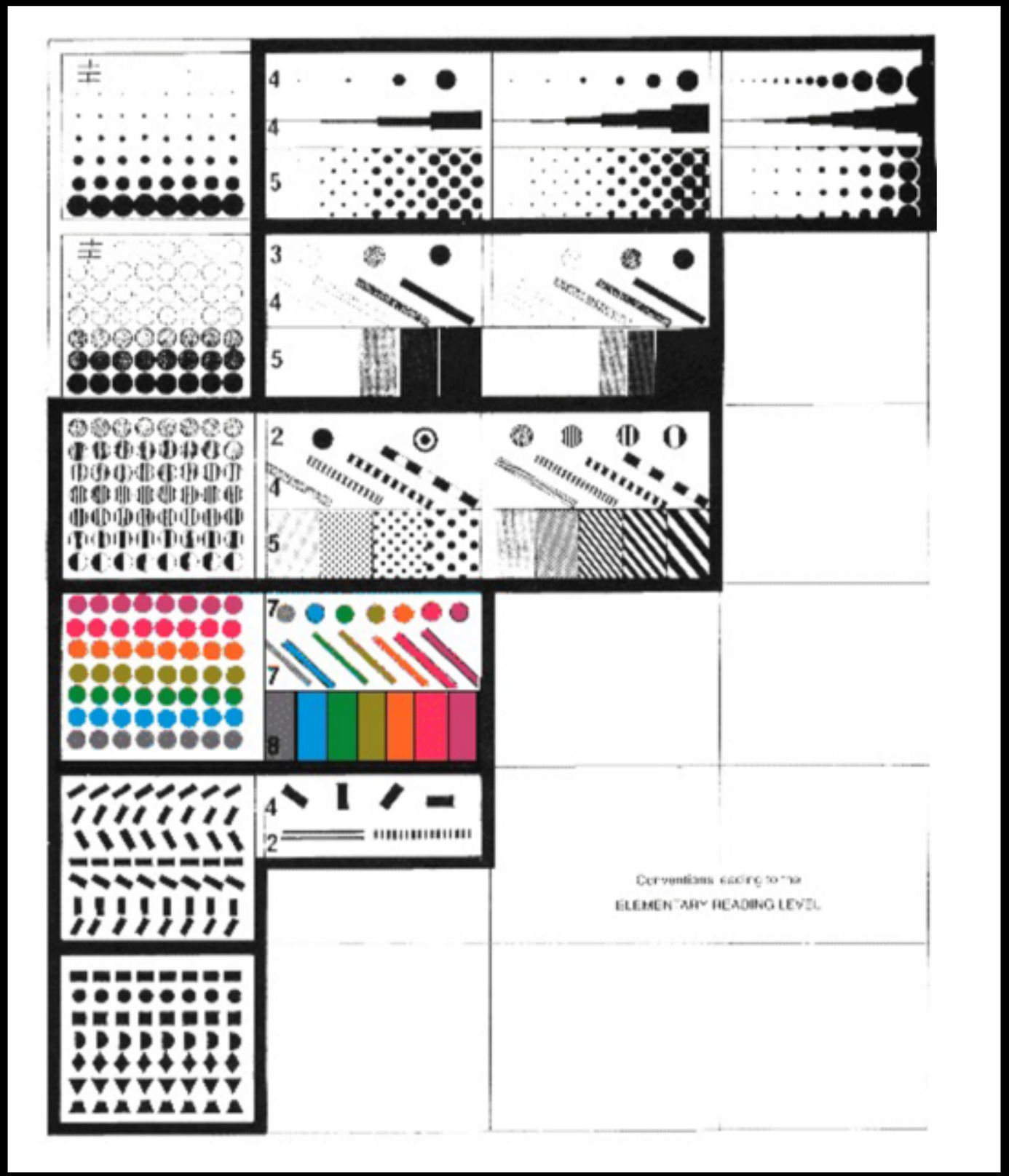
Value

Texture

Color

Orientation

Shape



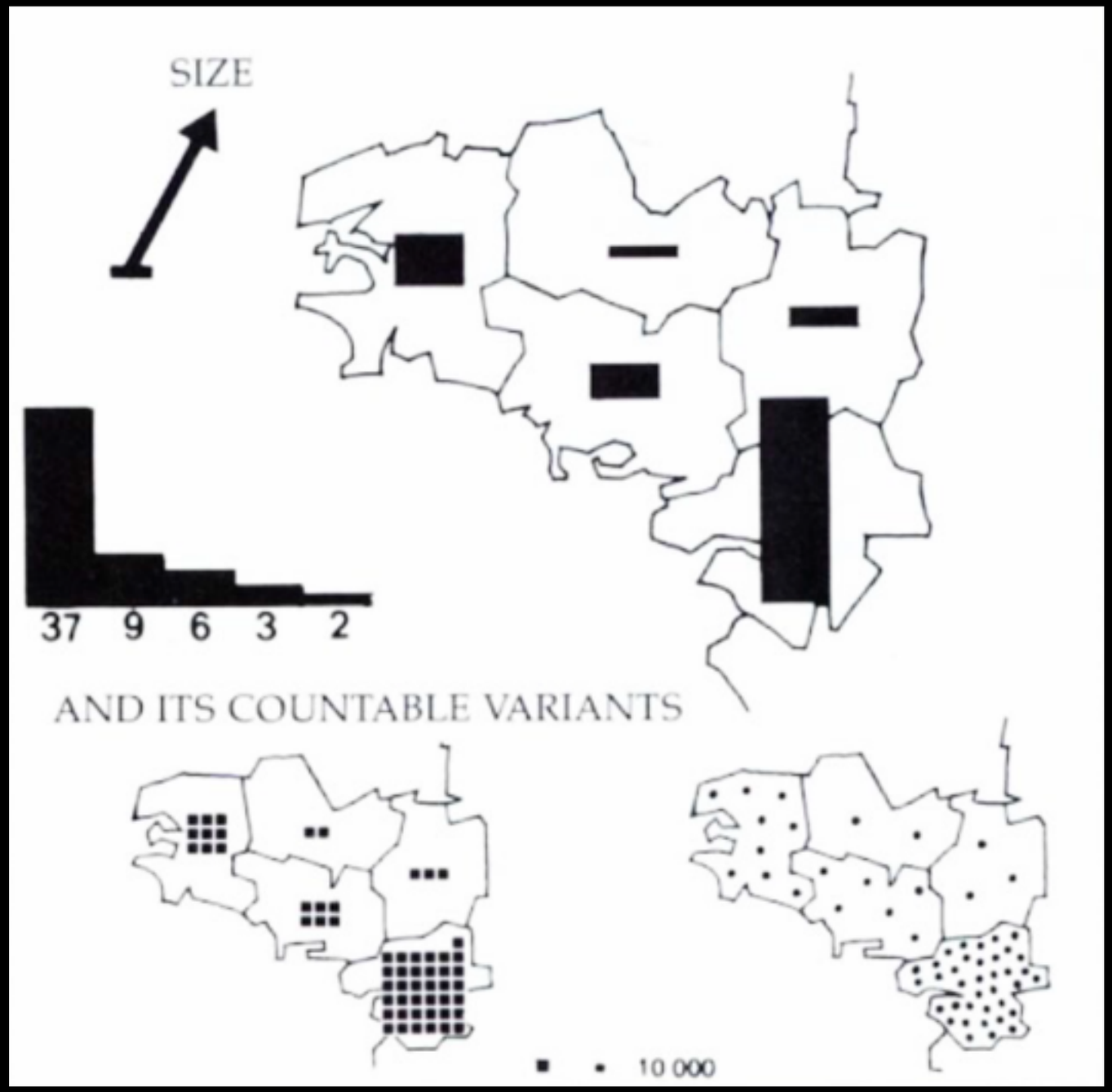
The Semiology of Graphics: Diagrams, Networks, Maps Jacques Bertin (1967)

Bertin’s

‘Retinal Variables’

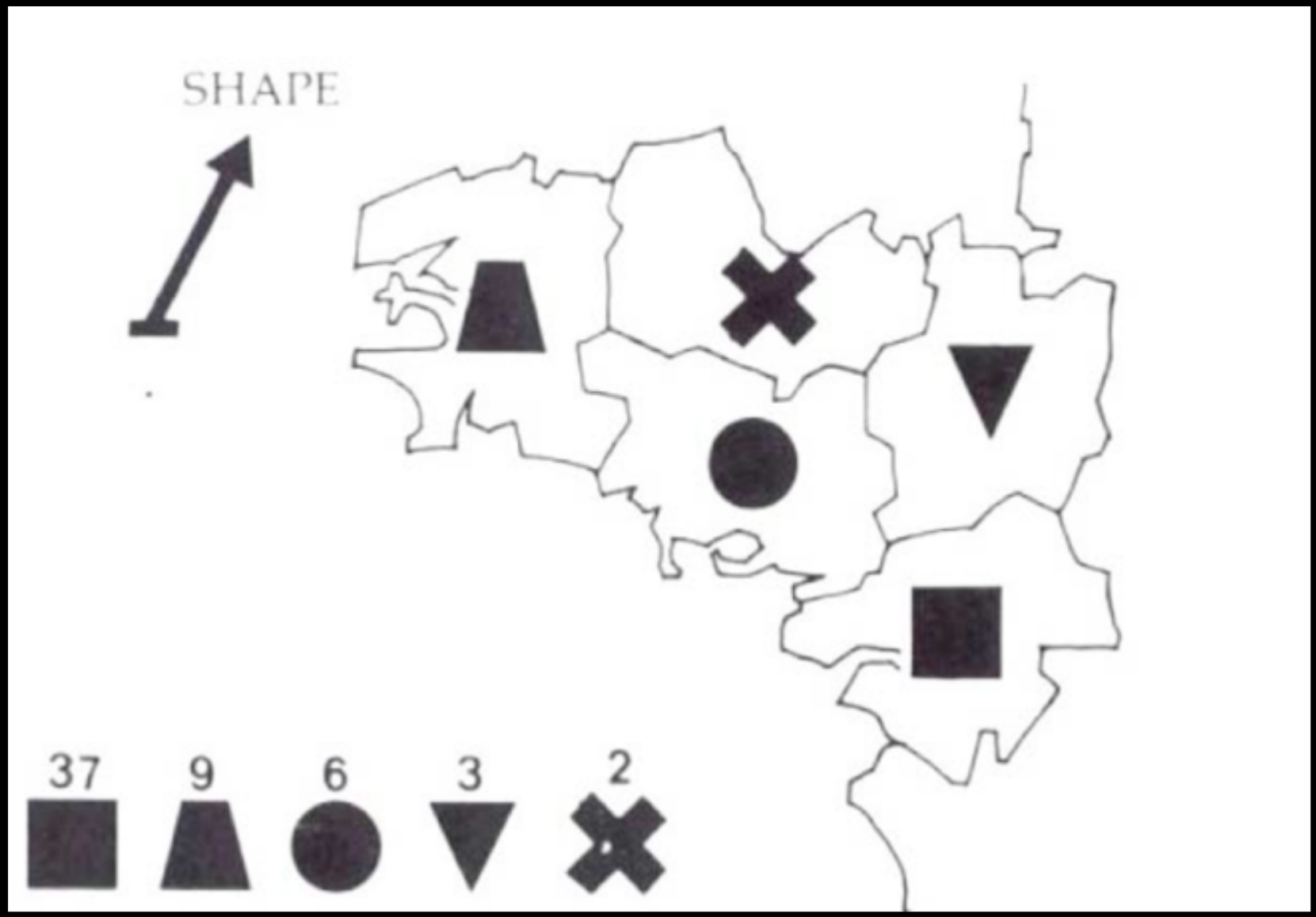
Retinal Variable: Size

Parameters
height
area
count



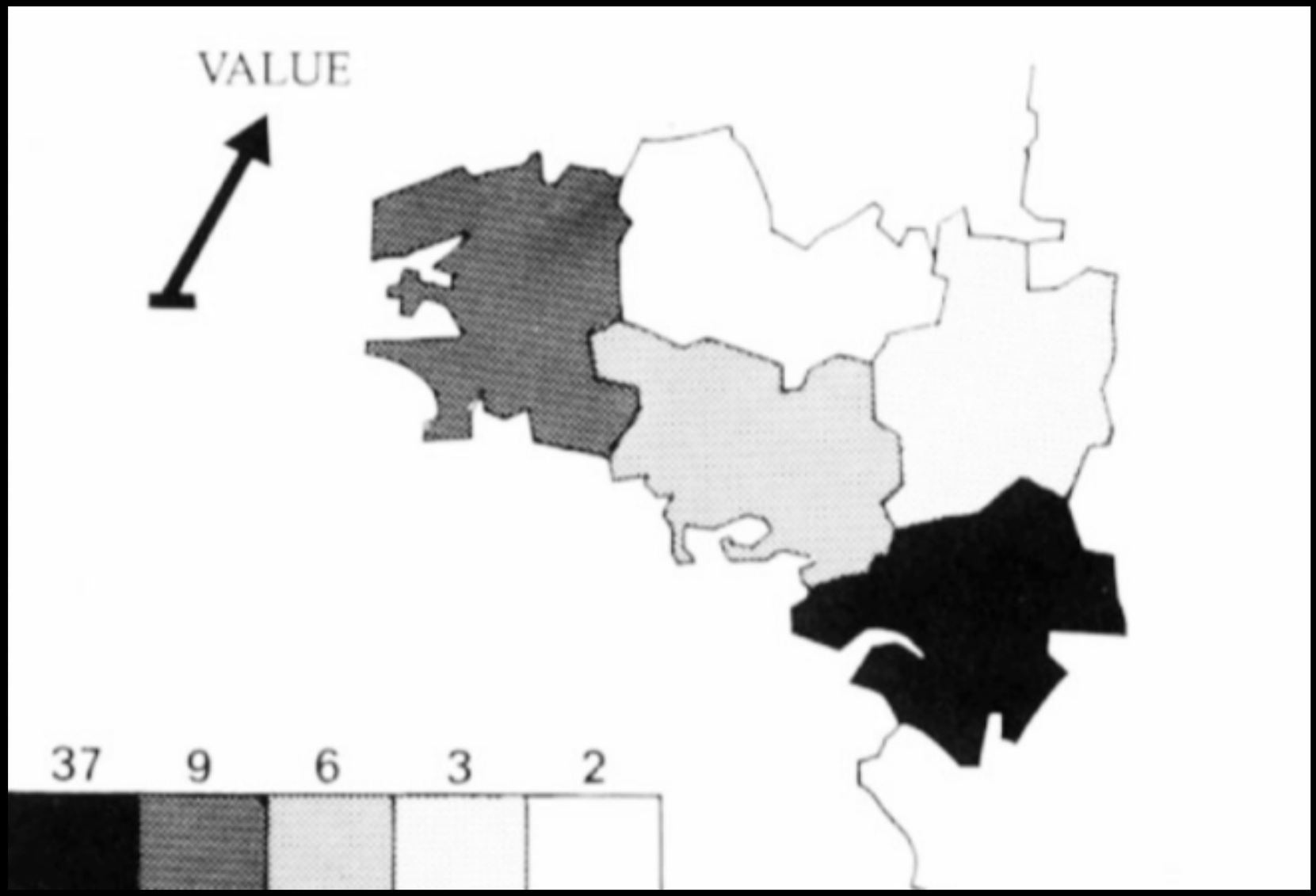
Retinal Variable: Shape

Parameters
outline
associated information in legend



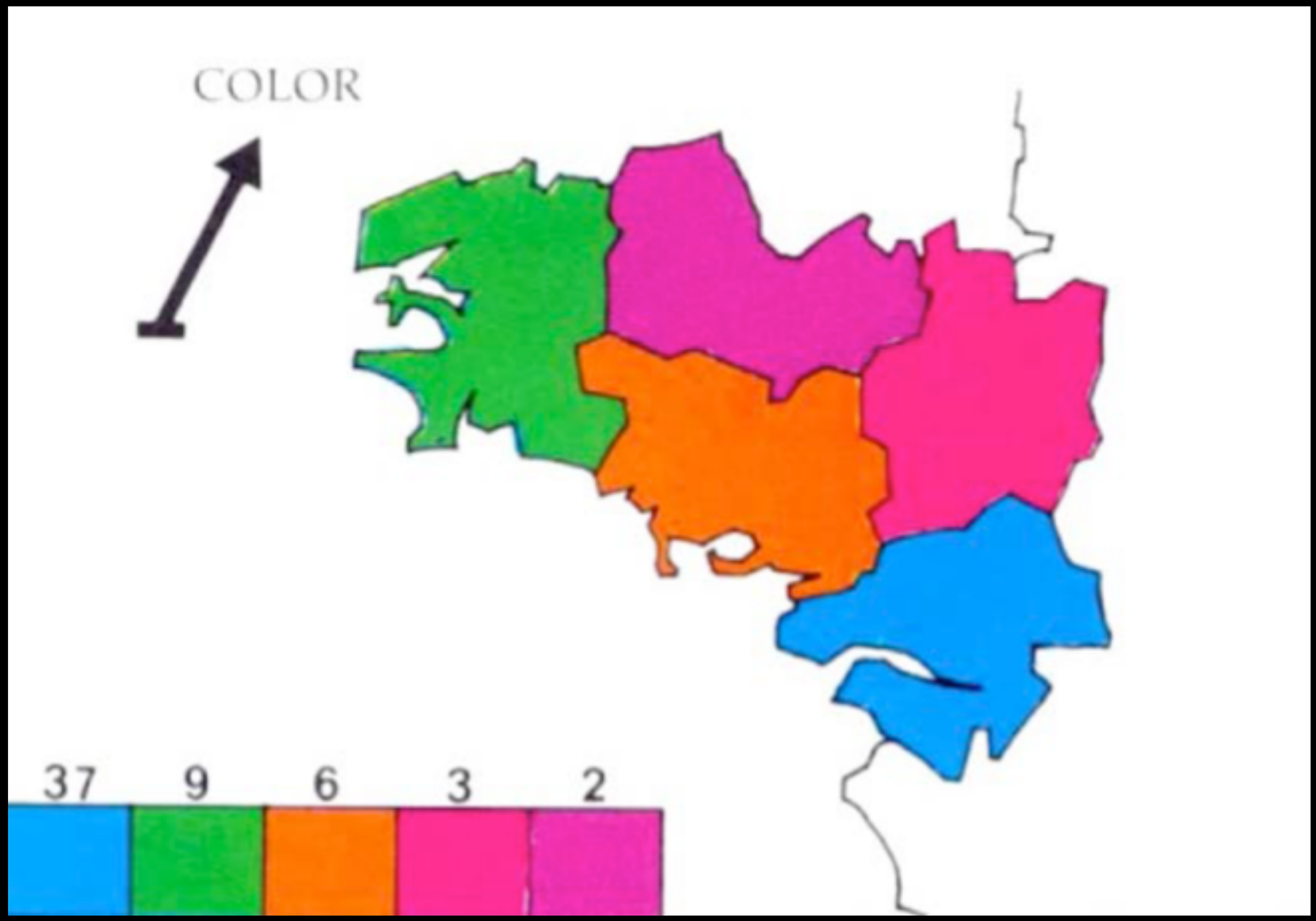
Retinal Variable: Value

Parameters
greyscale lightness



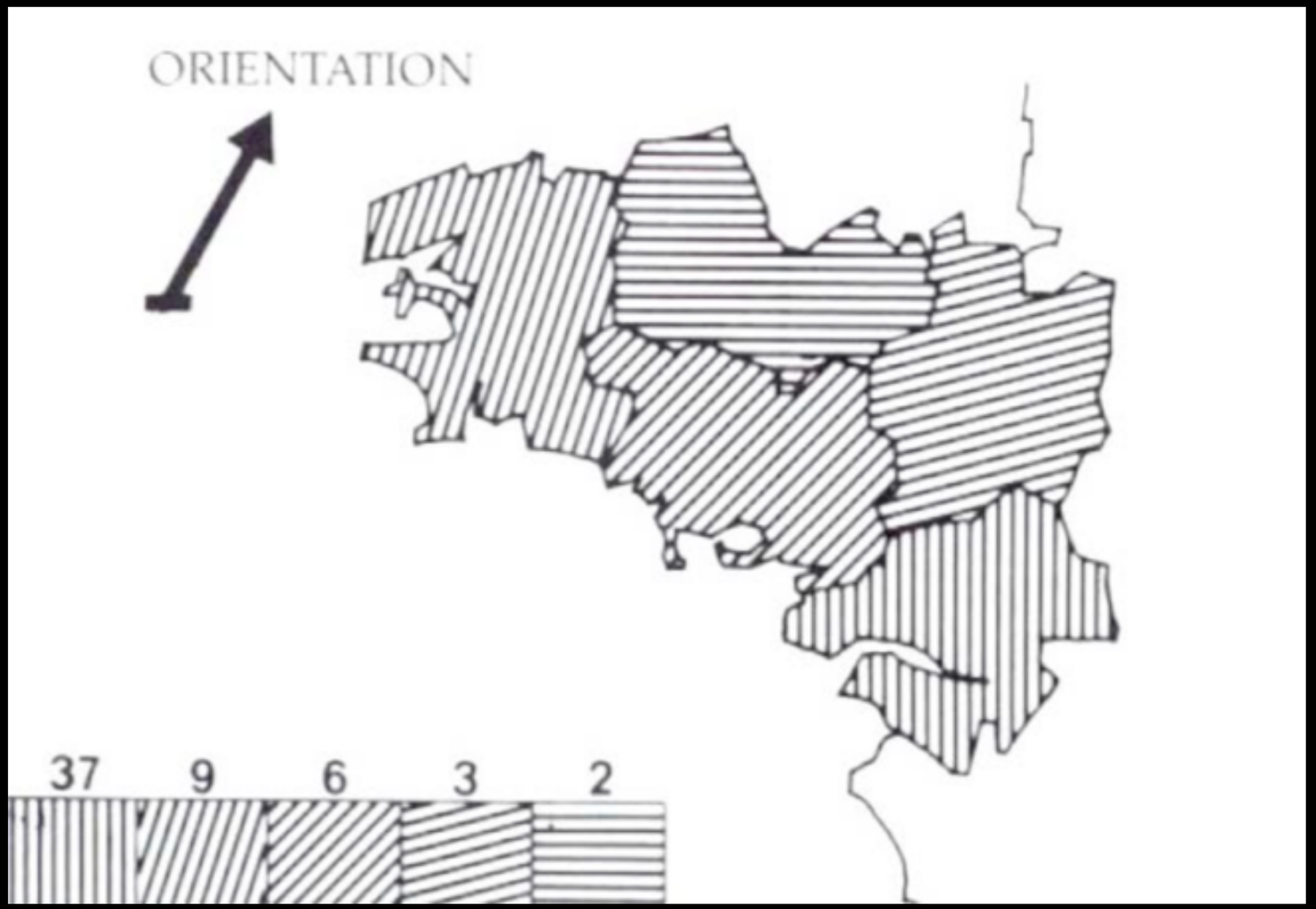
Retinal Variable: Color

Parameters
equiluminant hue differences



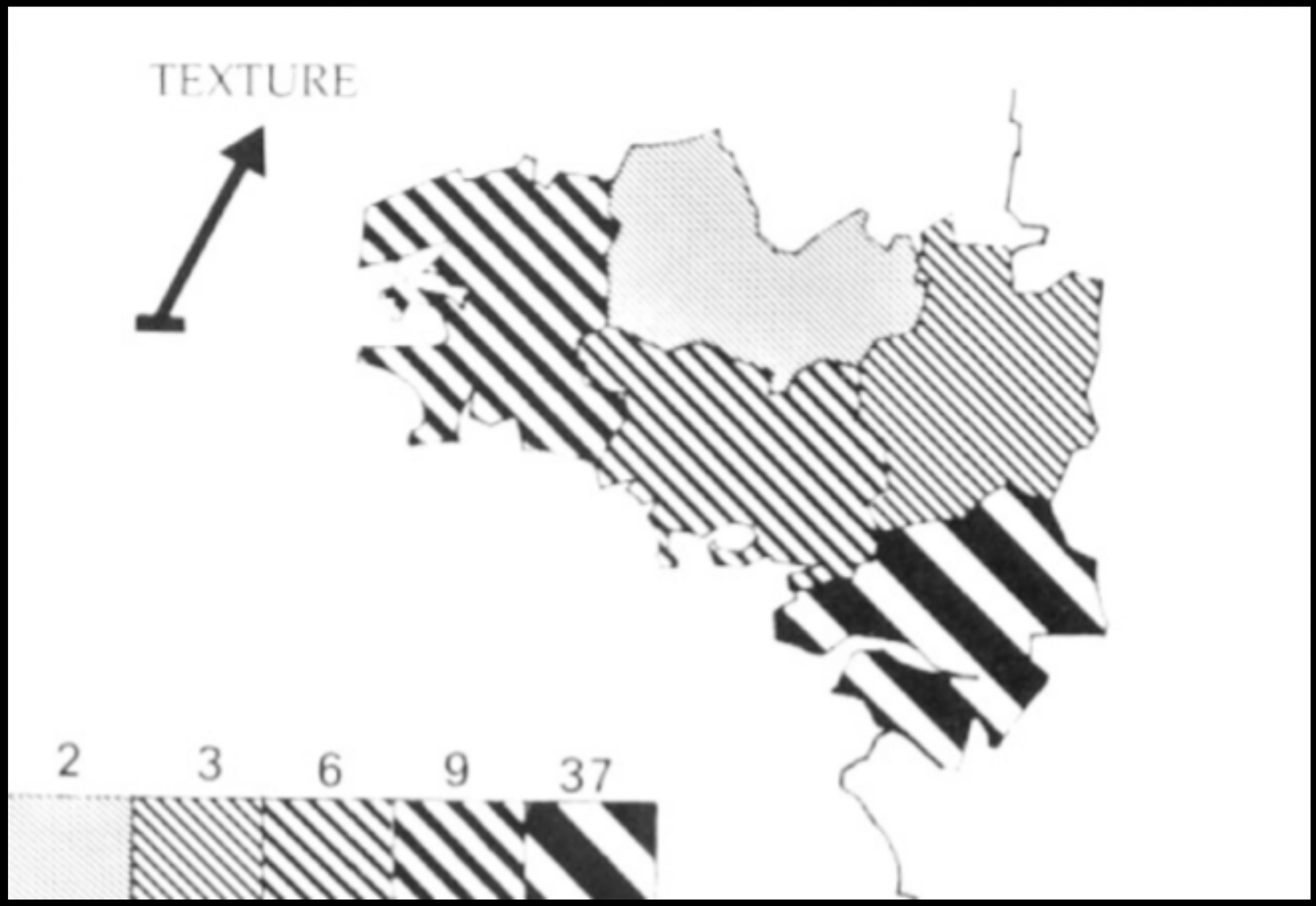
Retinal Variable: Orientation

Parameters
variation from horizontal ↔ vertical



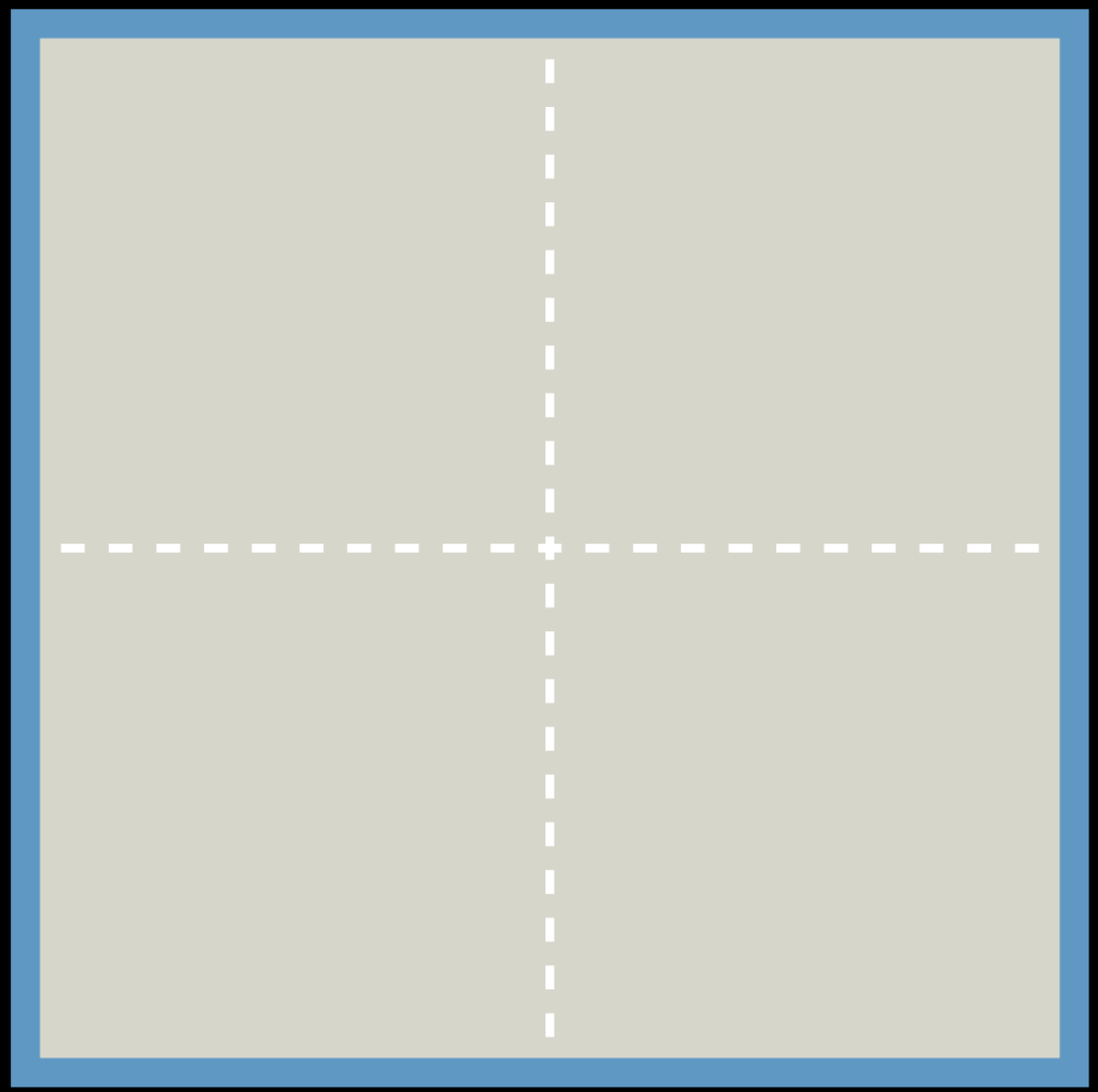
Retinal Variable: Texture

Parameters
stroke weight
spatial frequency



Retinal Variable: The plane

Parameters
origin
x, y, and ‘z’ axes



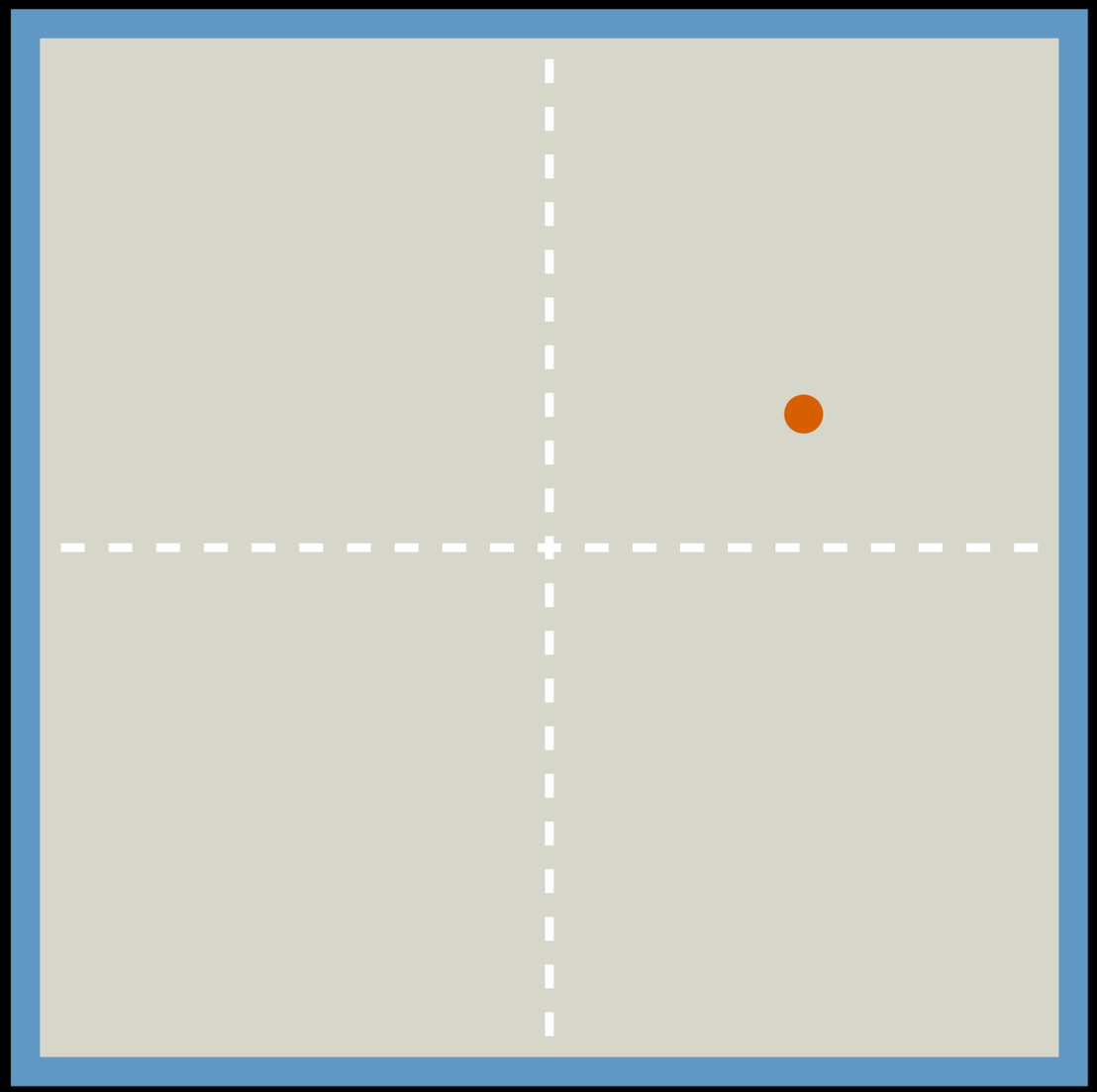
Retinal Variable: The plane

Points

"A point represents a location on the plane that has no theoretical length or area. This signification is independent of the size and character of the mark which renders it visible."

Can represent:
a position in 2D space
an entity with a pair of abstract values

Can vary in:
thickness
color & value
texture



Retinal Variable: The plane

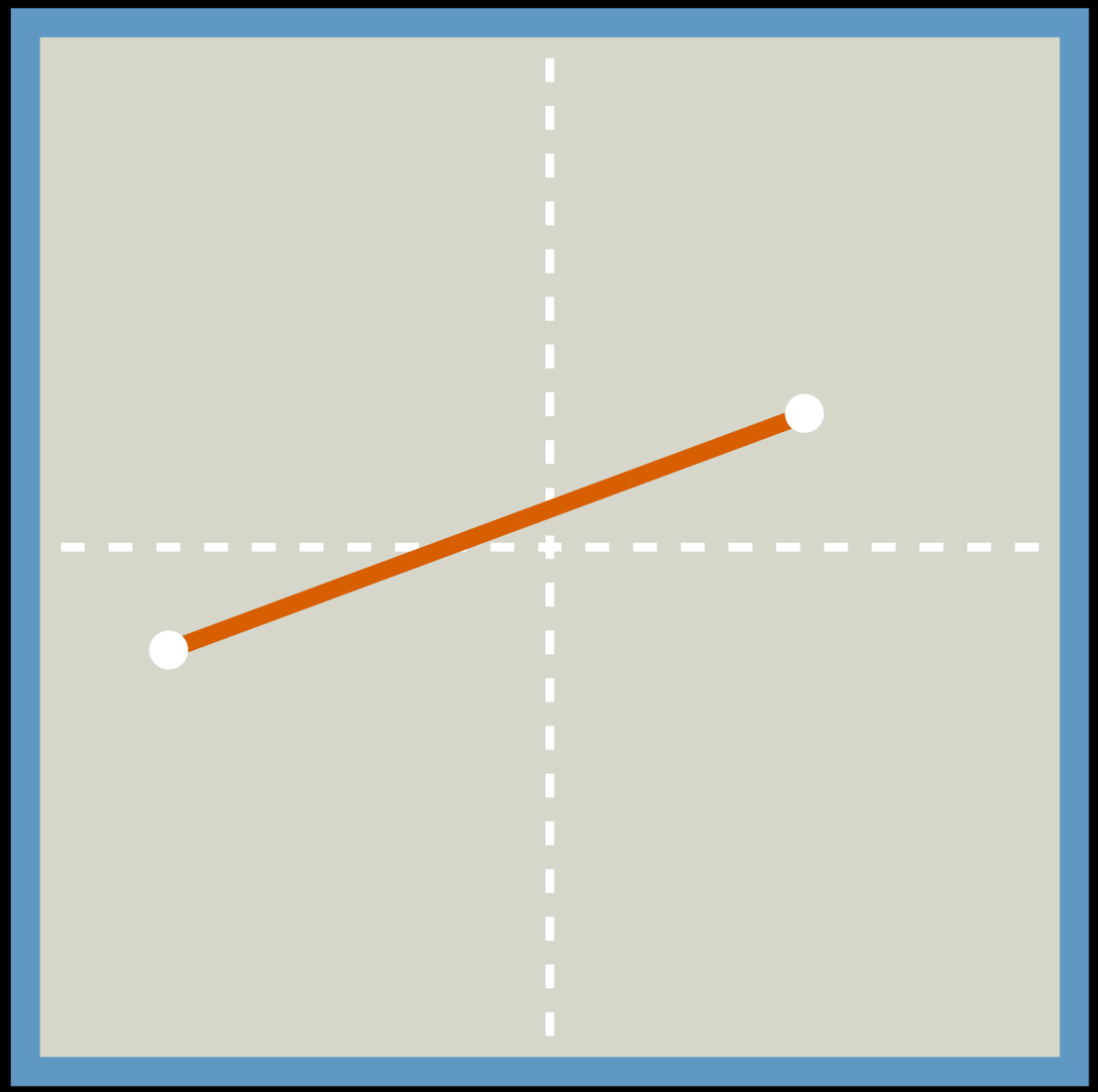
Lines

"A line signifies a phenomenon on the plane which has measurable length but no area. This signification is independent of the width and characteristics of the mark which renders it visible."

Can represent:
a connection
a boundary

Can vary in:
thickness
color & value
texture

Must keep constant:
positions of endpoints



Retinal Variable: The plane

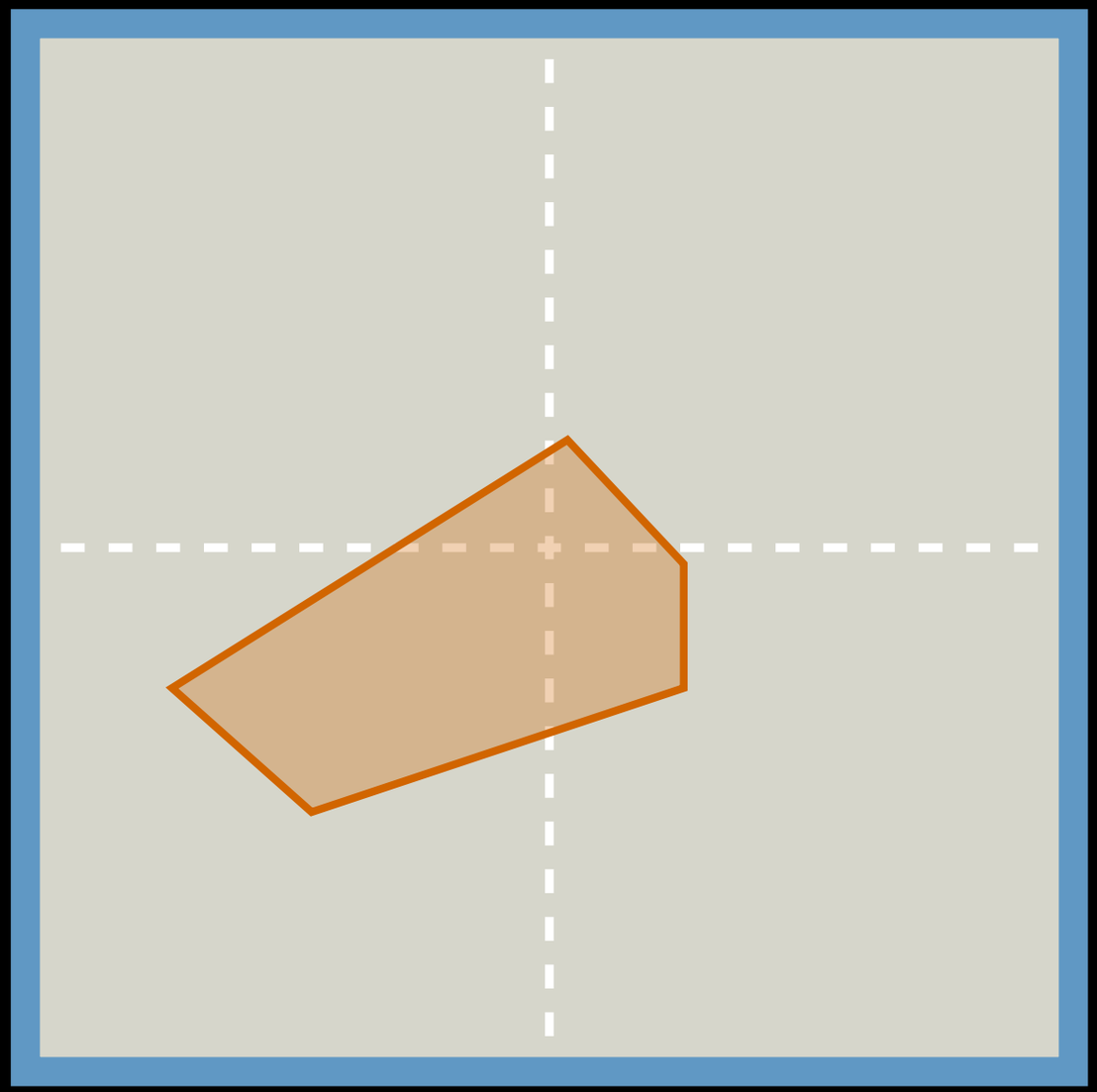
Areas

"An area signifies something on the plane that has measurable size. This signification applies to the entire area covered by the visible mark."

Can represent:
a quantity of variation in each dimension
a categorical grouping of points

Can vary in:
position

Must keep constant:
size
shape
orientation



Retinal Variable: The plane

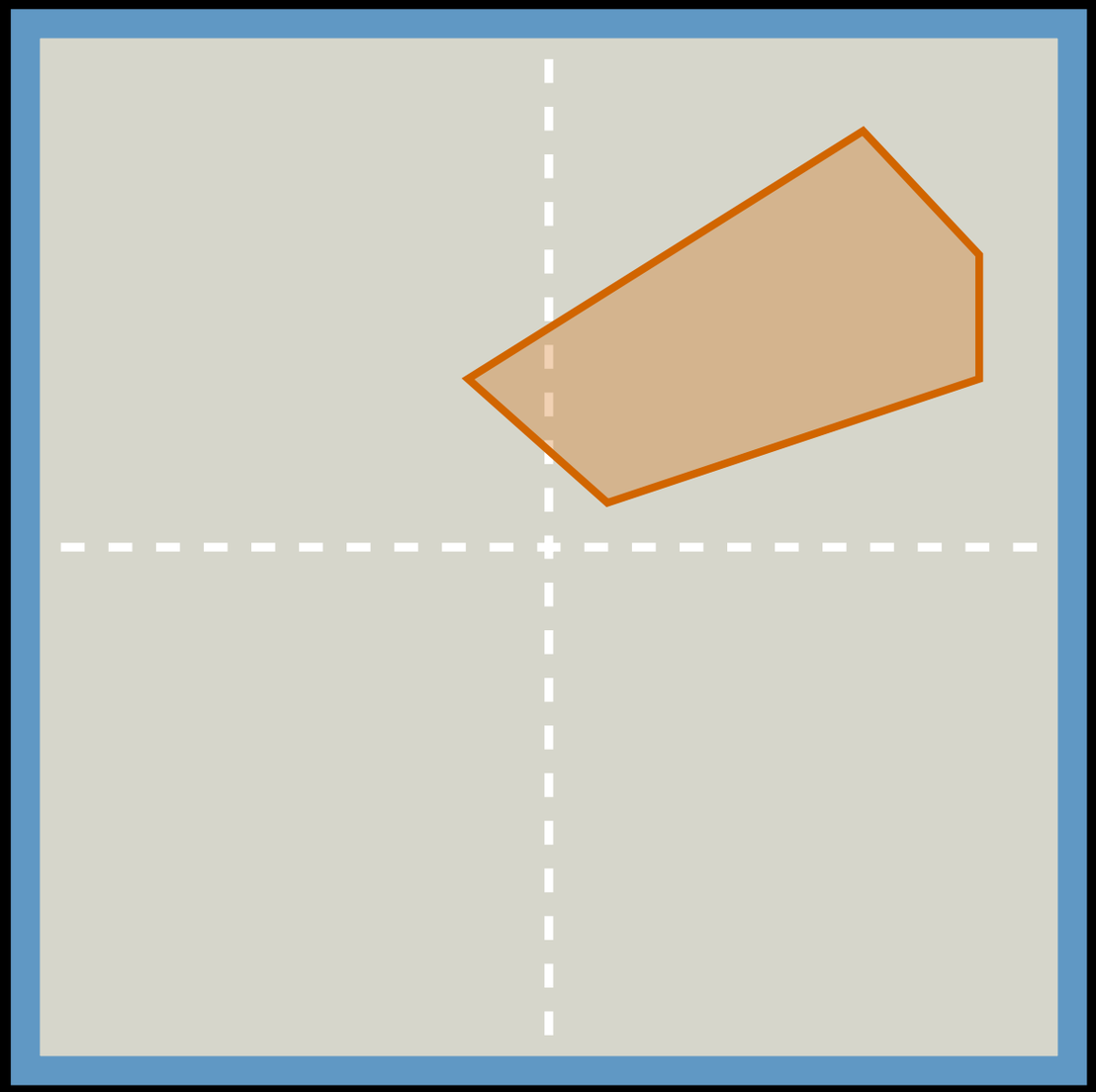
Areas

"An area signifies something on the plane that has measurable size. This signification applies to the entire area covered by the visible mark."

Can represent:
a quantity of variation in each dimension
a categorical grouping of points

Can vary in:
position

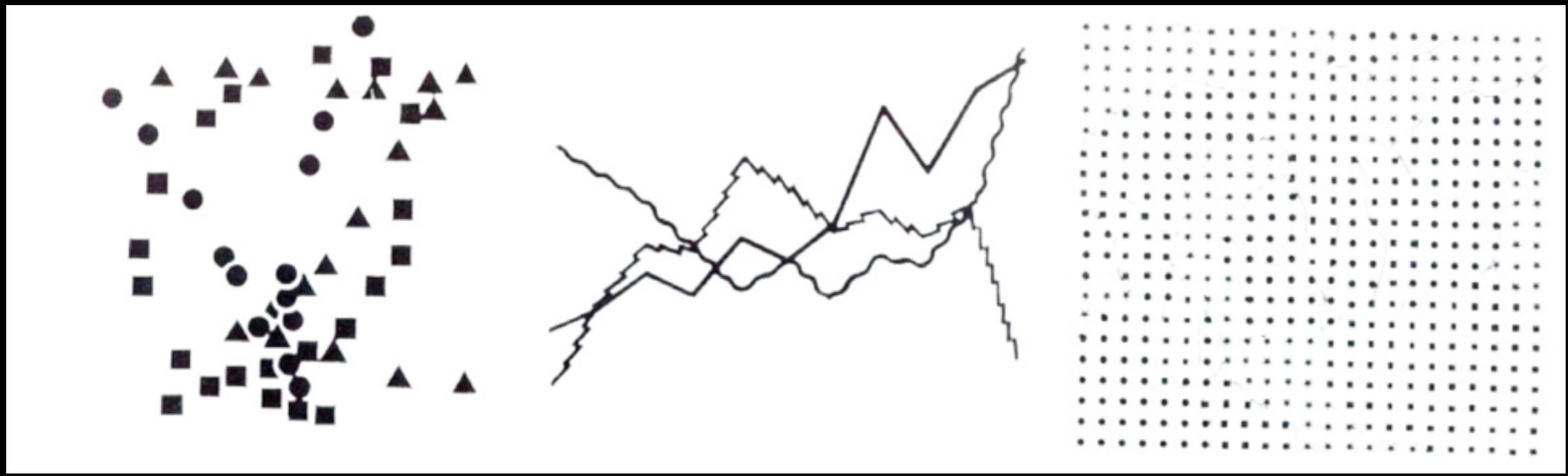
Must keep constant:
size
shape
orientation



Variables on the plane

Retinal Variable: Size

Retinal Variable: Shape



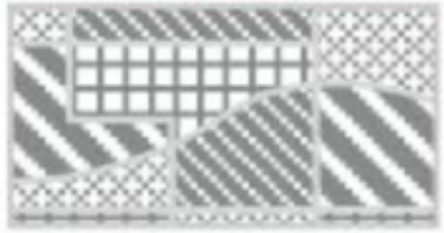
Retinal Variable: Value

Retinal Variable: Color

Retinal Variable: Orientation

Retinal Variable: Texture

To recap…

	Points	Lines	Areas	Best to show
Shape		possible, but too weird to show	cartogram	qualitative differences
Size			cartogram	quantitative differences
Color Hue				qualitative differences
Color Value				quantitative differences
Color Intensity				qualitative differences
Texture				qualitative & quantitative differences

Visual Variables Chart, Making Maps: A Visual Guide to Map Design for GIS John Krygier + Denis Wood (2005)

Case Study

Traffic accidents in 20th Century Paris

The Dataset: 2 dimensions

VEHICLE (or pedestrian)	Pedestrians	Bicycles	Motorcycles	Four-wheeled vehicles
QUANTITIES	28 957	17 247	74 887	63 07[illegible]

The Dataset: 3 dimensions

VEHICLE	Pedestrians		Bicycles		Motorcycles		Four-wheel vehicles	
SEX	M	F	M	F	M	F	M	F
QUANTITIES	16 702	12 249	13 009	4238	61 609	13 278	39 732	23 3[illegible]9

The Dataset: 4 dimensions

VEHICLE
SEX
CONSEQUENCES (dead, injured)
QUANTITIES

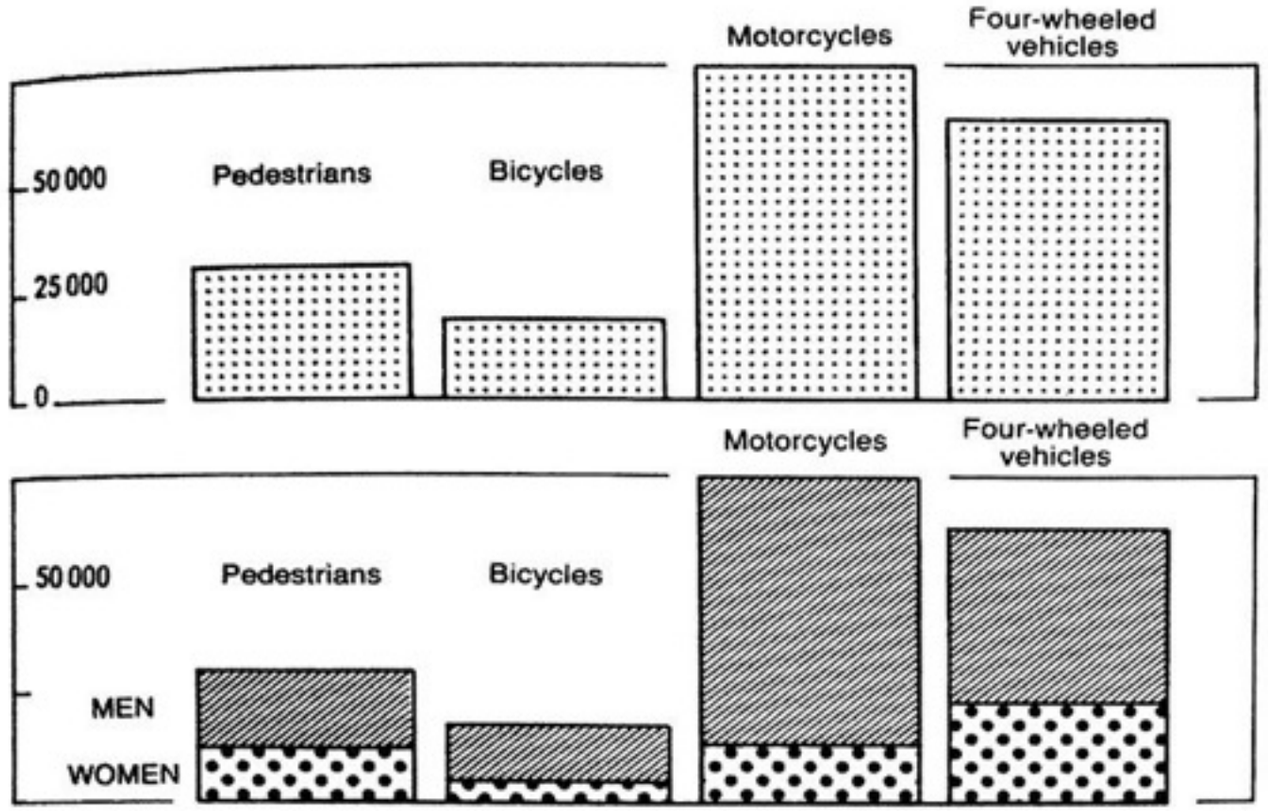
V	Pedestrians		Bicycles		Motorcycles		Four-wheeled vehicles	
S	M	F	M	F	M	F	M	F
C / Q: d	1232	570	701	126	2 664	322	1 817	694
C / Q: i	15 470	11 679	12 308	4112	58 945	12 956	37 915	22 645

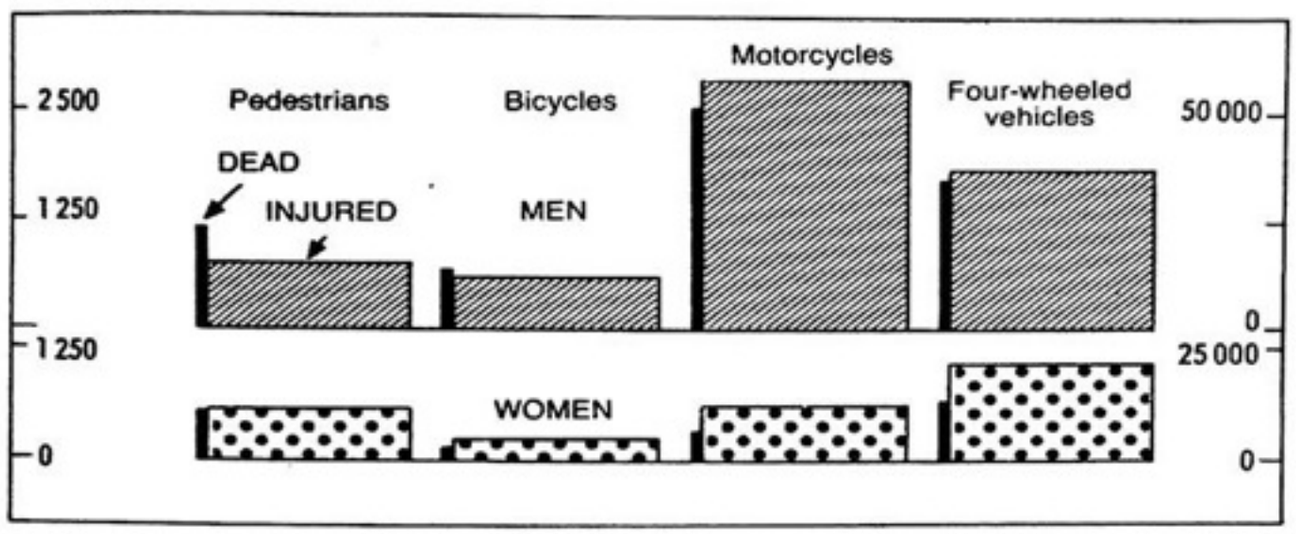
The Dataset: 5 dimensions

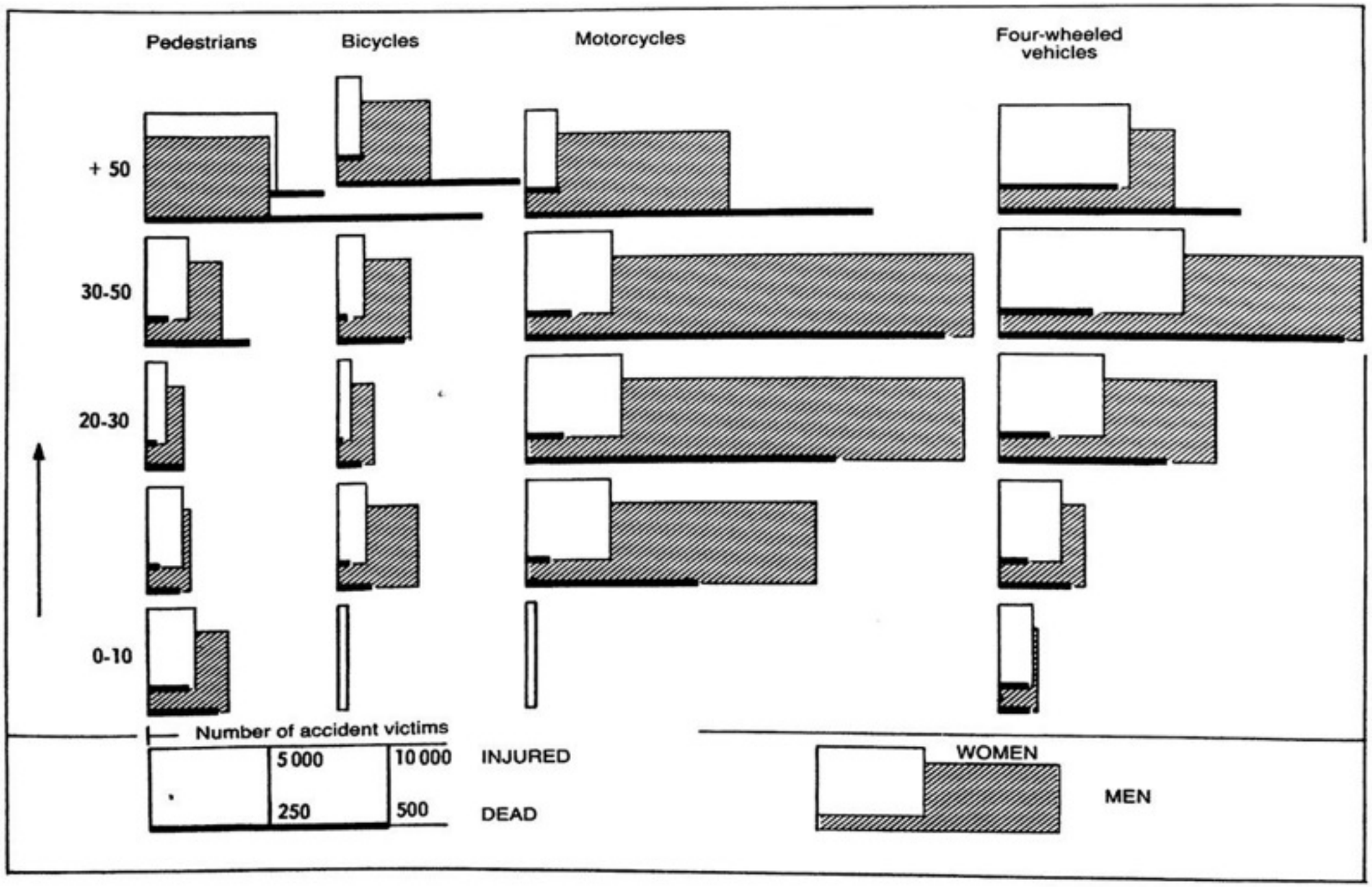
VEHICLE
SEX
CONSEQUENCES
AGE
QUANTITIES

V	Pedestrians		Bicycles		Motorcycles		Four-wheeled vehicles	
S	M	F	M	F	M	F	M	F
Q A C								
50 d	704	378	396	56	742	78	513	253
50 i	5 206	5 449	3 863	1 030	8 597	1 387	7 423	5 552
30 d	223	49	146	24	889	98	720	199
30 i	3 178	1 814	3 024	1 118	18 909	3 664	15 086	7 712
20 d	78	24	55	10	660	82	353	107
20 i	1 521	864	1 565	609	18 558	4 010	9 084	4 361
10 d	70	28	76	31	362	54	150	61
10 i	1 827	1 495	3 407	1 218	12 311	3 587	3 543	2 593
d	150	89	26	5	6	6	70	65
i	3 341	1 967	378	126	181	131	1 593	1 362

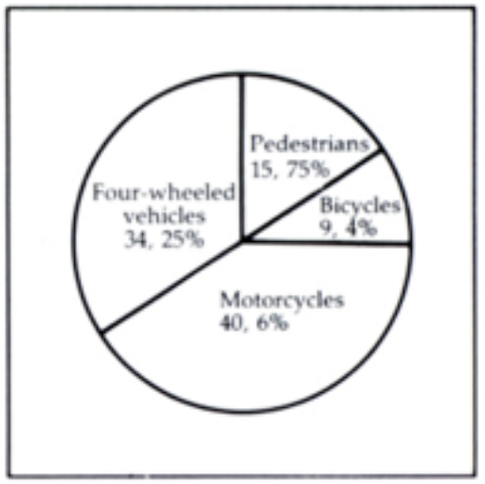
Source: Ministère des Travaux Publics

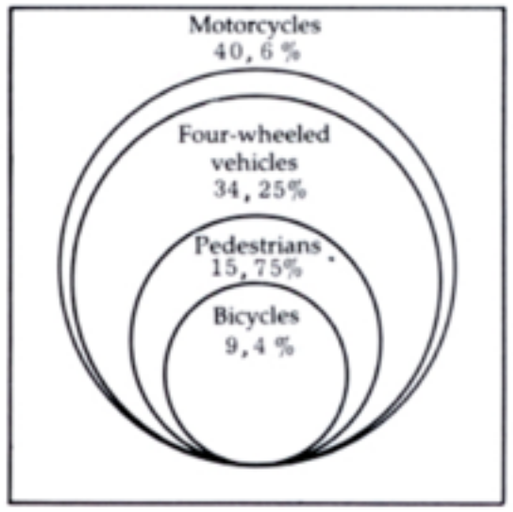

Motorcycles
Four-wheeled vehicles
50 000
25 000
0
Pedestrians
Bicycles
Motorcycles
Four-wheeled vehicles
50 000
Pedestrians
Bicycles
MEN
WOMEN

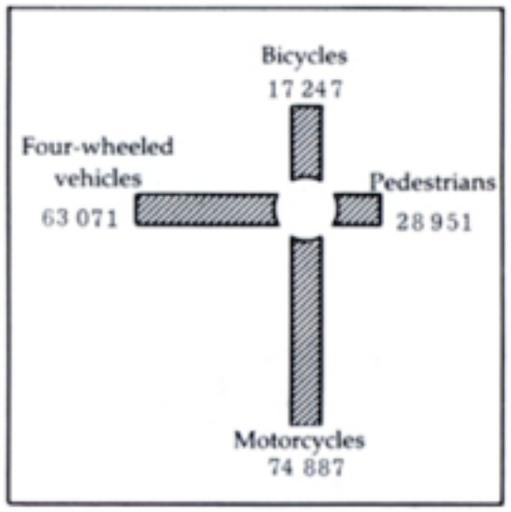

Motorcycles
2 500
Pedestrians
Bicycles
Four-wheeled vehicles
50 000
DEAD
INJURED
1 250
MEN
0
1 250
25 000
WOMEN
0
0


Pedestrians
Bicycles
Motorcycles
Four-wheeled vehicles
+ 50
30-50
20-30
0-10
Number of accident victims
5 000
10 000
INJURED
250
500
DEAD
WOMEN
MEN

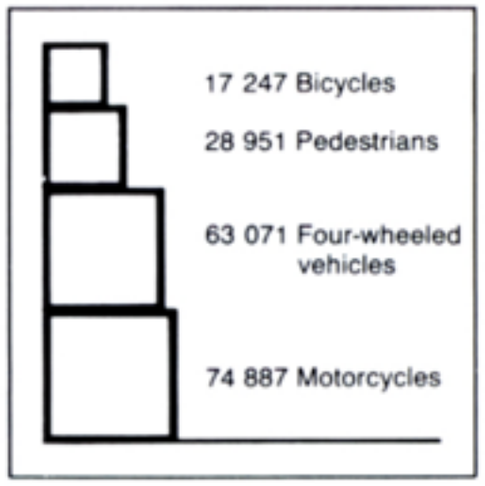

Pedestrians
Bicycles
Motorcycles
Four-wheeled vehicles
28 951
17 247
74 887
63 071

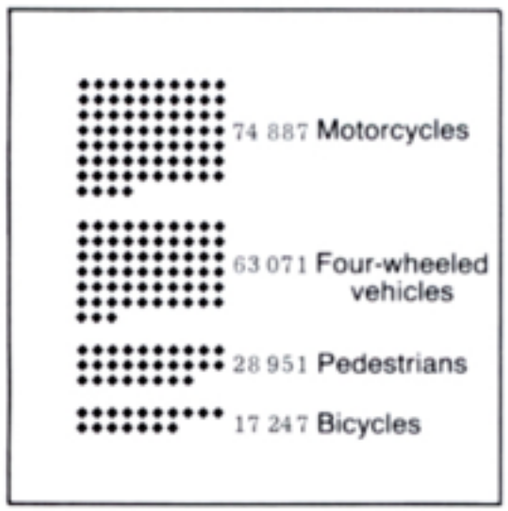

Pedestrians
15, 75%
Four-wheeled vehicles
34, 25%
Bicycles
9, 4%
Motorcycles
40, 6%

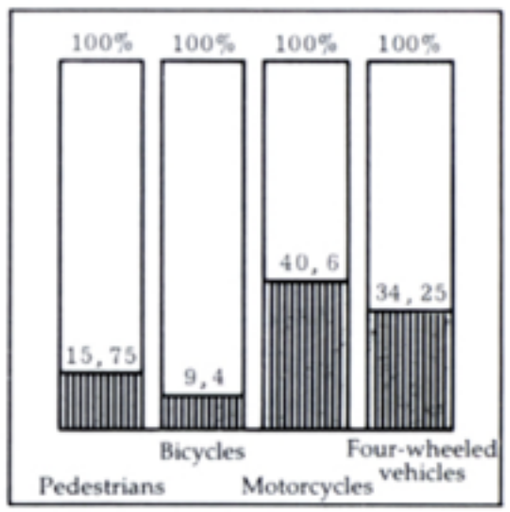

Motorcycles
40, 6 %
Four-wheeled vehicles
34, 25%
Pedestrians
15, 75%
Bicycles
9, 4 %

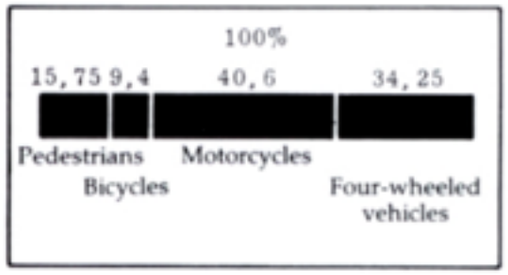

Bicycles
17 247
Four-wheeled vehicles
63 071
Pedestrians
28 951
Motorcycles
74 887

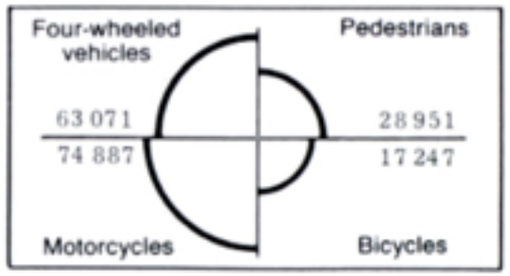

74 887
Motorcycles
63 071
Four-wheeled vehicles
28 951 Pedestrians
17 247 Bicycles


17 247 Bicycles
28 951 Pedestrians
63 071 Four-wheeled vehicles
74 887 Motorcycles


74 887 Motorcycles
63 071 Four-wheeled vehicles
28 951 Pedestrians
17 247 Bicycles


100%
100%
100%
100%
15, 75
9, 4
40, 6
34, 25
Pedestrians
Bicycles
Motorcycles
Four-wheeled vehicles


100%
15, 75
9, 4
40, 6
34, 25
Pedestrians
Bicycles
Motorcycles
Four-wheeled vehicles

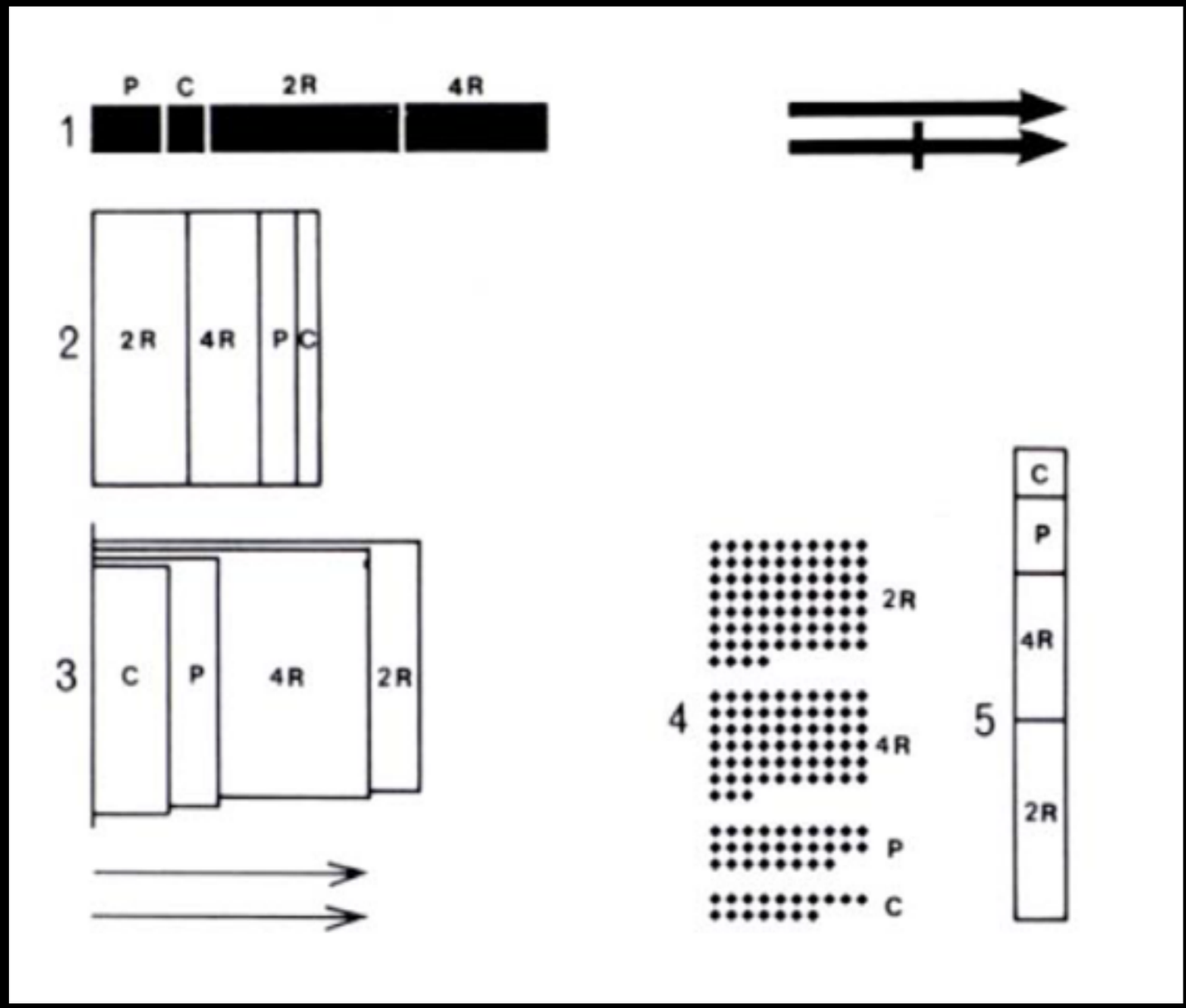

Four-wheeled vehicles
Pedestrians
63 071
28 951
74 887
17 247
Motorcycles
Bicycles

Linear Construction

Total quantity depicted through line-length
(1 planar dimension)

Figures

1: unsorted
2: sorted horizontally
3: overlapped to show proportion
4: countable representation
5: sorted vertically

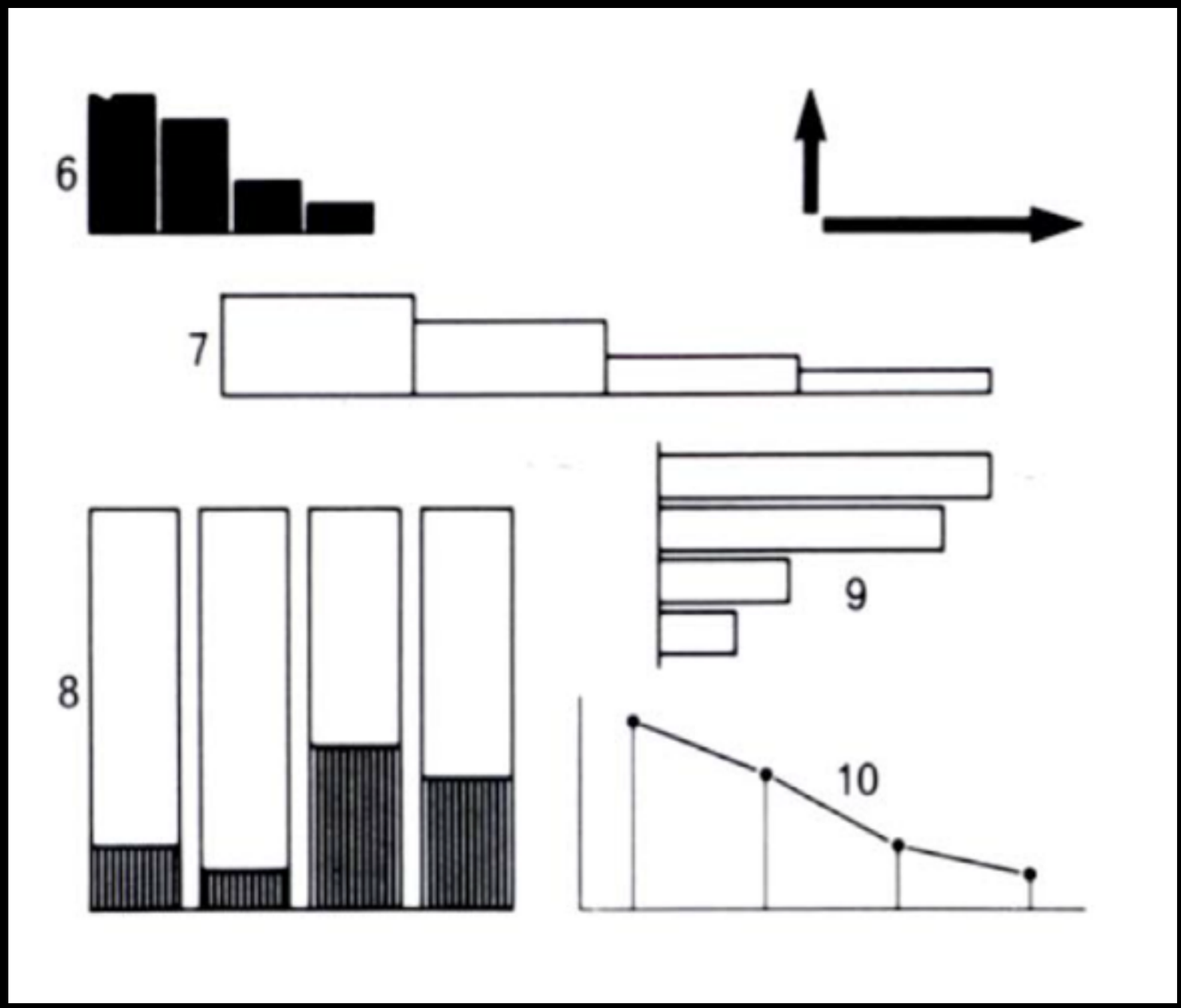


Orthogonal Construction

Total not depicted but comparisons enabled
(2 planar dimensions)

Figures

6 & 7: quantities on vertical axis
9: categories on vertical axis
8: hollow bars reinforce ‘100%’ measure
10: show ‘trends’ by linking categories

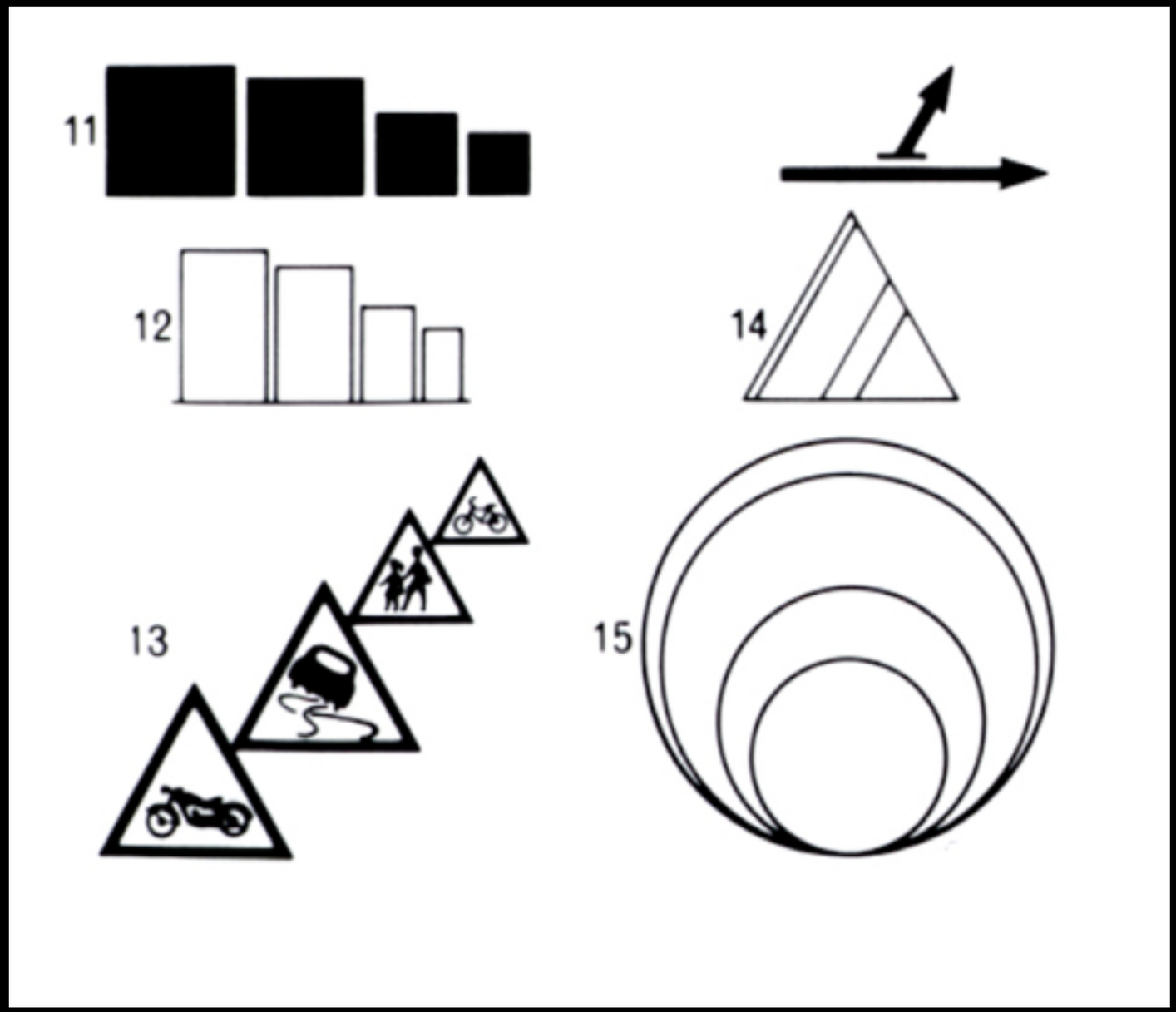


Rectilinear Elevation

Total not depicted and comparisons impeded
(1 planar dimension, 1 area dimension)

Figures

11 & 12: areas proportional to horizontal scale
13: diagonal arrangement (shudder)
14 & 15: regions overlaid to show proportion

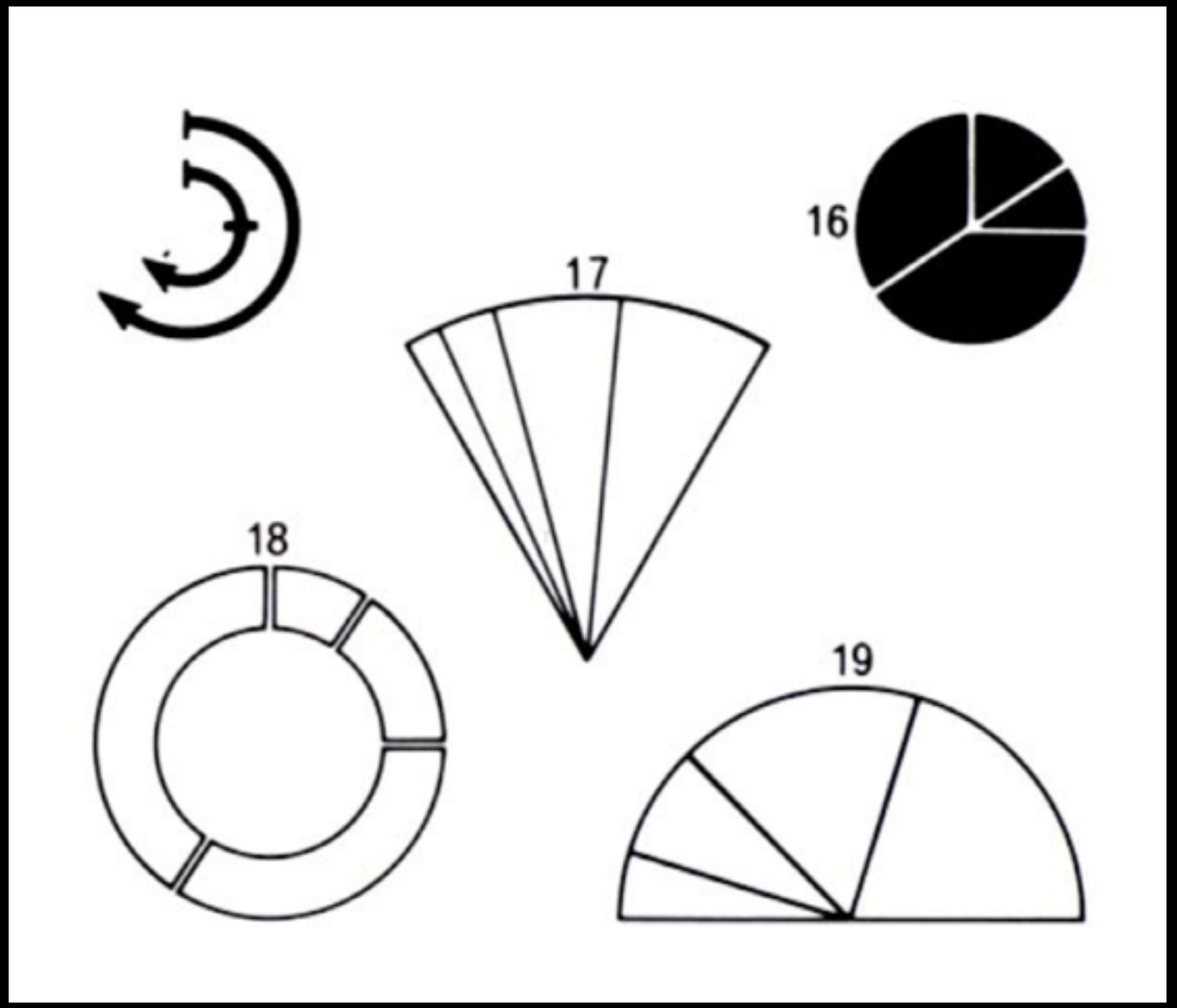


Circular Construction

Total depicted in arc angle
(1 polar dimension)

Figures

18: simple bar graph but on a curve
16, 17, & 19: slices of entire circle or a subset



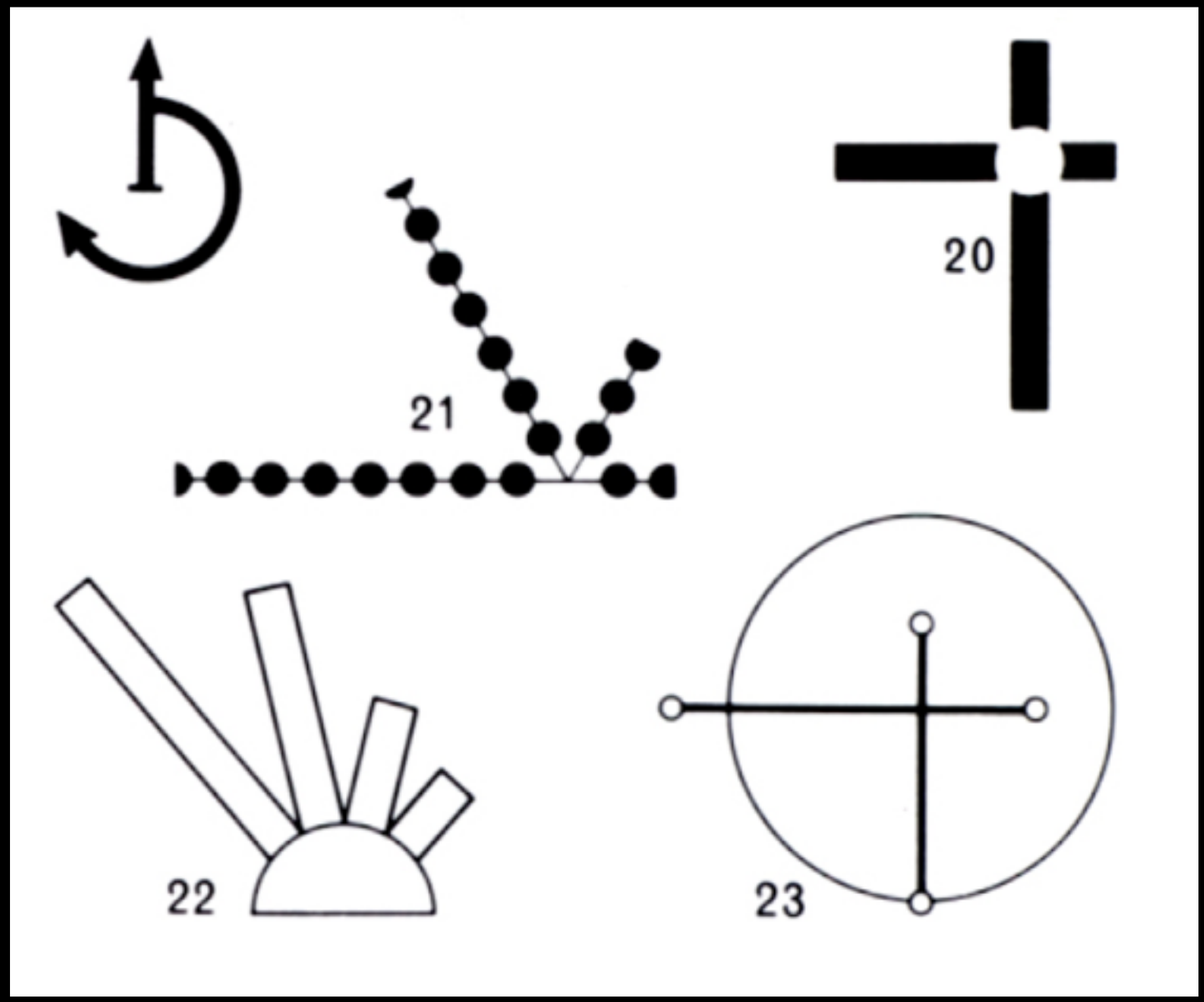
Polar Construction

Total not depicted. Quantities shown through line-length and category through angle.
(1 planar dimension, 1 polar dimension)

Figures

20: simple bar graph with differing bar orientations

23: outer circle to aid comparison

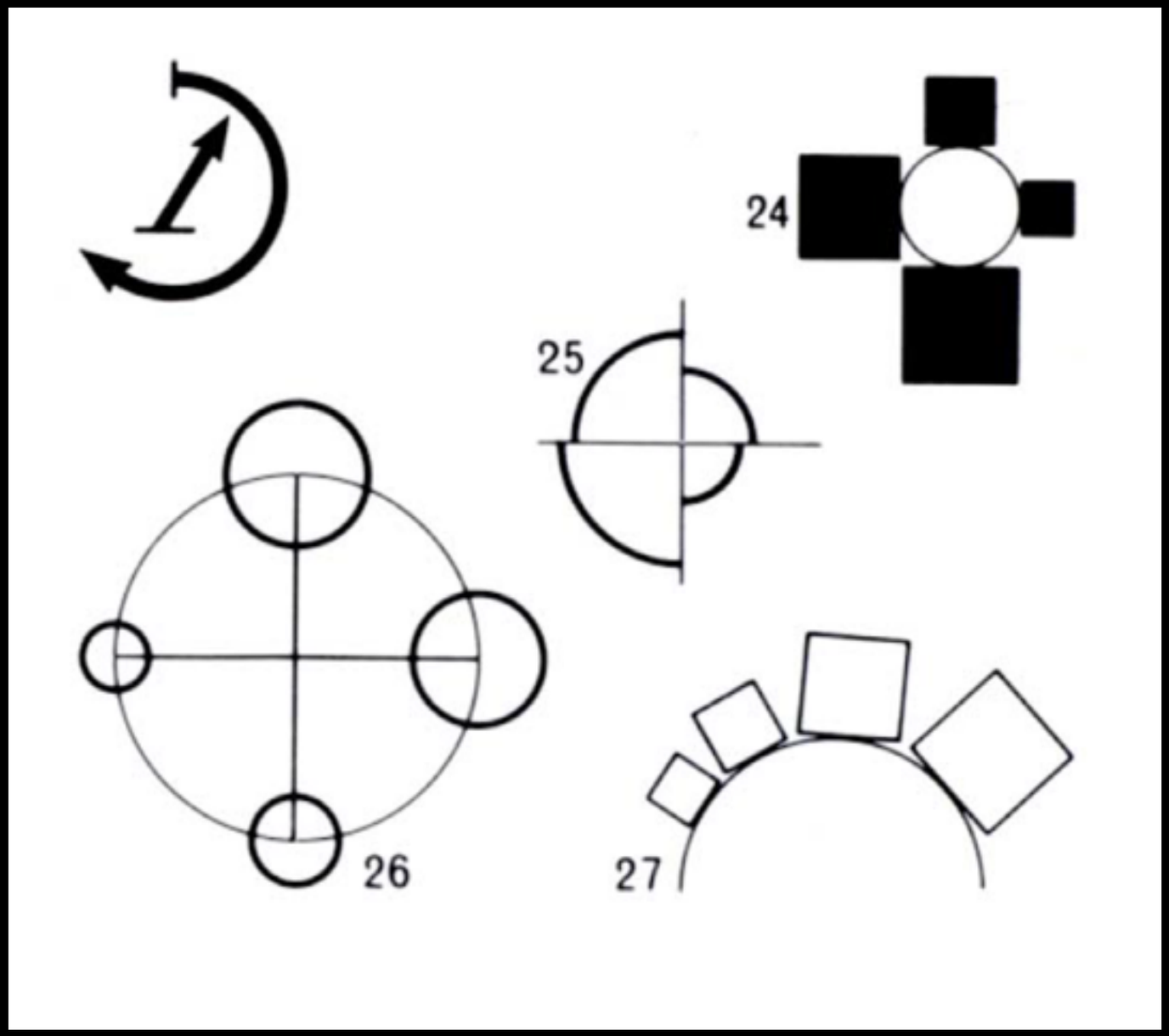


Circular Elevation

Total not depicted. Individual quantities shown through area and categories through angle.
(1 polar dimension, 1 area dimension)

Figures

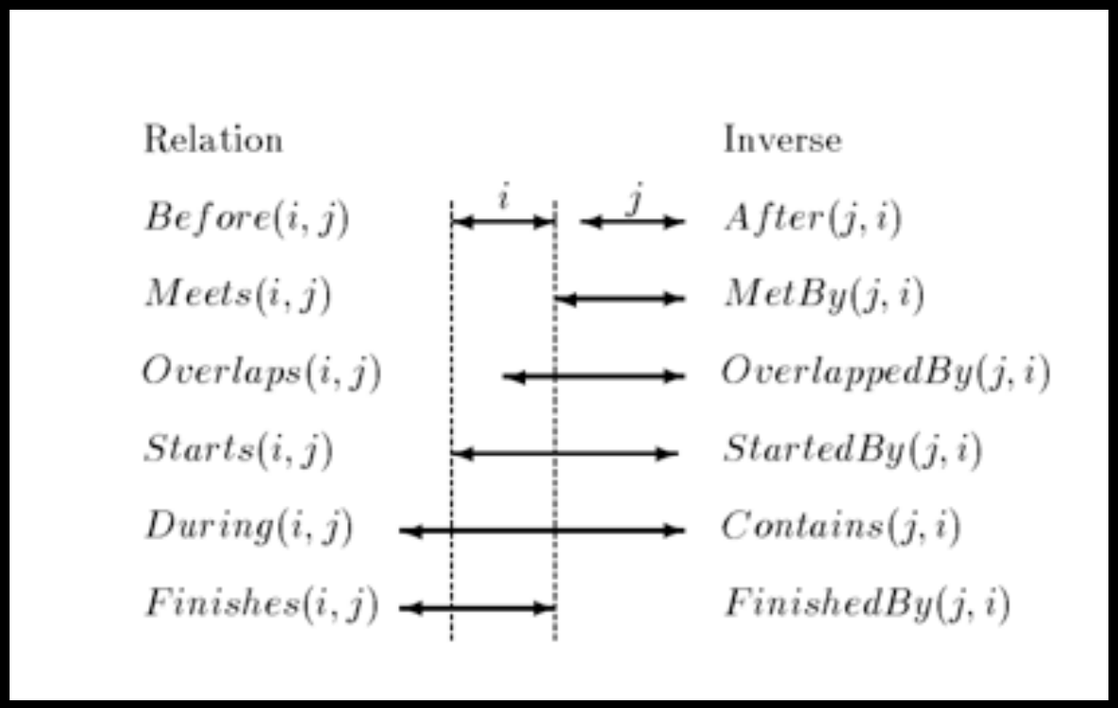
- 24: curved form of Rectilinear Elevation plot
- 25: radius of arc (Nightingale Rose)
- 26: area of circle
- 27: same as 24 but on a semi-circle



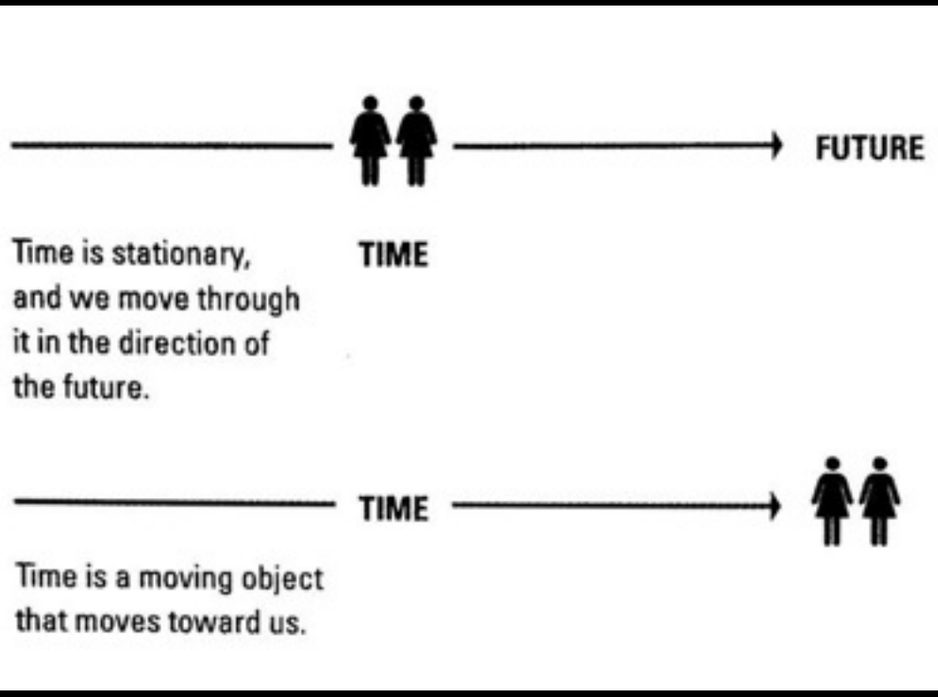
Exercise #1

Mapping Time

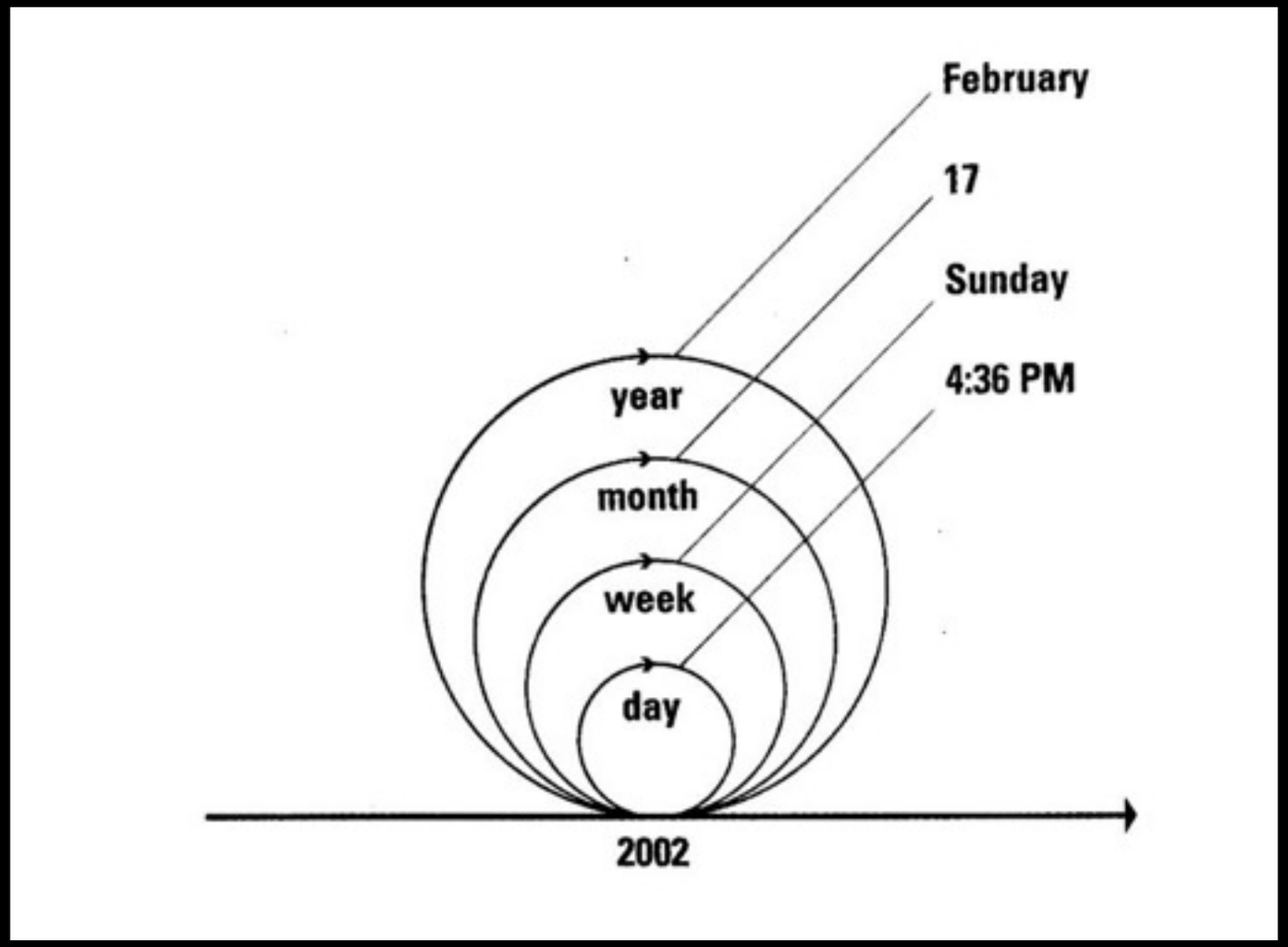
Babylonian star chart and calendar from Ashurbanipal, Nineveh, Assyrian cuneiform (circa 720 BCE)



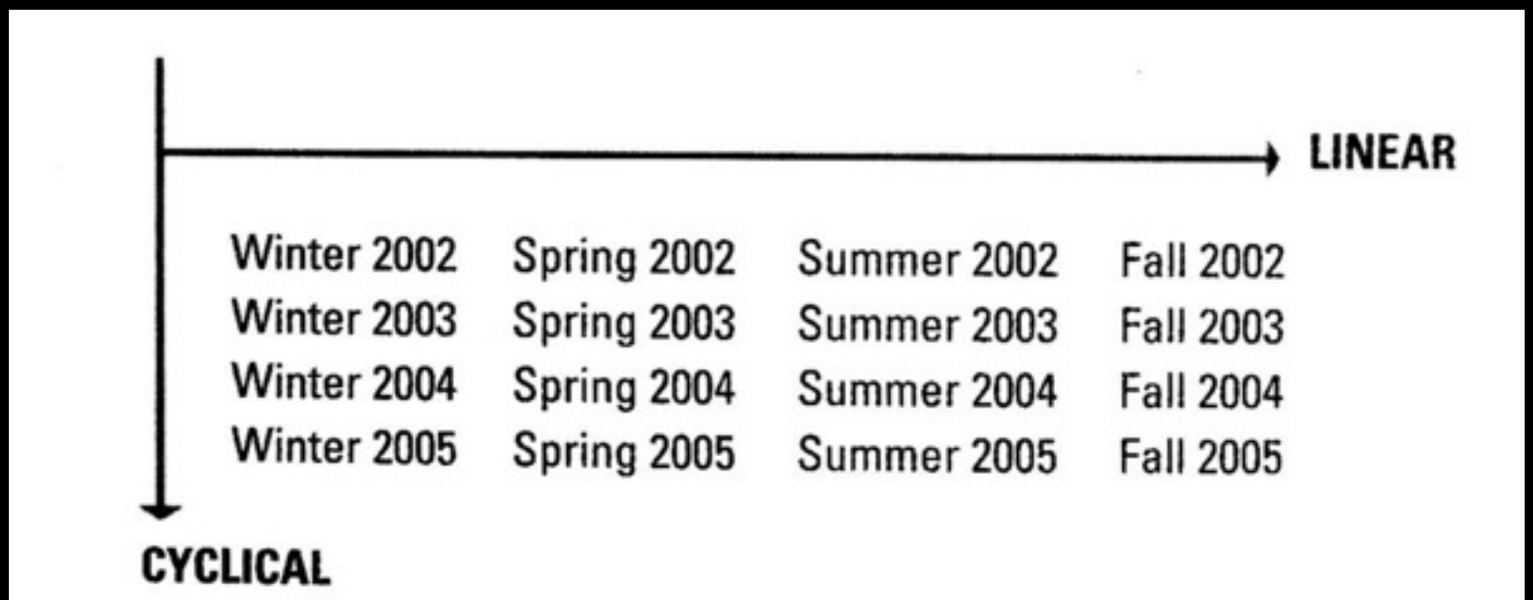
Actions and Events in Interval Temporal Logic, James F. Allen, George Ferguson, 1997



Design for Information – Isabel Meirelles

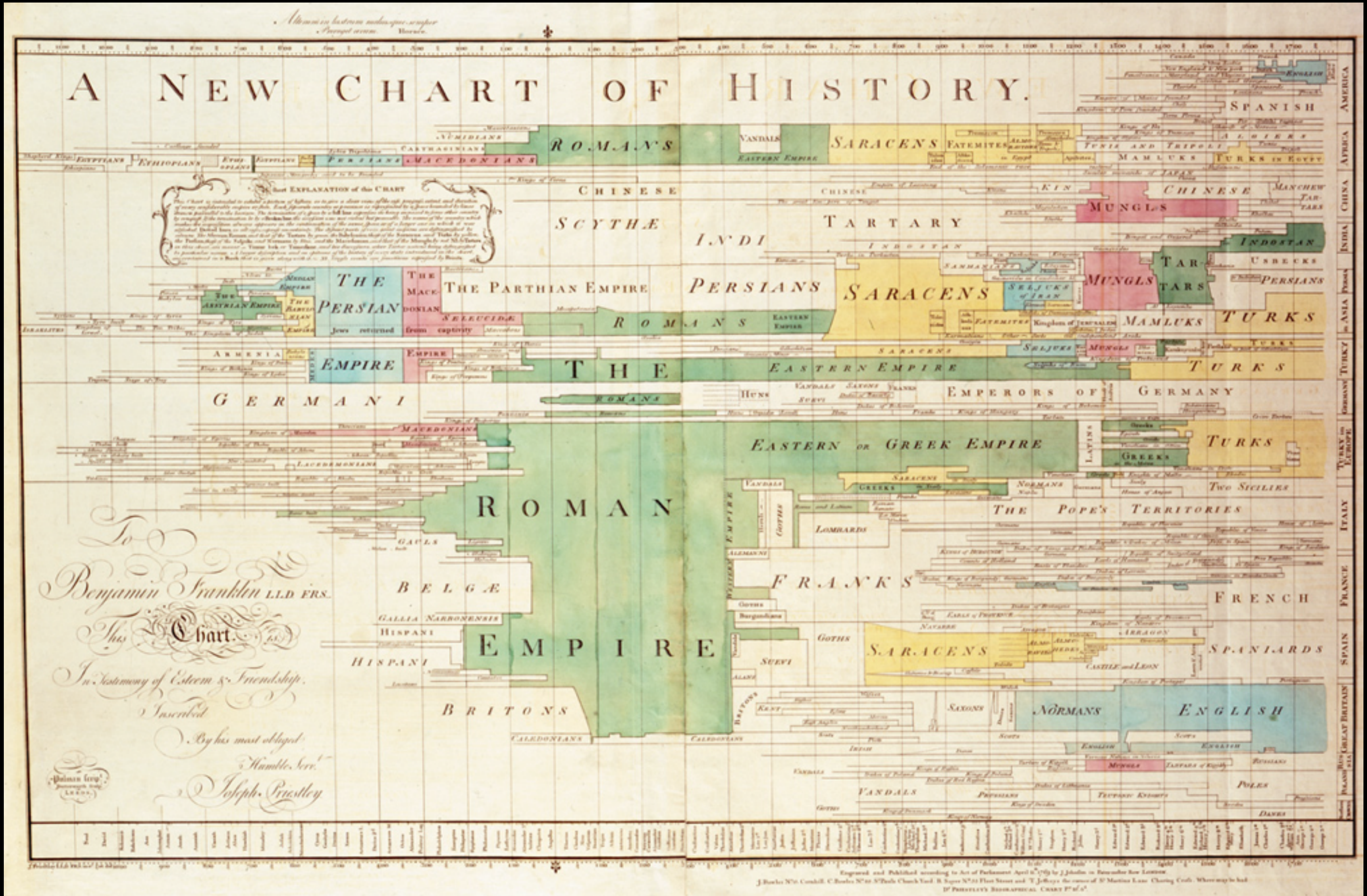


Design for Information – Isabel Meirelles



Design for Information – Isabel Meirelles

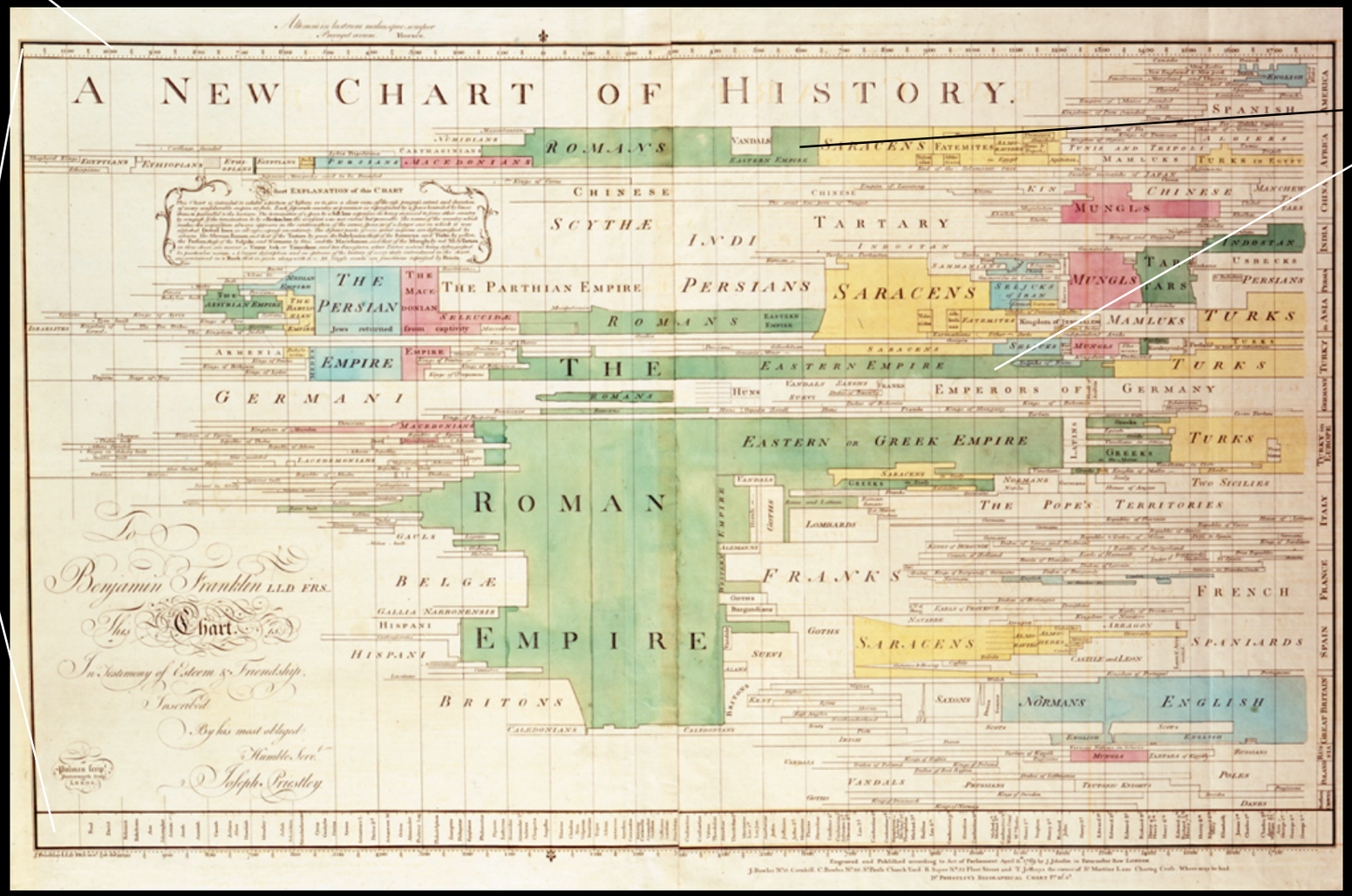
Timelines



Joseph Priestley's A New Chart of History (1769)

Timescale

Time Indicators

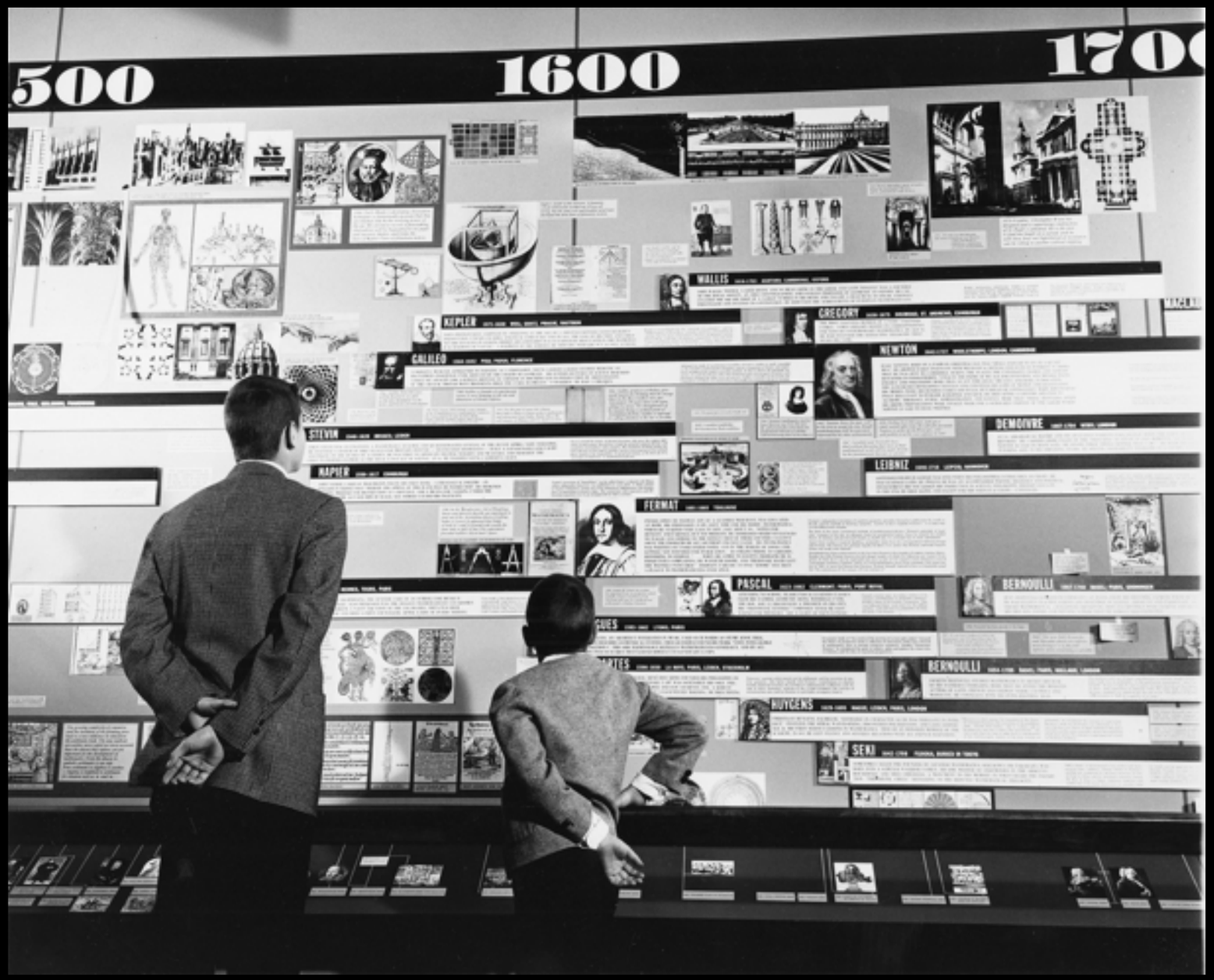


Color

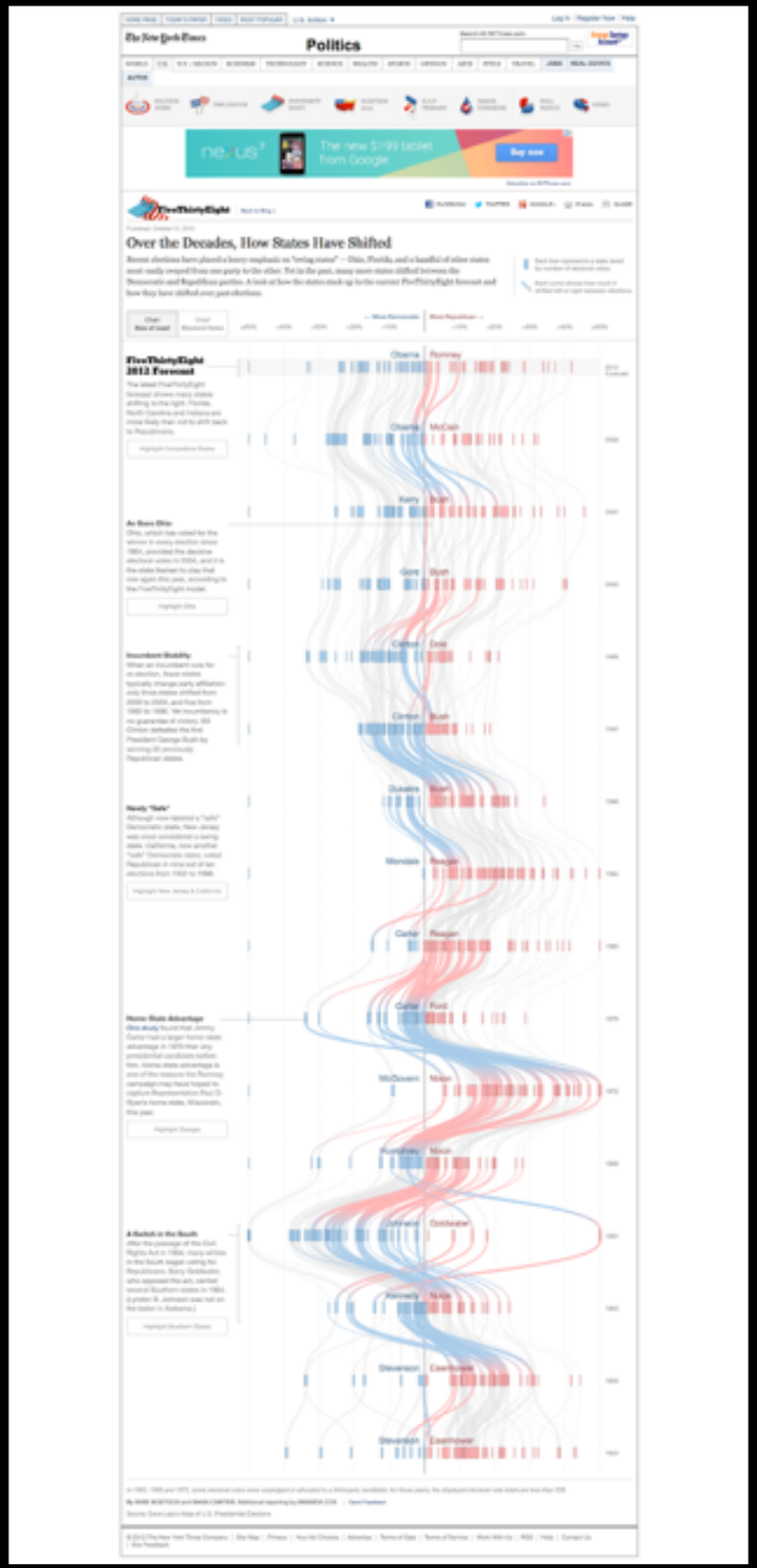
Thematic sections

Line indicators (length)

Joseph Priestley's A New Chart of History (1769)



Charles & Ray Eames, Minds of Modern Mathematics 1964

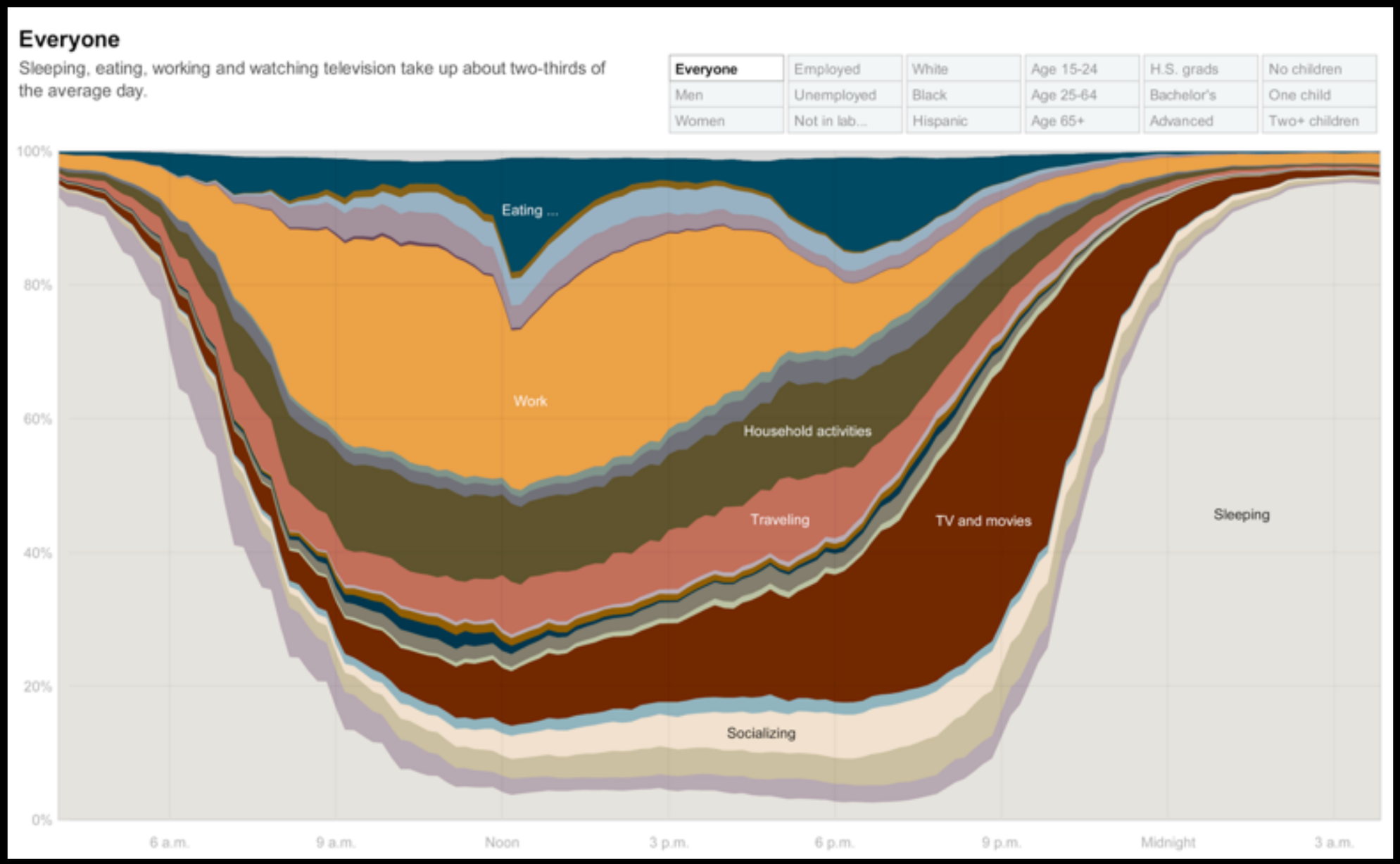


[Over the Decades](#) – NYT

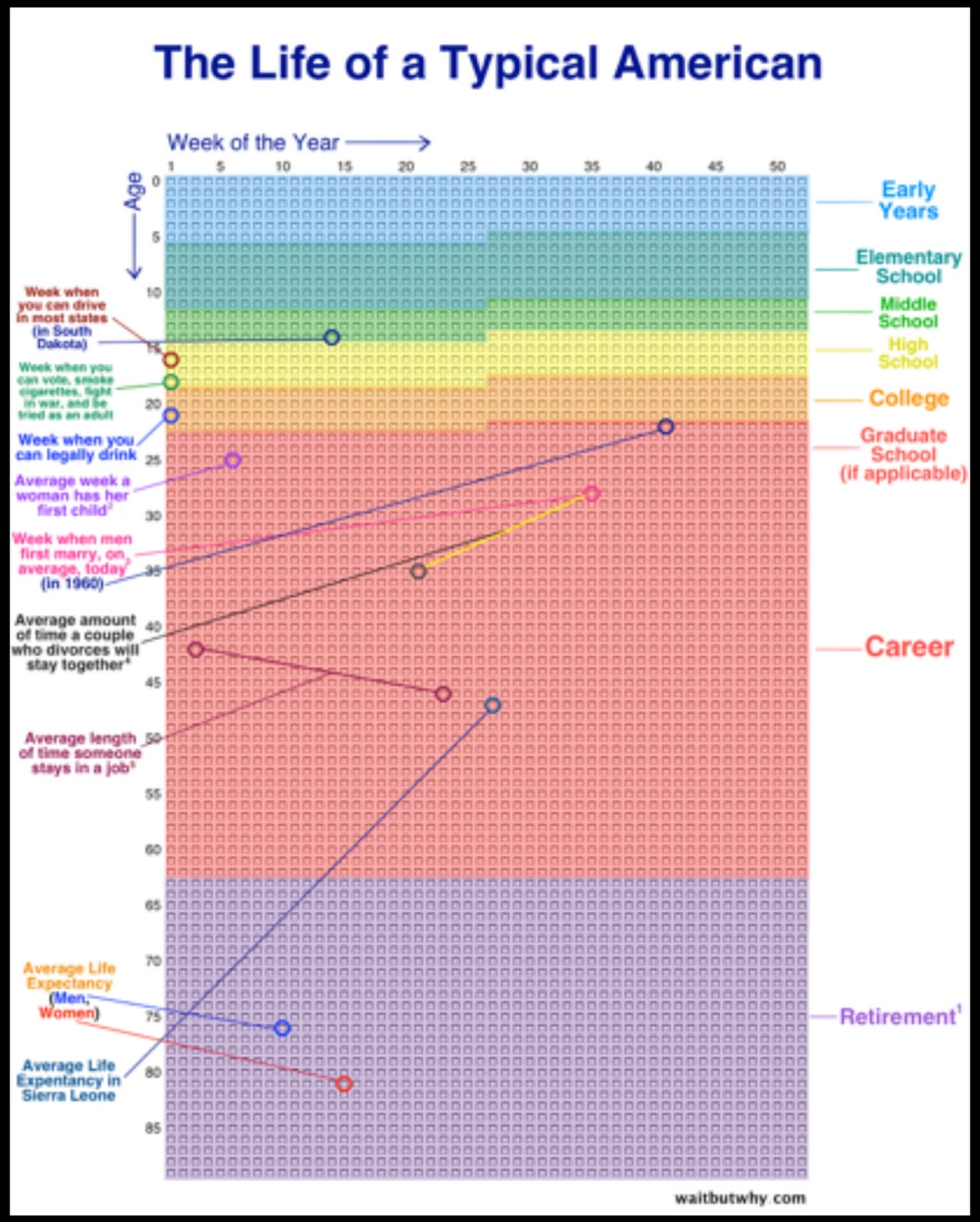
HERE IS THIS MONTH

- back | Okay +

[Here is Today]

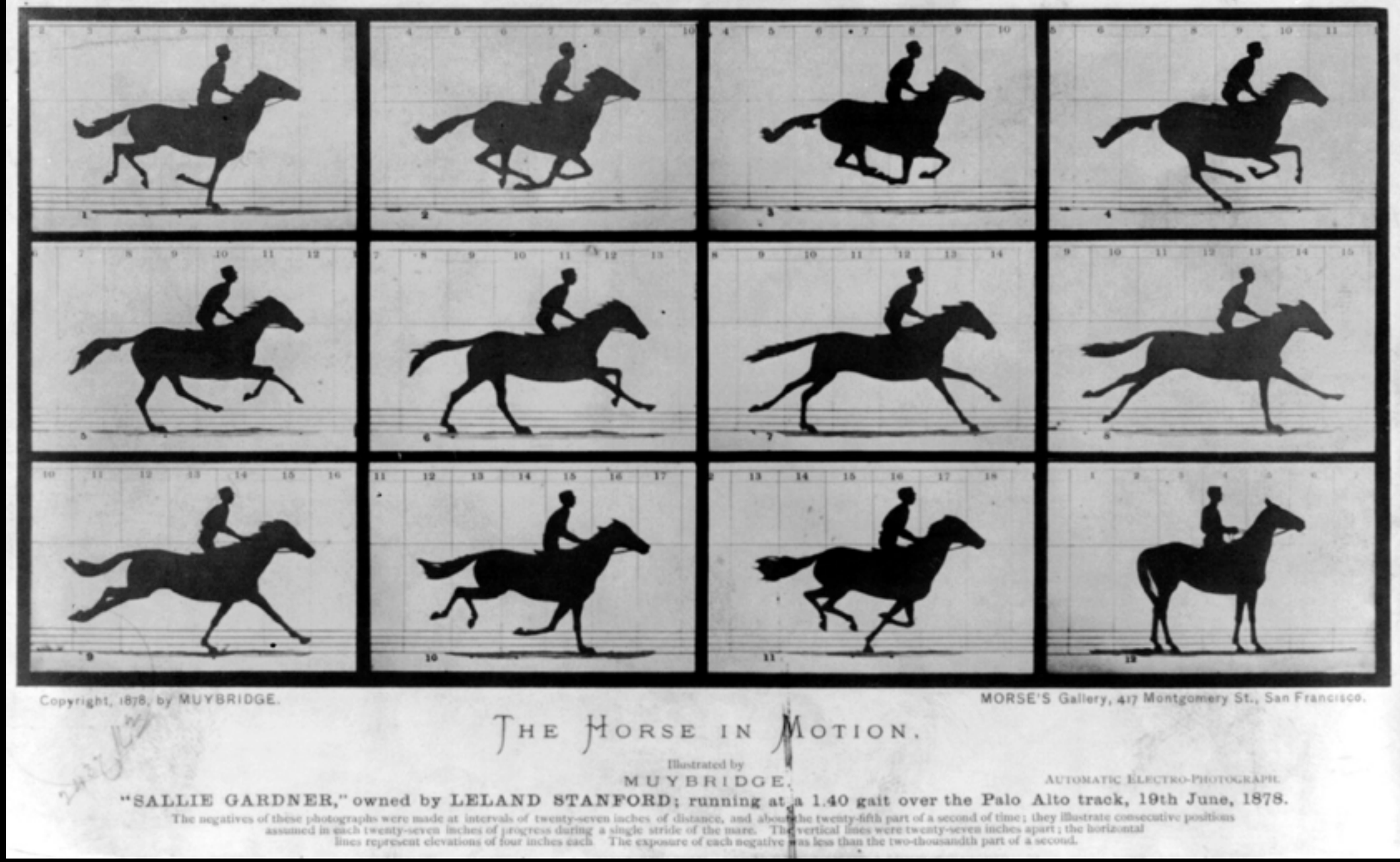


[How different groups spend their day](#) – **NYT**



[Life of a Typical American](#) - Wait But Why?

Snapshots



Copyright, 1878, by MUYBRIDGE. MORSE'S Gallery, 417 Montgomery St., San Francisco.

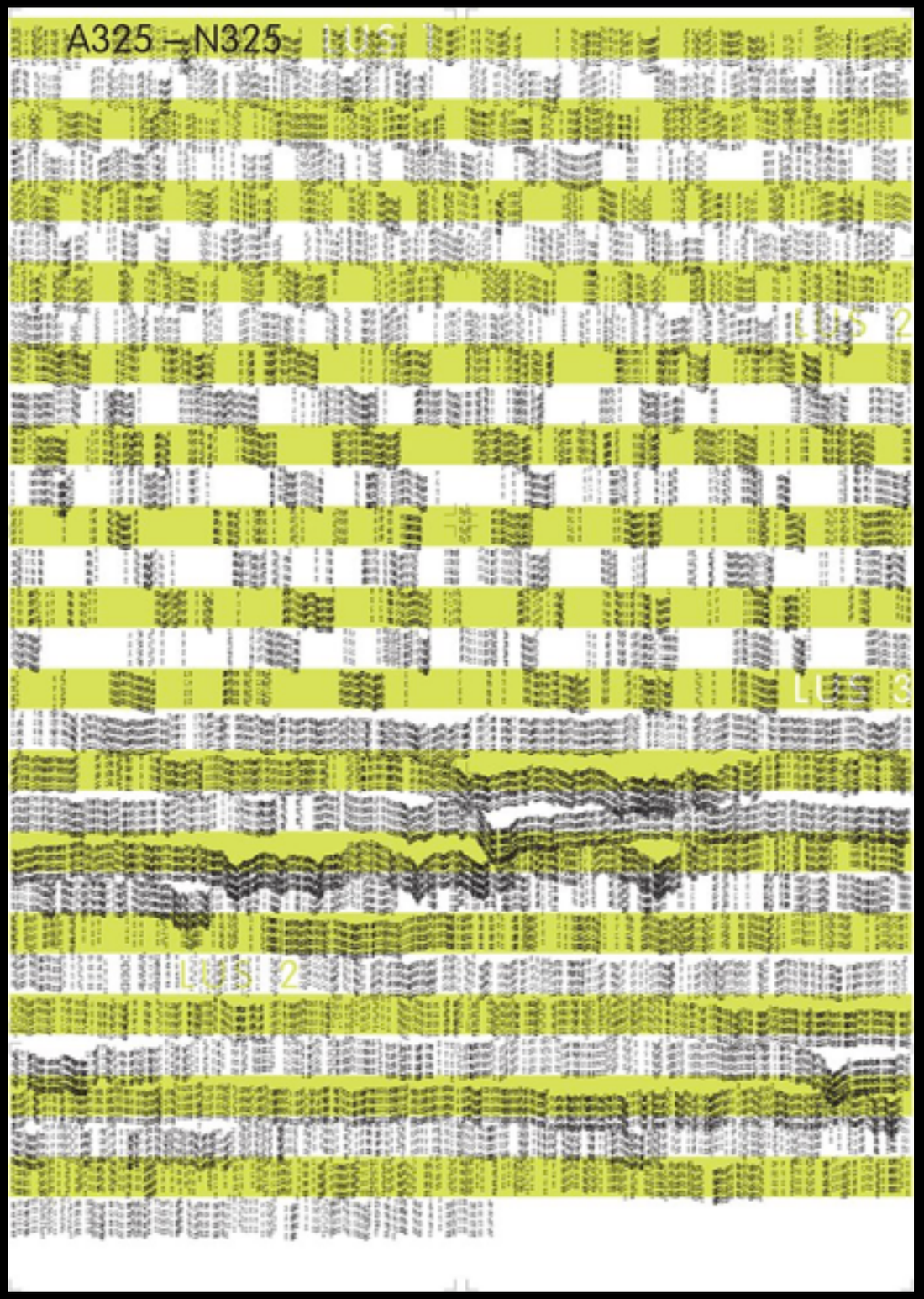
THE HORSE IN MOTION.

Illustrated by
MUYBRIDGE. AUTOMATIC ELECTRO-PHOTOGRAPH.

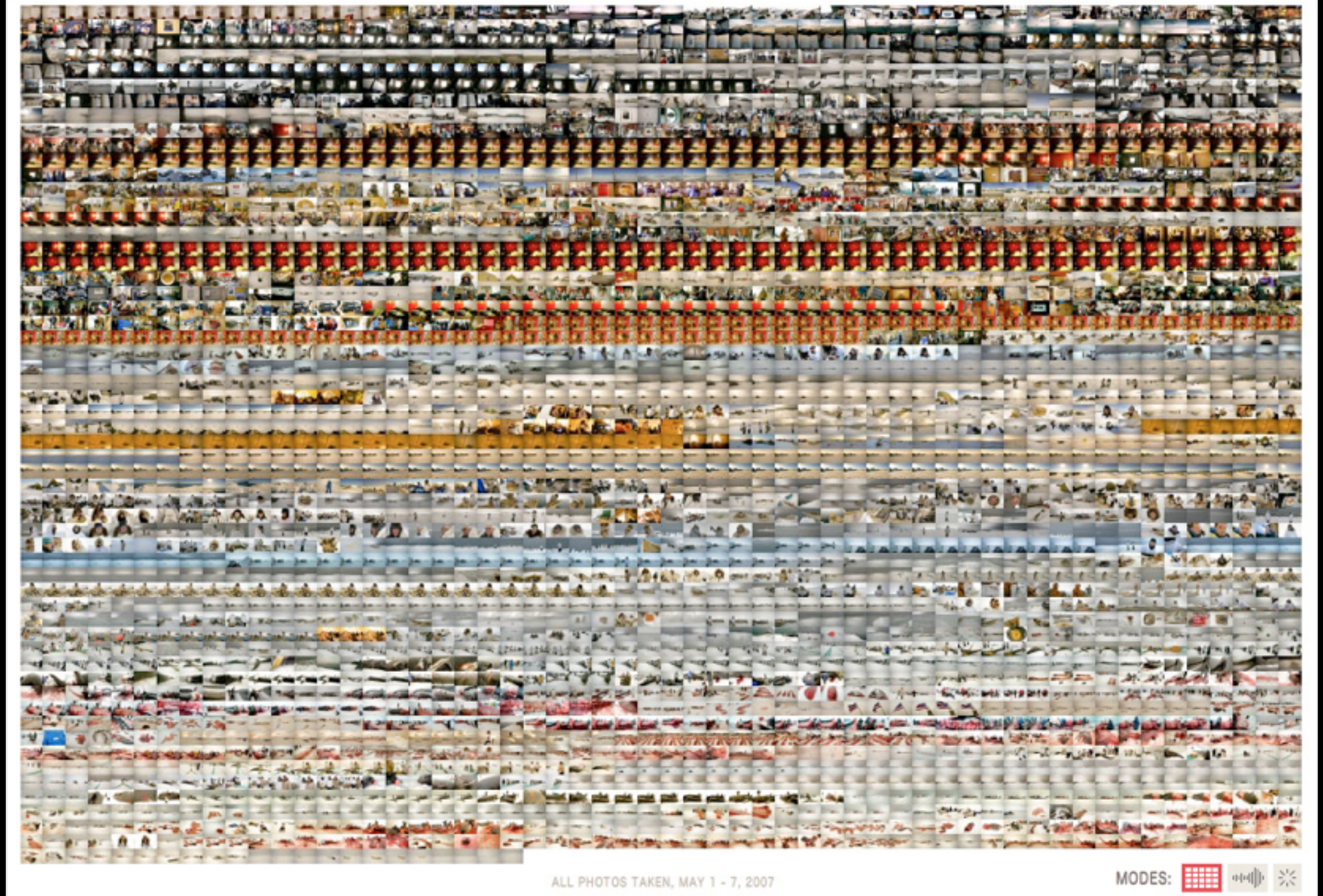
"SALLIE GARDNER," owned by LELAND STANFORD; running at a 1.40 gait over the Palo Alto track, 19th June, 1878.

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 in each twenty-seven inches of progress 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 exposure of each negative was less than the two-thousandth part of a second.

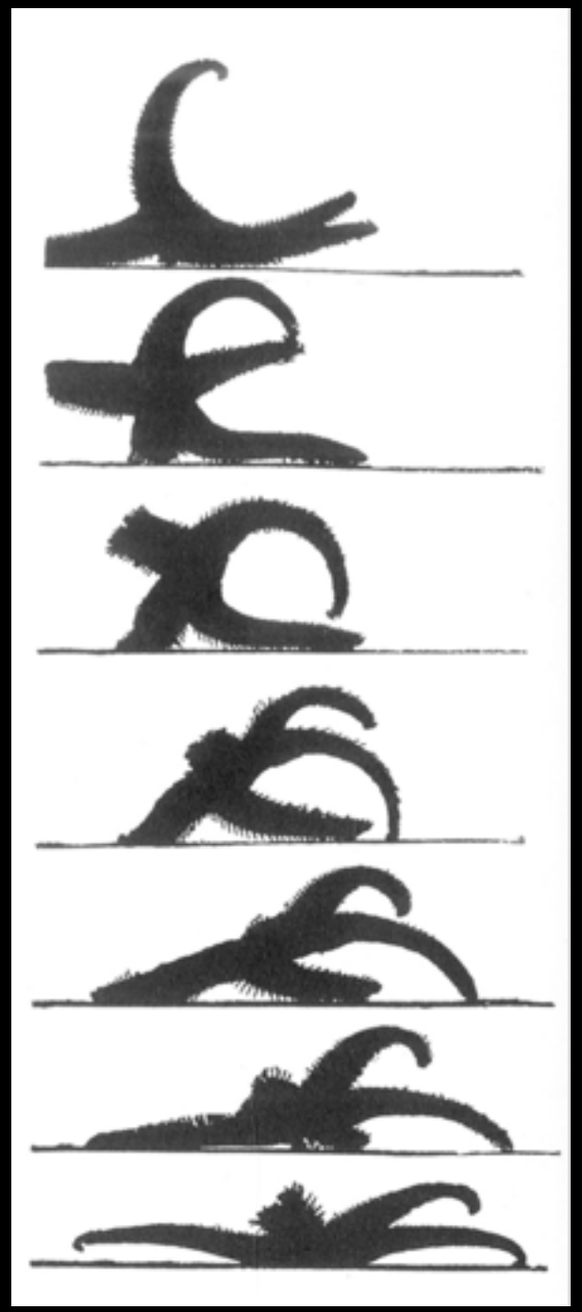
Muybridge, The Horse in Motion



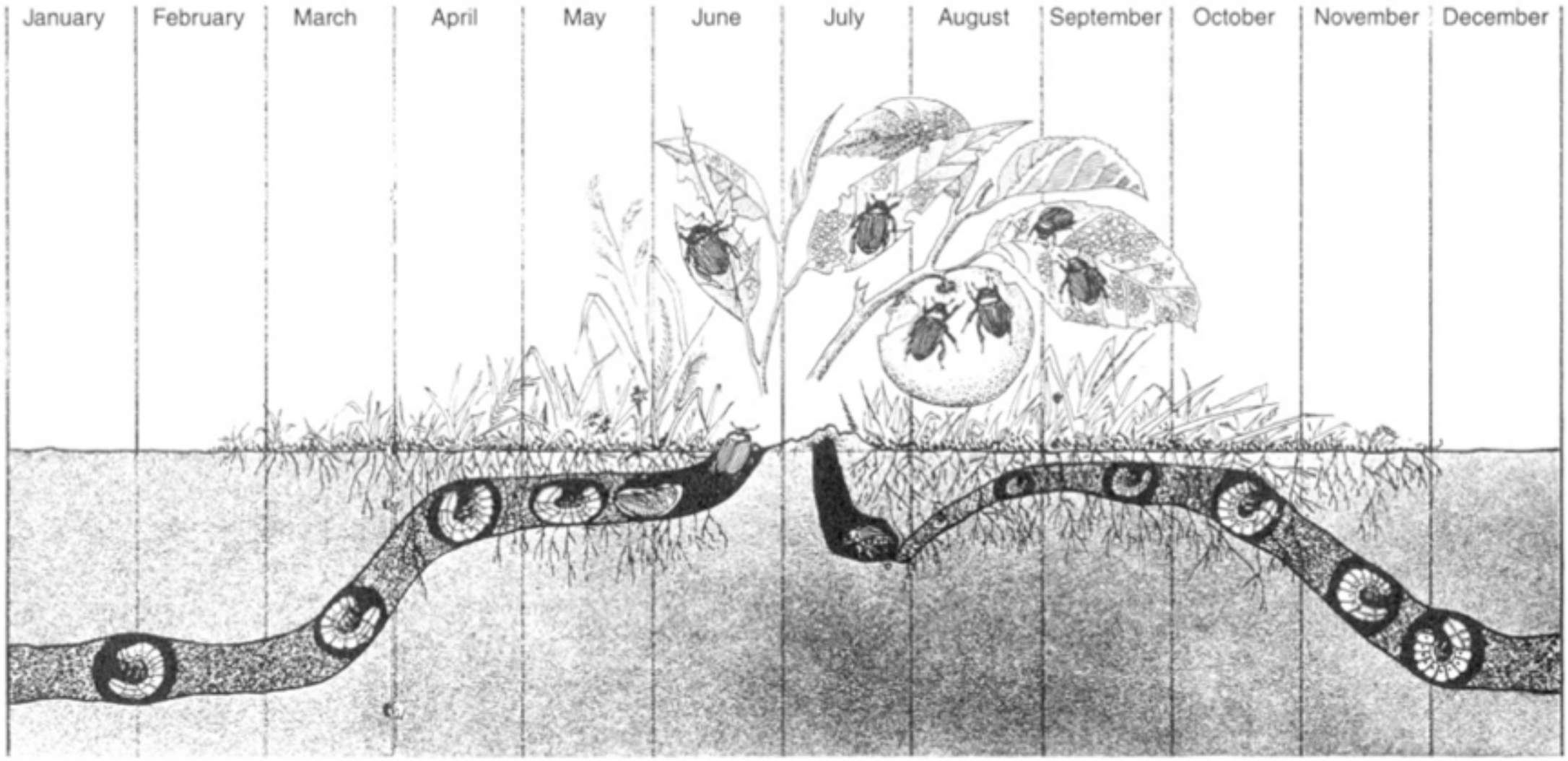
CatalogTree 2005. A325-N325: 10.000 cars passing a bridge
The time of passing-by, the speed and the distance between two cars.



[The Whale Hunt](#) – Jonathan Harris

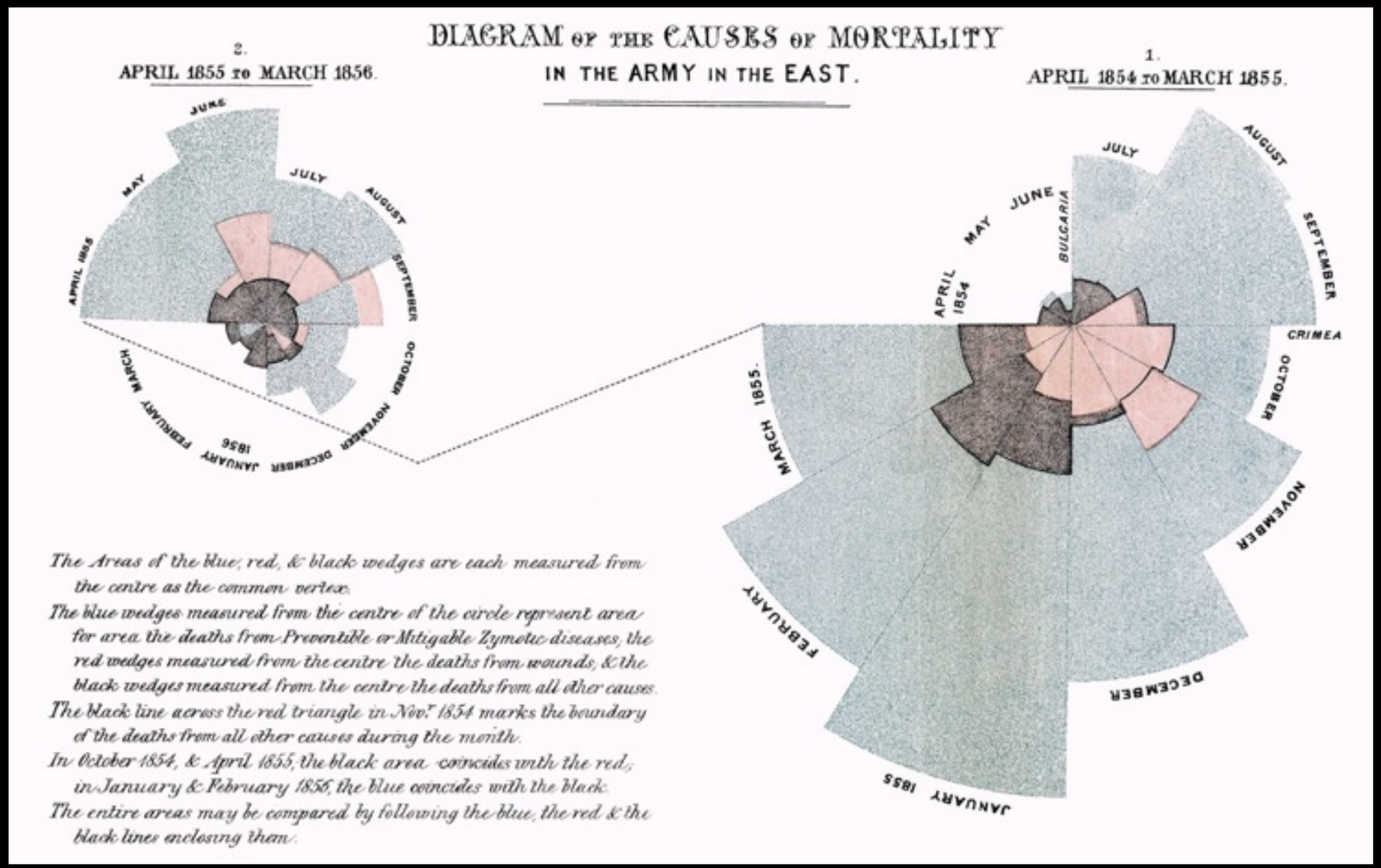


Turning over of a Starfish Étienne-Jules Marey, Mouvement (1895)

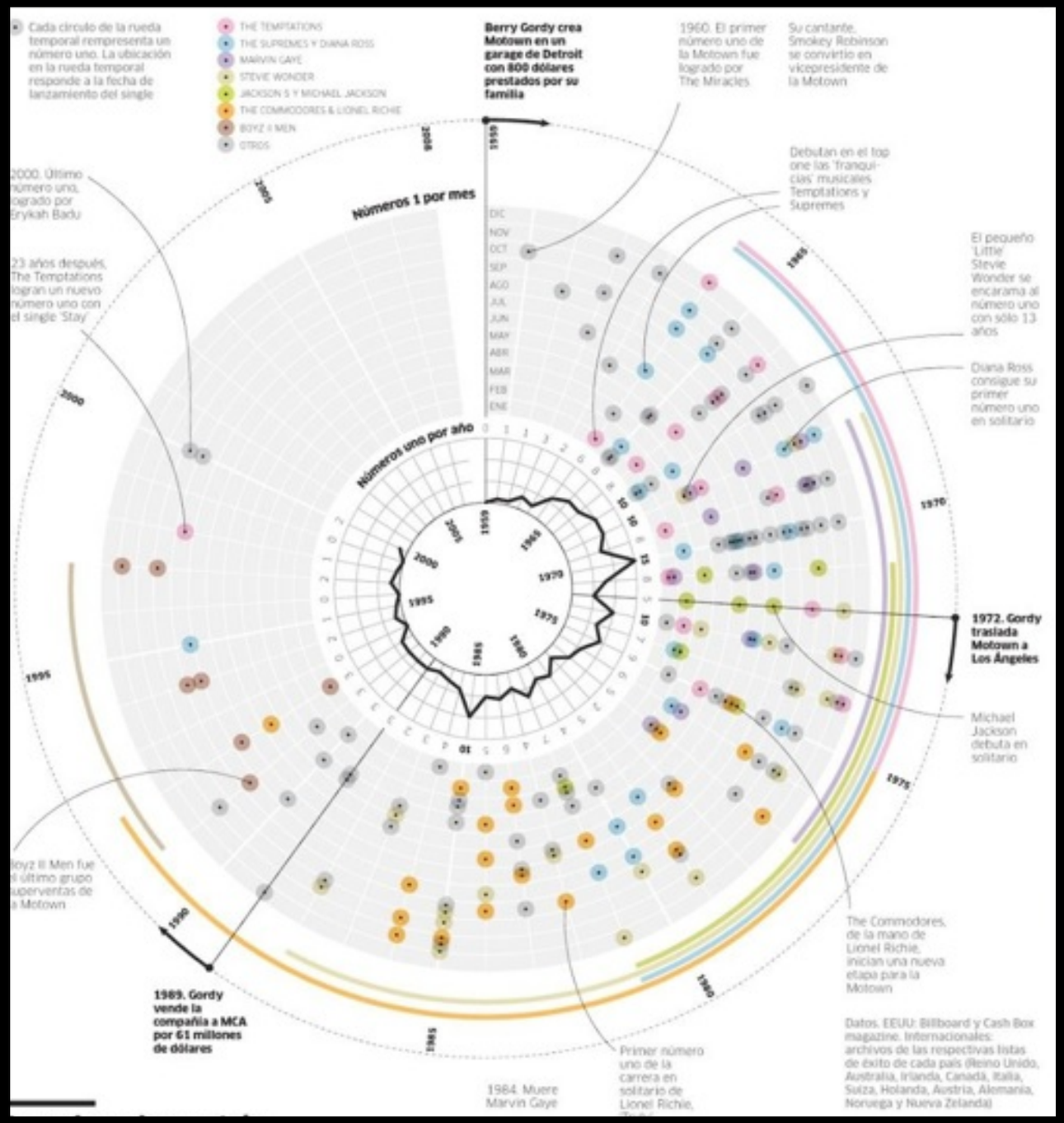


Year-long life cycle of Popillia japonica Newman L. Hugh Newman, Man and Insects (1965)

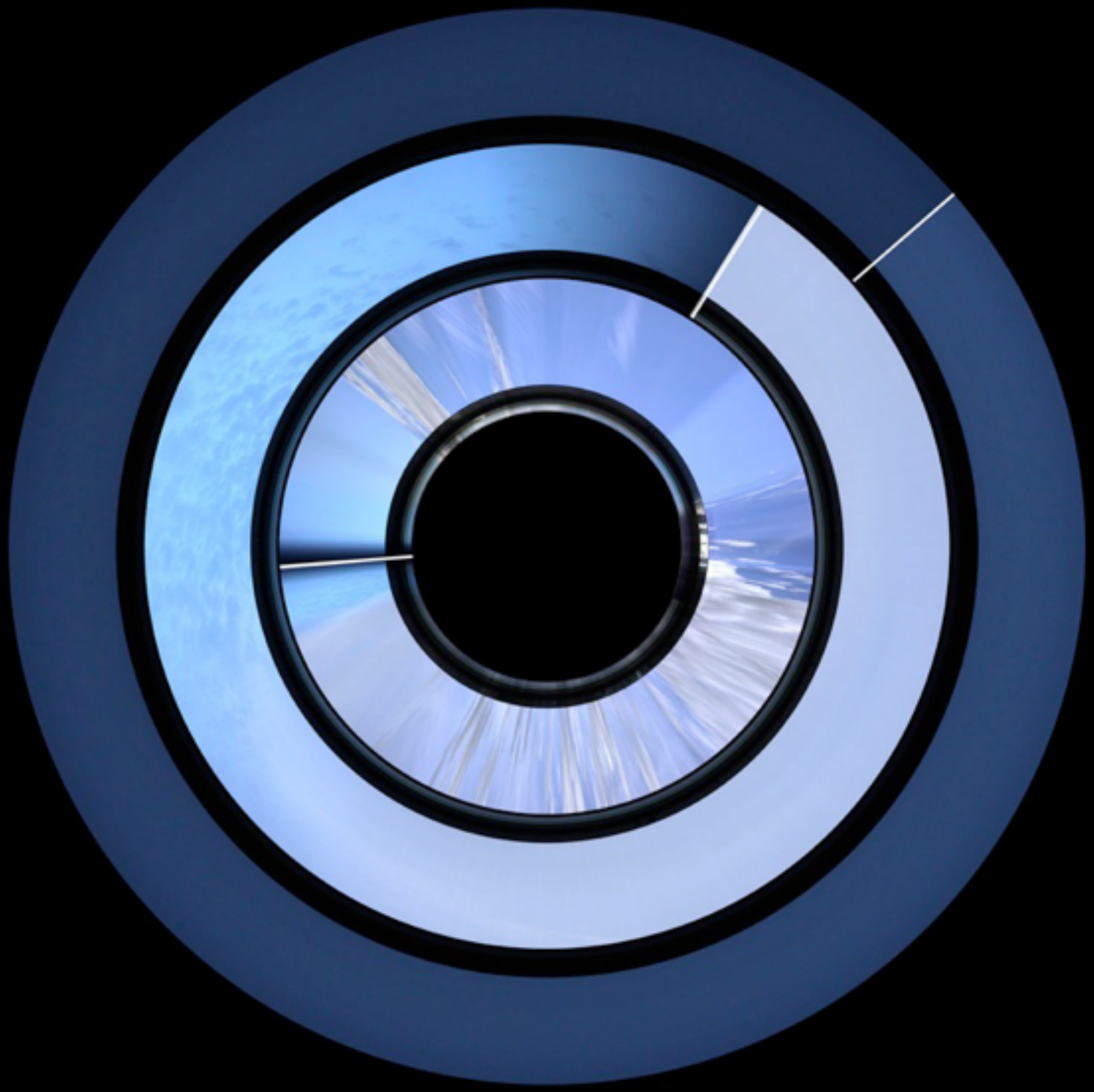
Cycles



"Diagram of the causes of mortality in the army in the East" by Florence Nightingale (Wikipedia)



Motown 191 Number One Hits. Publico Newspaper, 2008, Spain



[Last Clock](#) - New Mediology