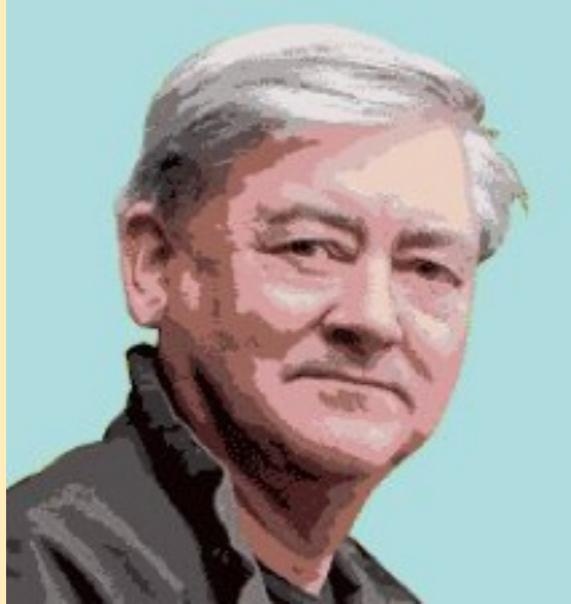


The

Grammar *of* Graphics

with Conrad Taylor

ISKO UK seminar on 'The Shape of Knowledge' at the London College of Communication, 4 September 2012



Conrad Taylor

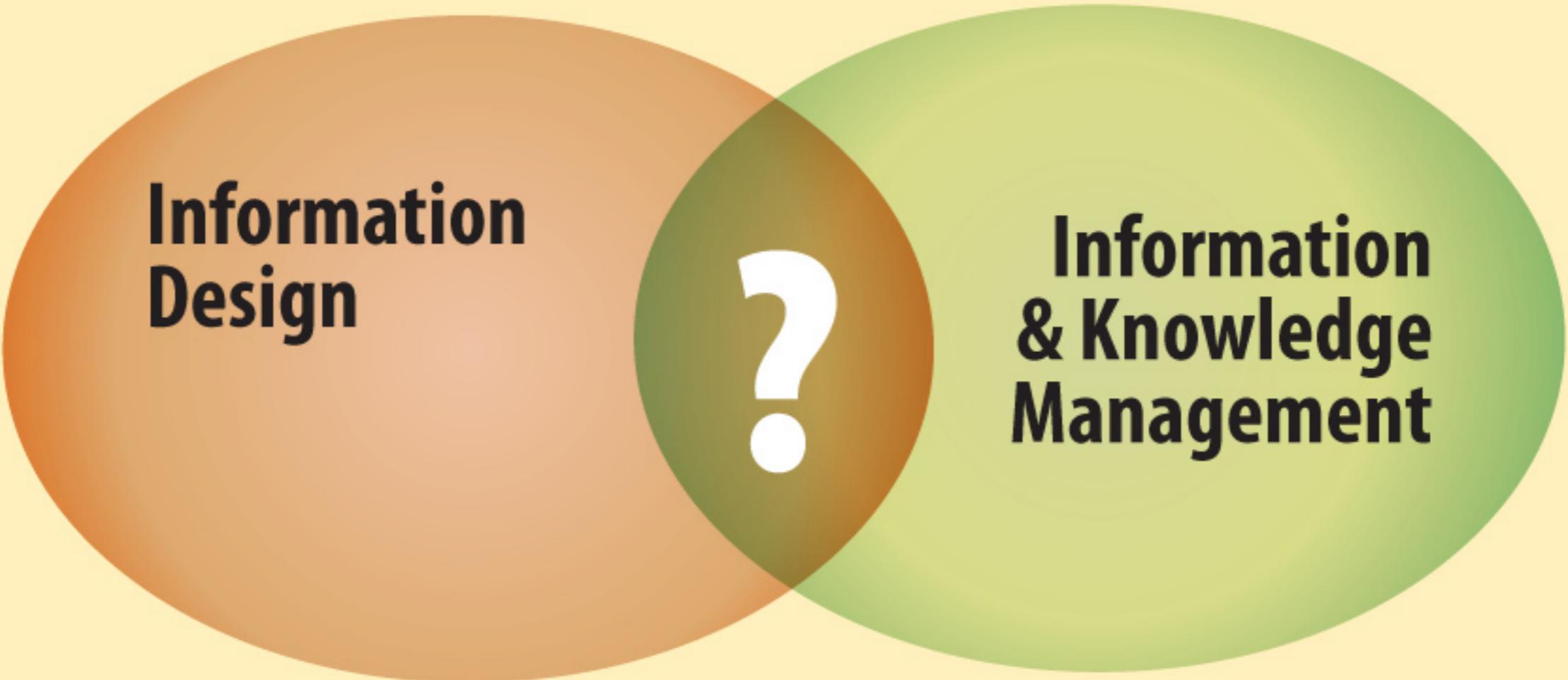
www.conradiator.com

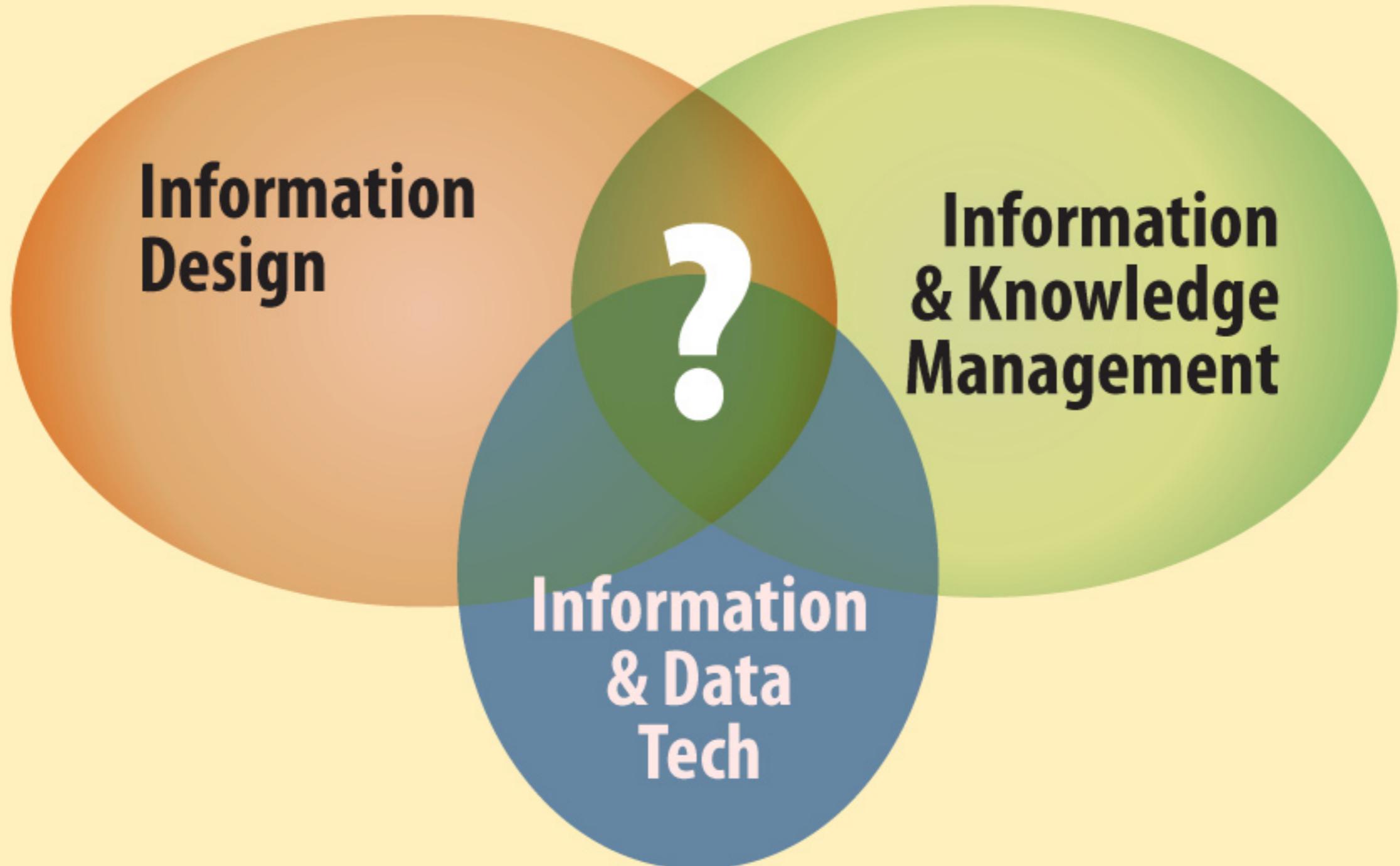
conradtaylorbcs@gmail.com

Information Design



Information Design Journal, from 1980s on...

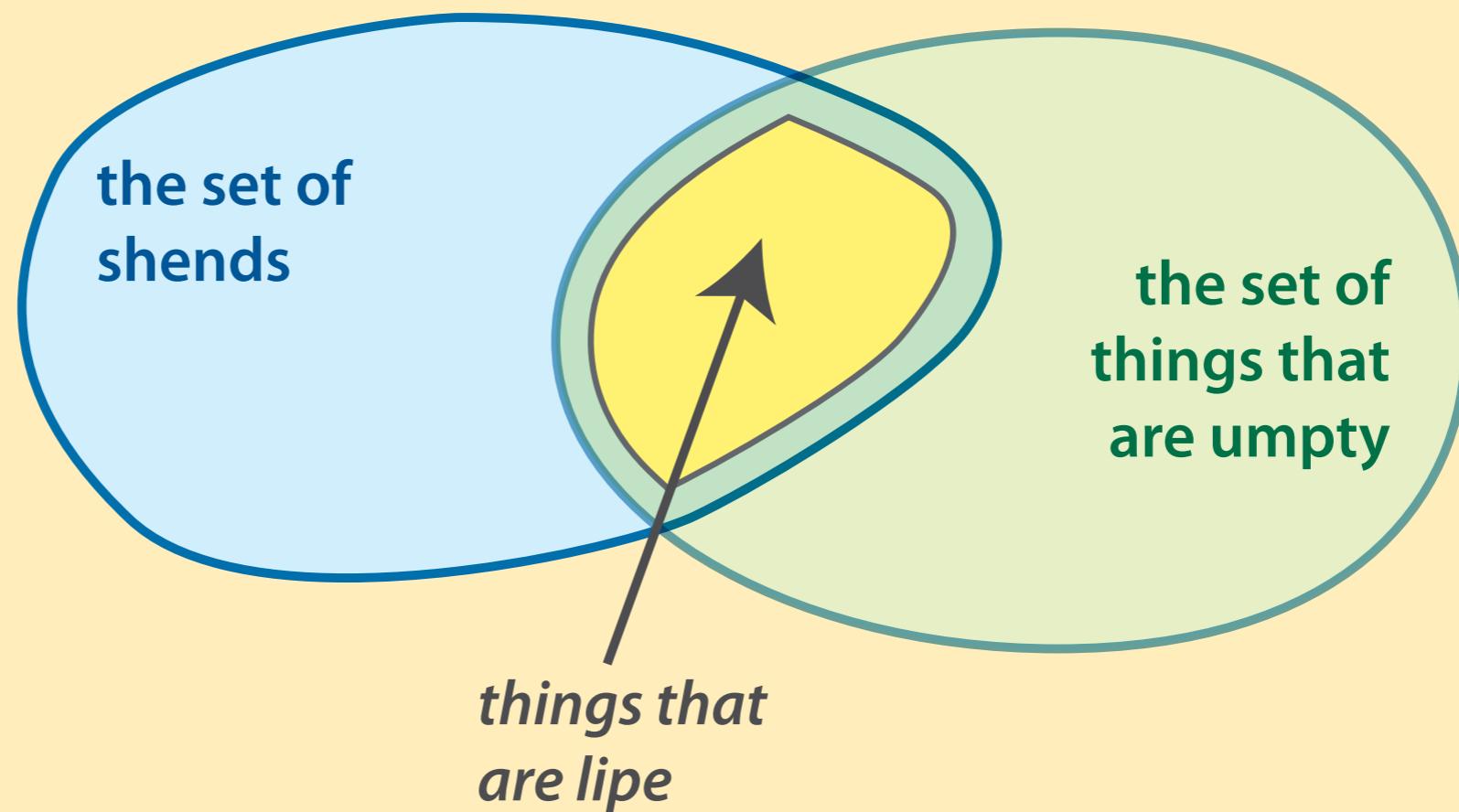




Memories of the New Maths, Scotland, 1960s...

'All lipe shends are umpty'

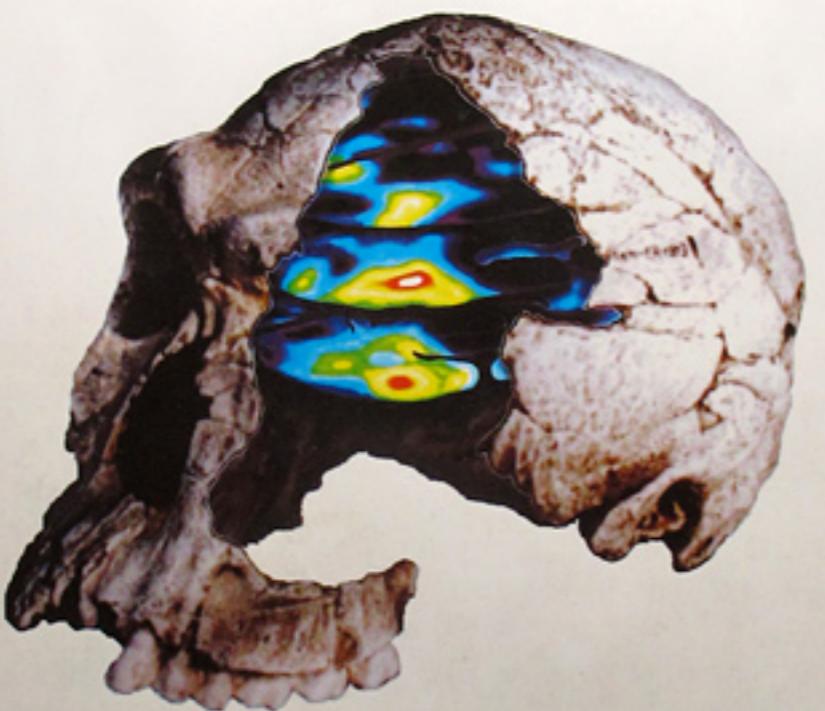
*Draw a
Venn Diagram
in which the
above statement
is true*



the shape
of knowledge

Visual intelligence

Images via Wikipedia Commons: Wegmann (bushbaby), Nobu Tamura (Dienonychus, FireFly5 (Cuttlefish), Mpinedag ('Lucy')



THE SYMBOLIC SPECIES

*The co-evolution
of language and
the human brain*

TERRENCE DEACON



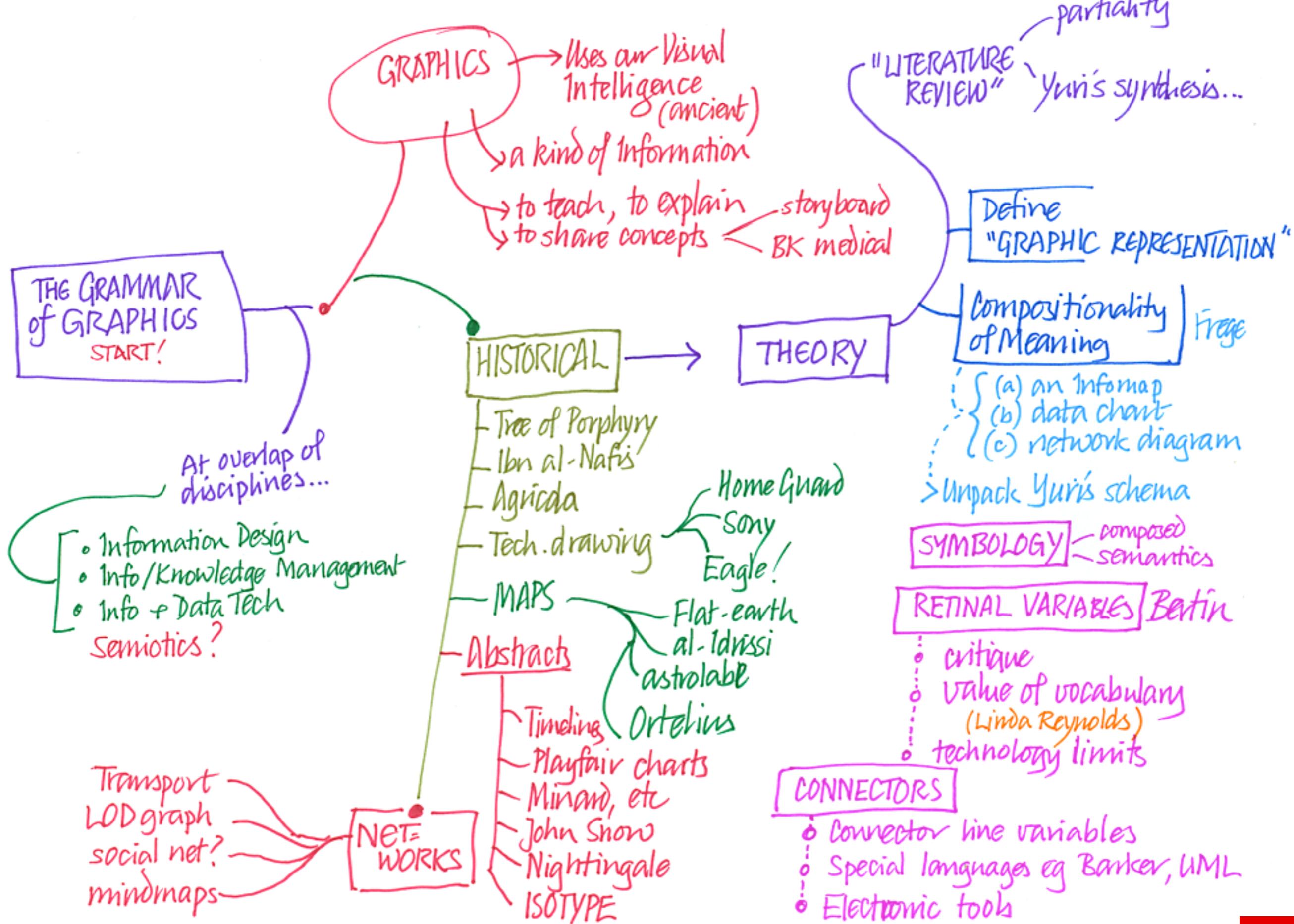
Graphic Representations

of Data and Knowledge

**a form of
information**

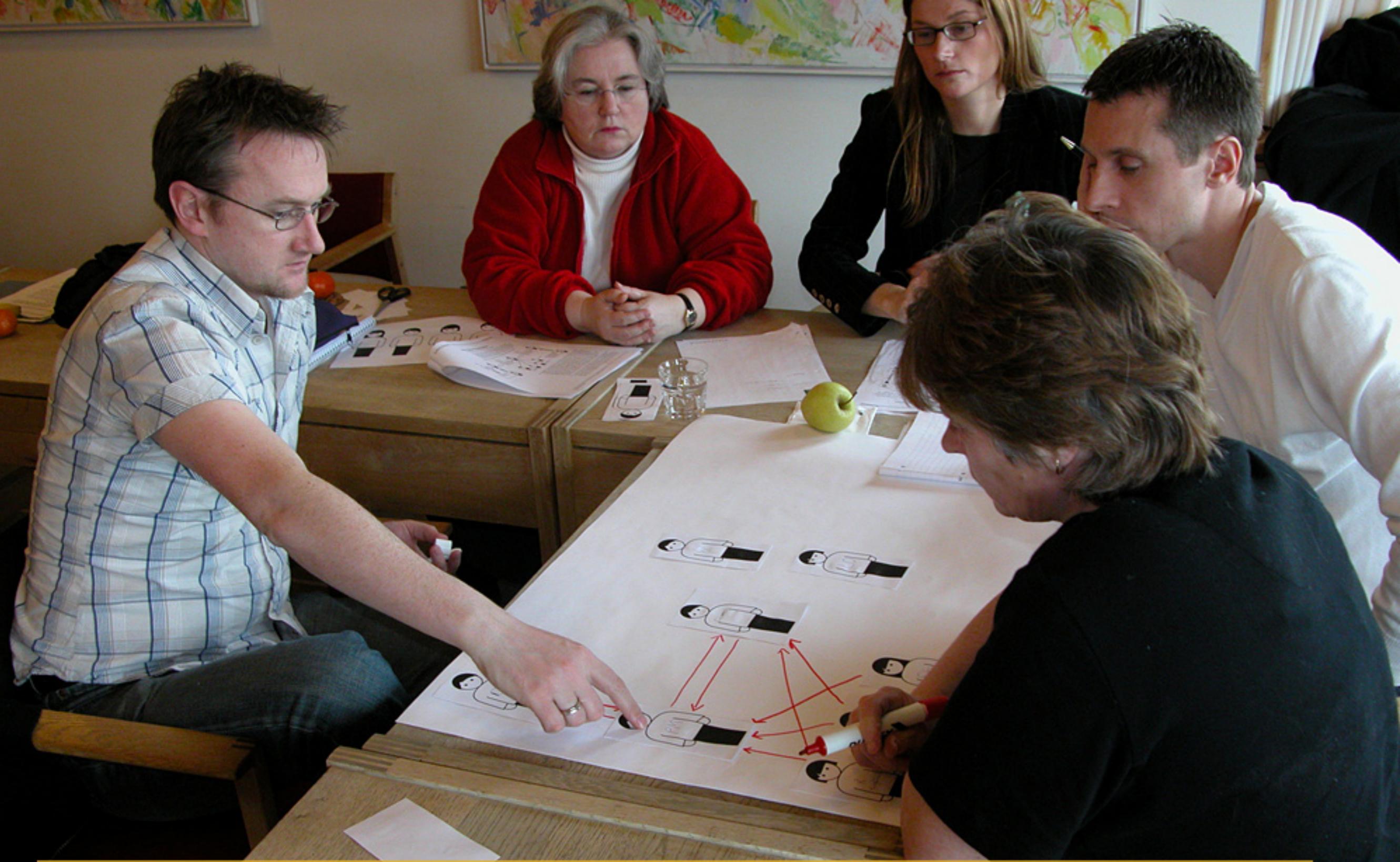


Teaching about heart disease

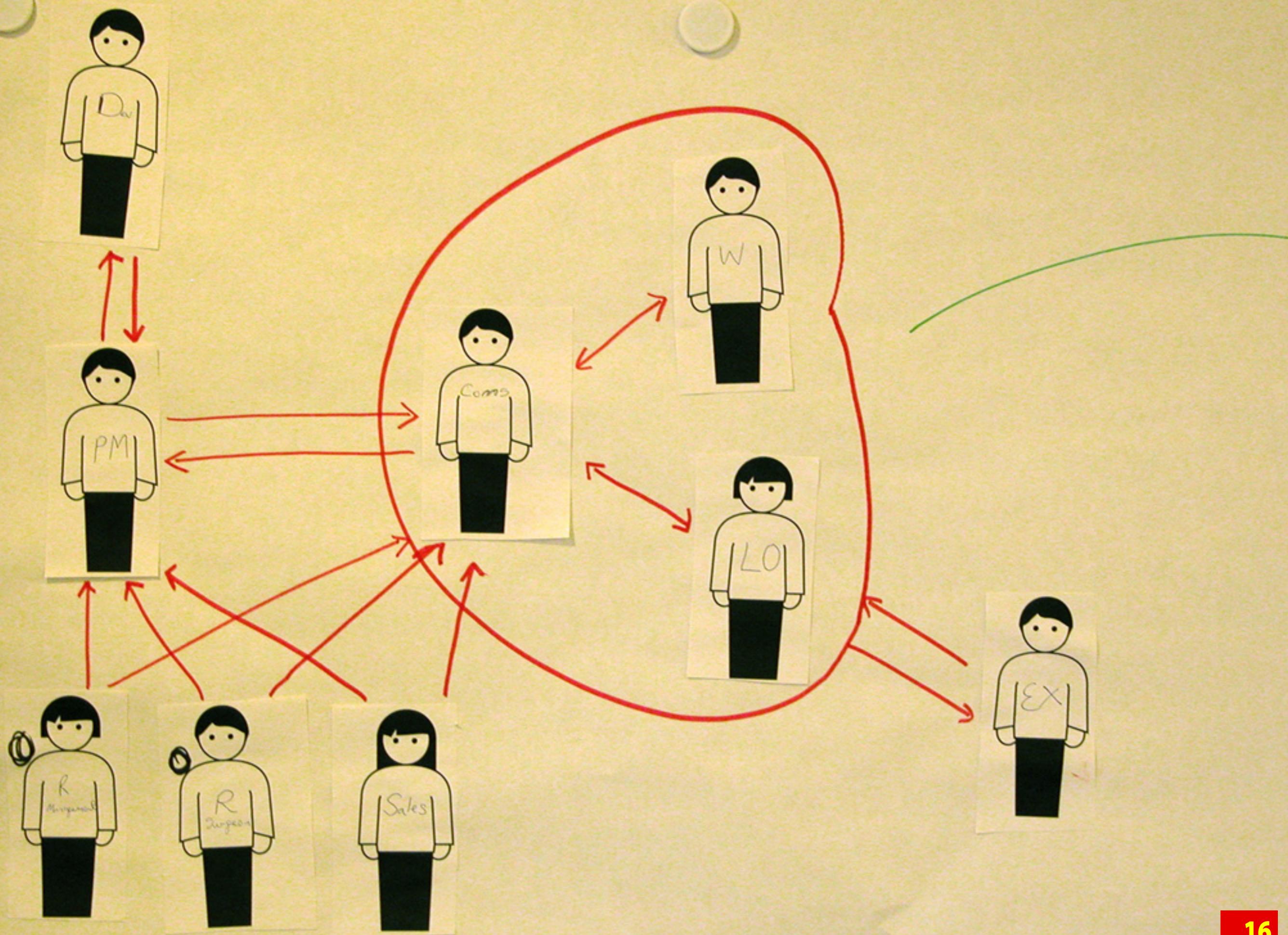


Storyboarding Web interaction





Technical sales brochure design workshop, BK Medical, Denmark 2005
Modelling the production workflow between departments





REGENERATED FREIREAN LITERACY
THROUGH EMPOWERING COMMUNITY TECHNIQUES

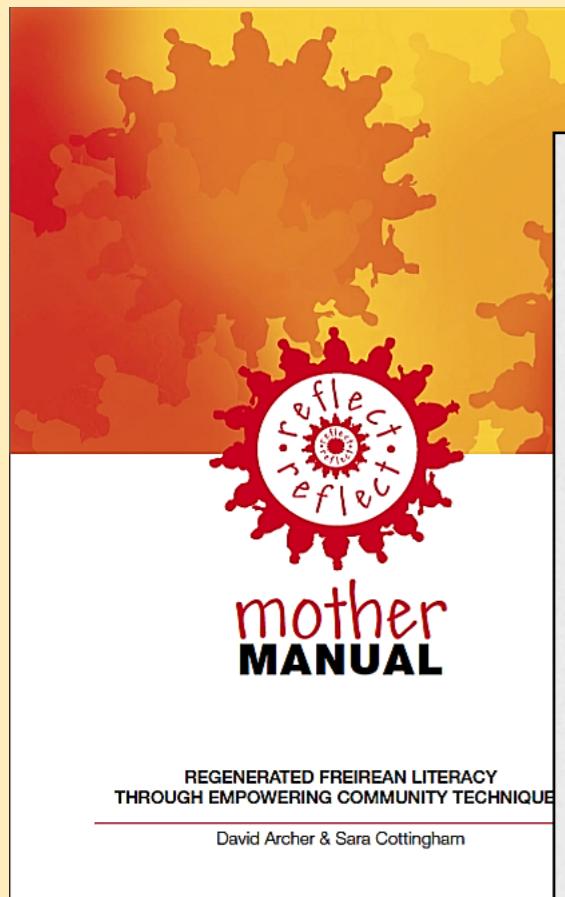
David Archer & Sara Cottingham

ACTION-REFLECT:

**Based on Participatory
Rural Assessment...**

**'Lines in the Dust'
with found-object
markers...**

**a Freireian approach to
promoting literacy with
empowerment.**



Lines in the Dust - Ghana

JOURNEYMAN PICTURES [Subscribe](#) 4,574 videos

03:36 / 25:09

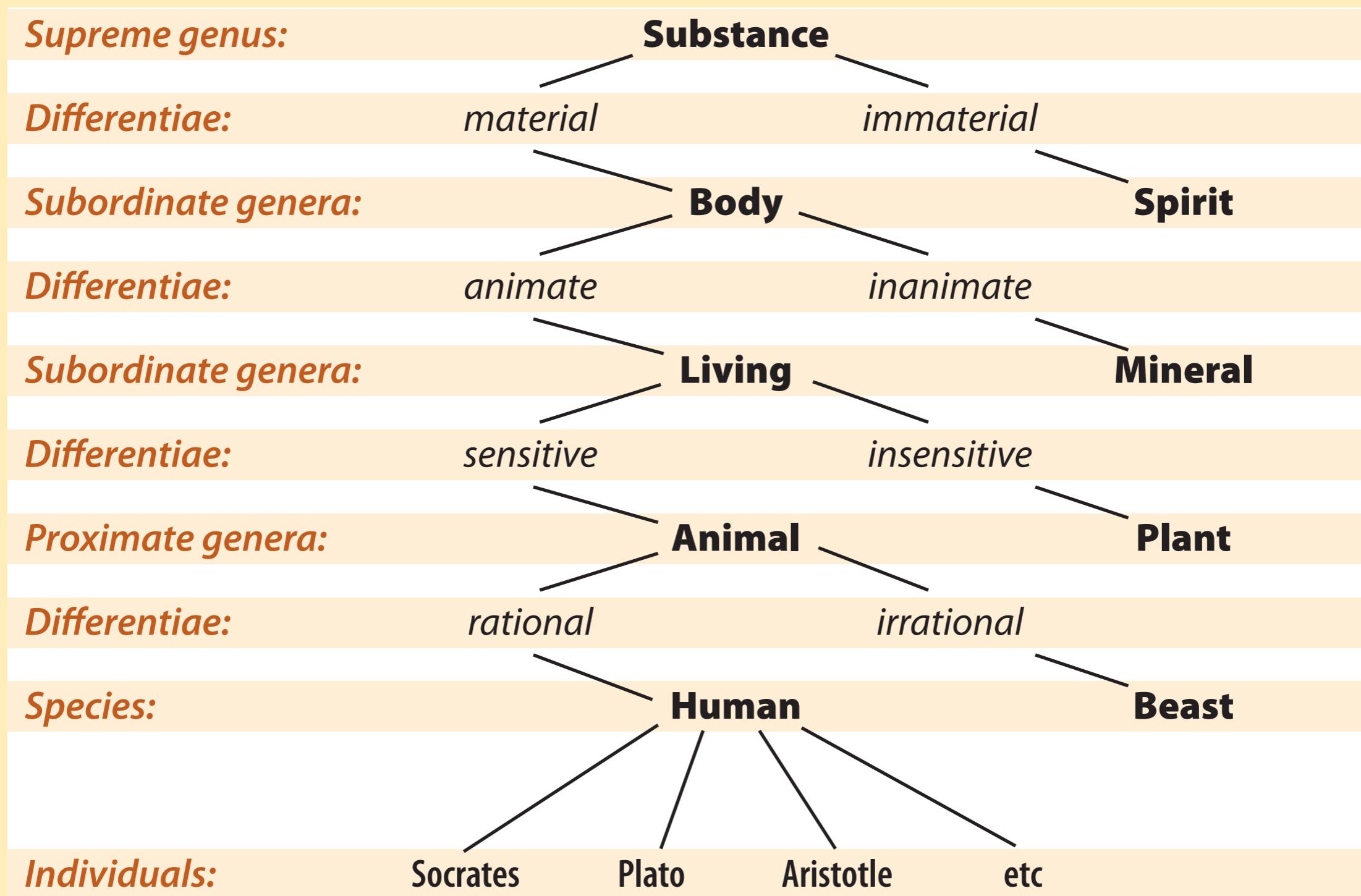
Like [Share](#) 10,388

www.youtube.com/watch?v=F5xzpuydxjA

www.youtube.com/watch?v=F5xzpuydxjA

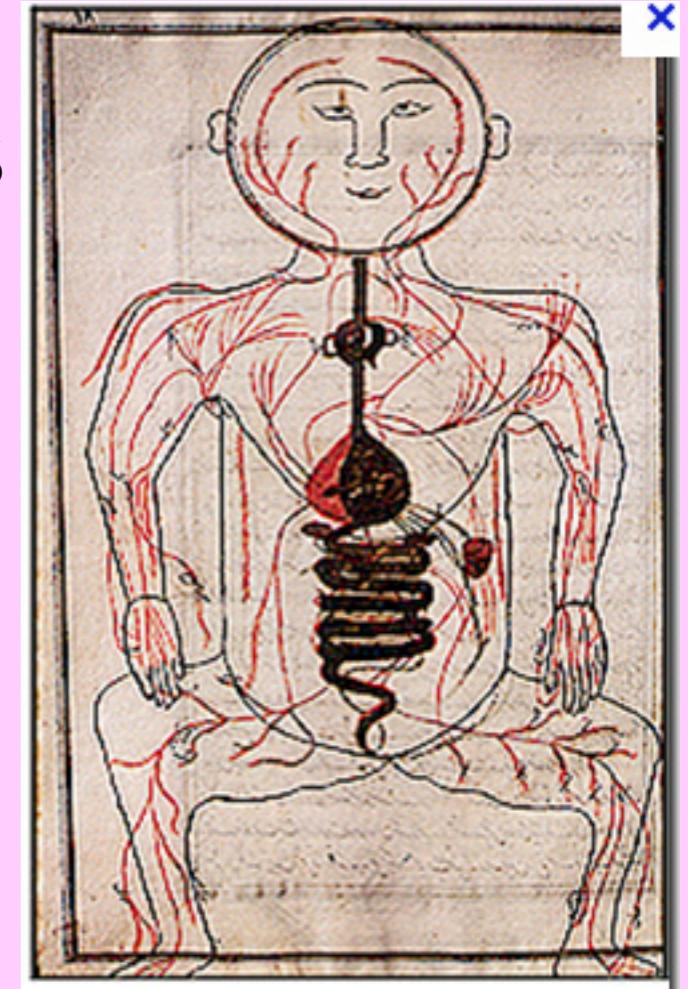
graphic representations and visualisations: a flying history

Porphyry: diagramming ontology

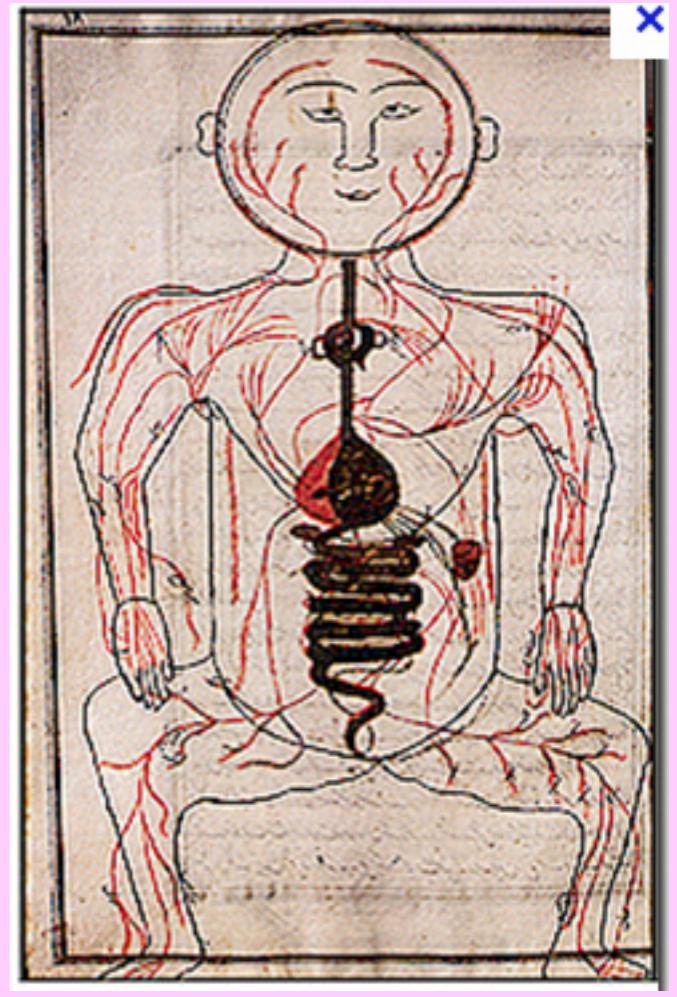


Ibn al-Nafis

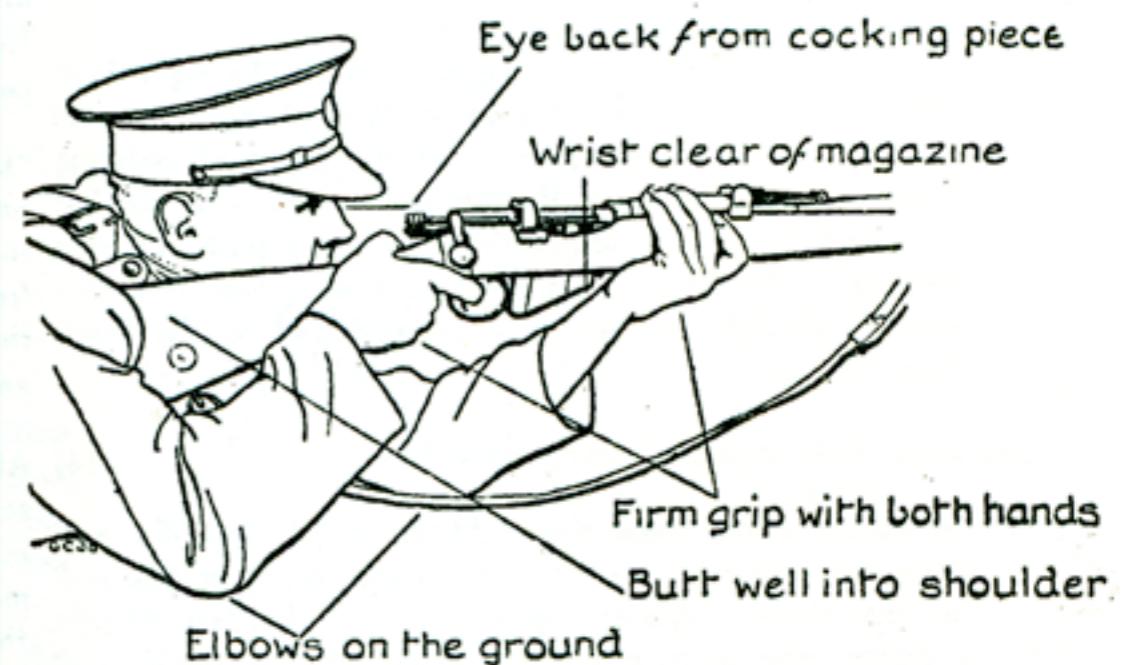
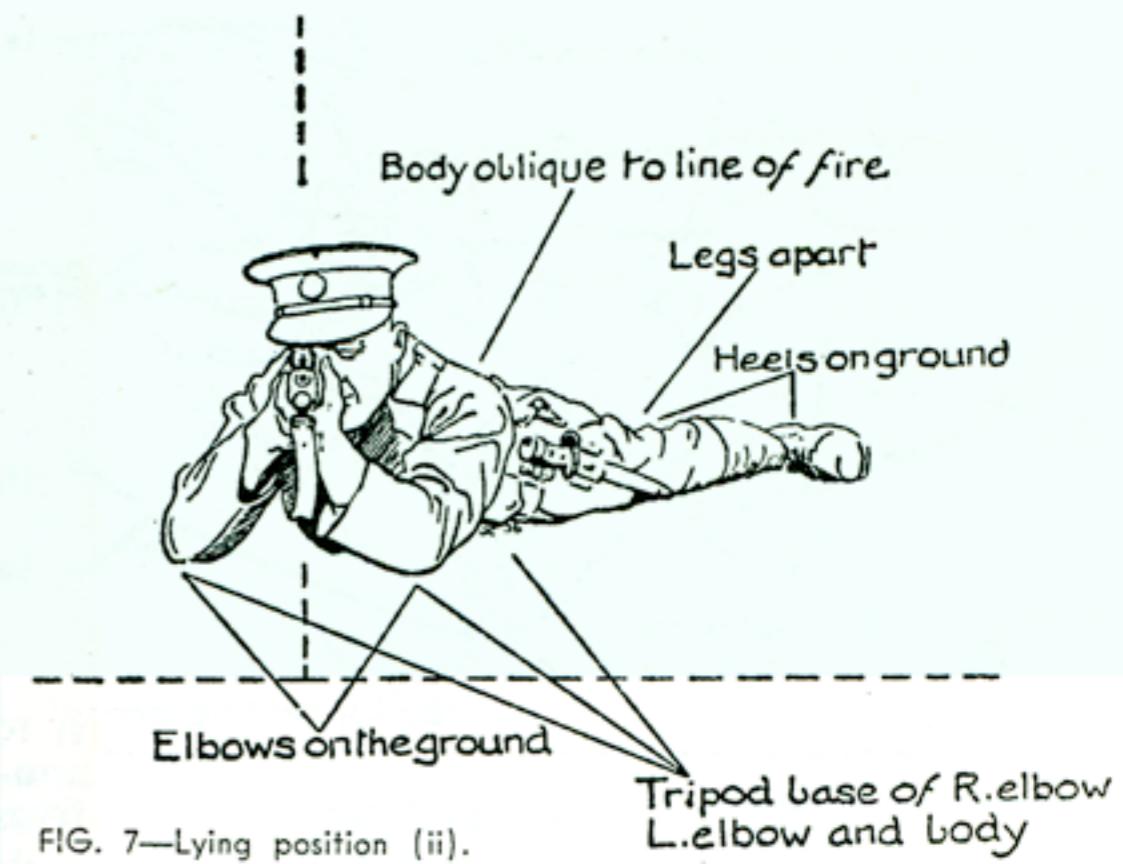
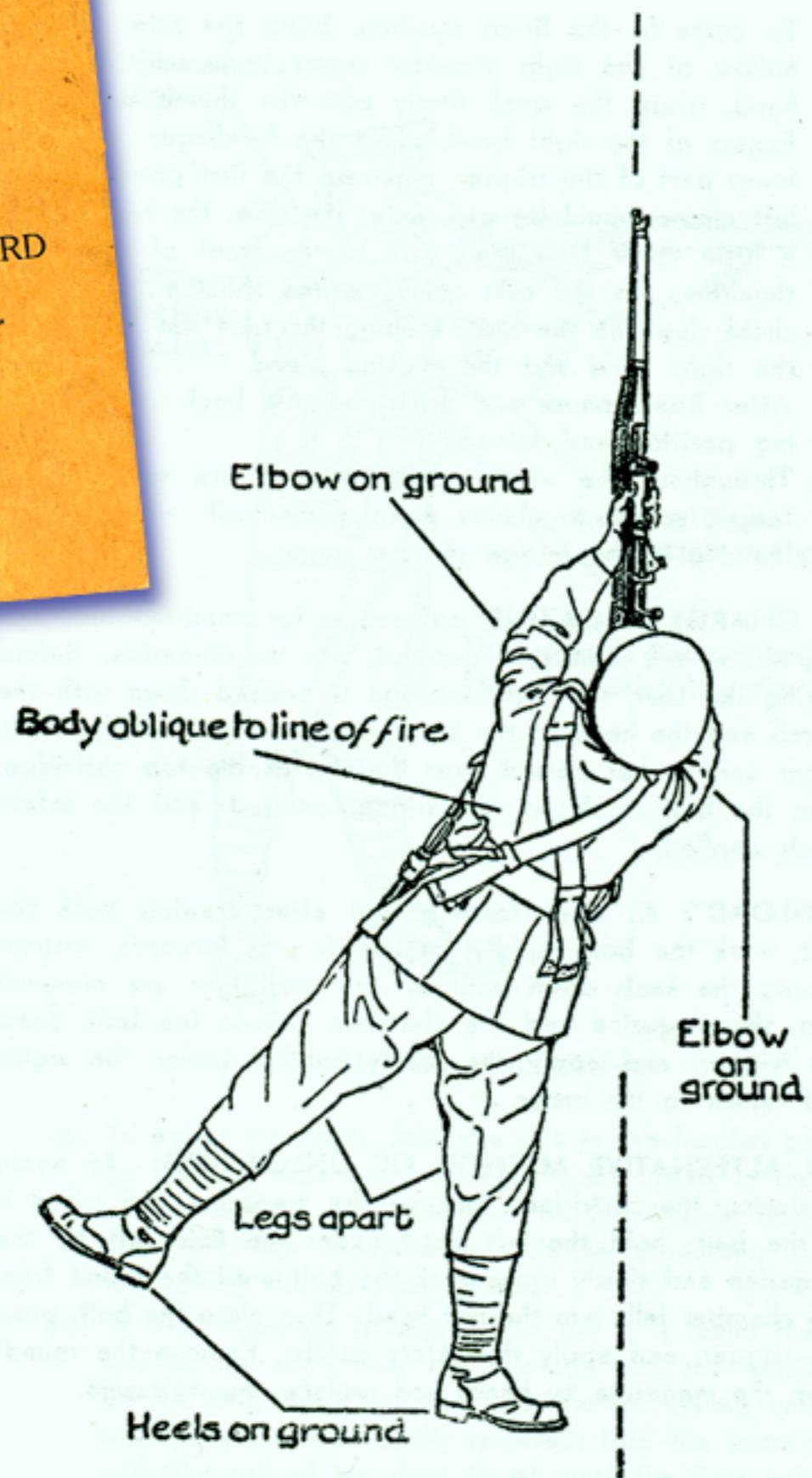
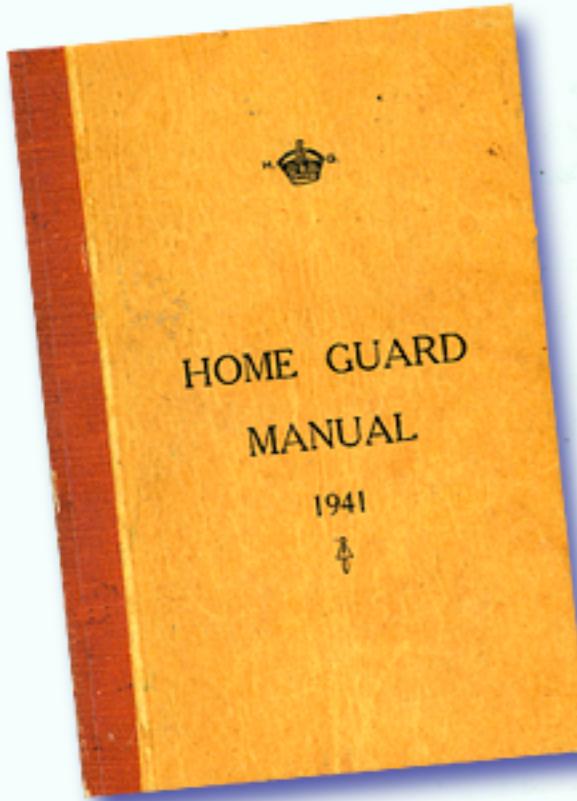
**Pictures ‘doctored’
to assist with teaching,
to assist memory**



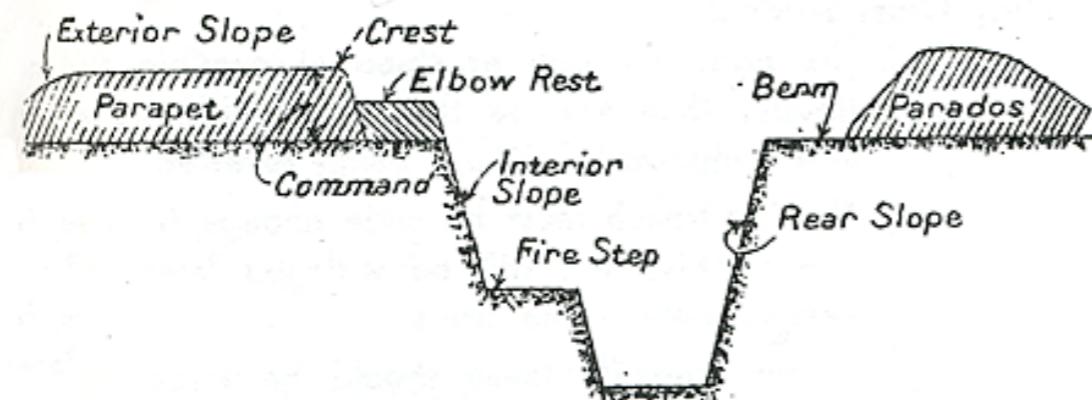
Ibn al-Nafis



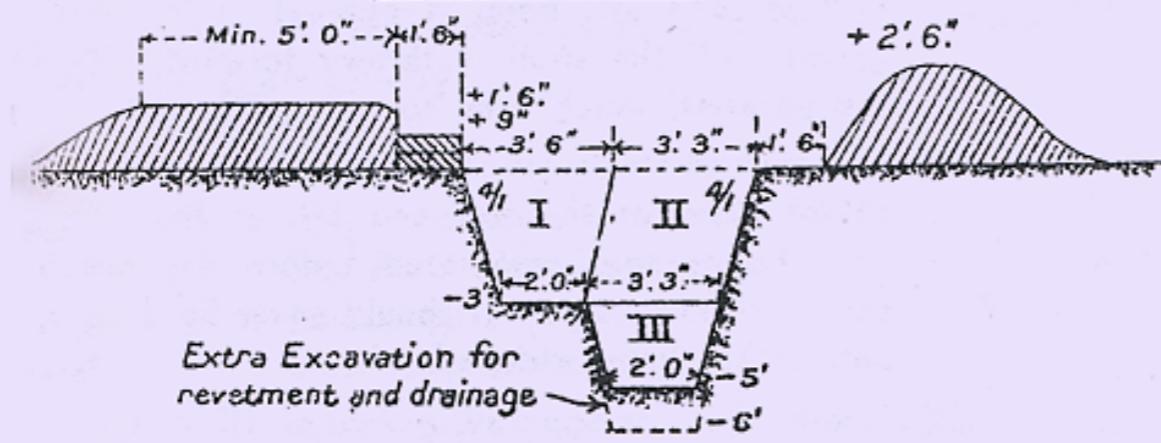
Agricola *De Re Metallica* 1556



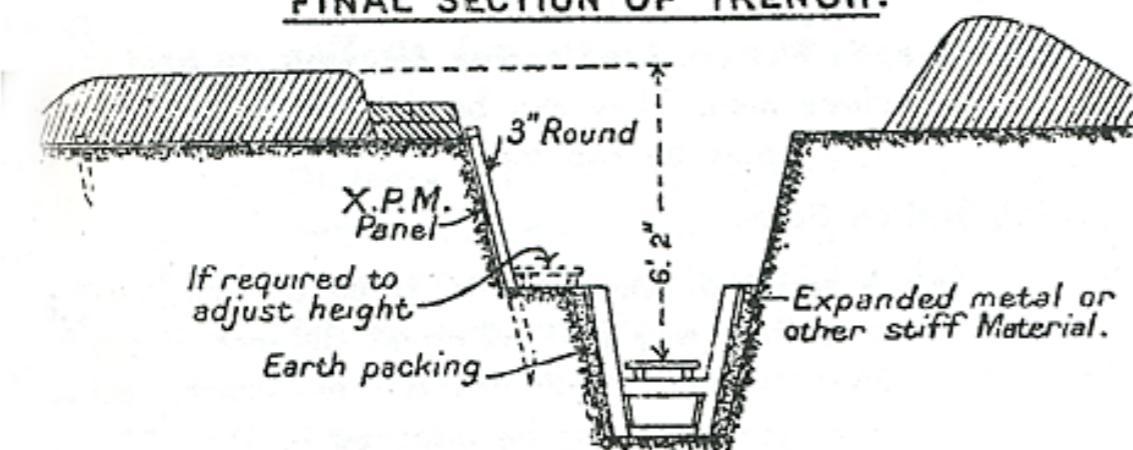
NORMAL SECTION OF FIRE TRENCH



ORDER OF WORK.

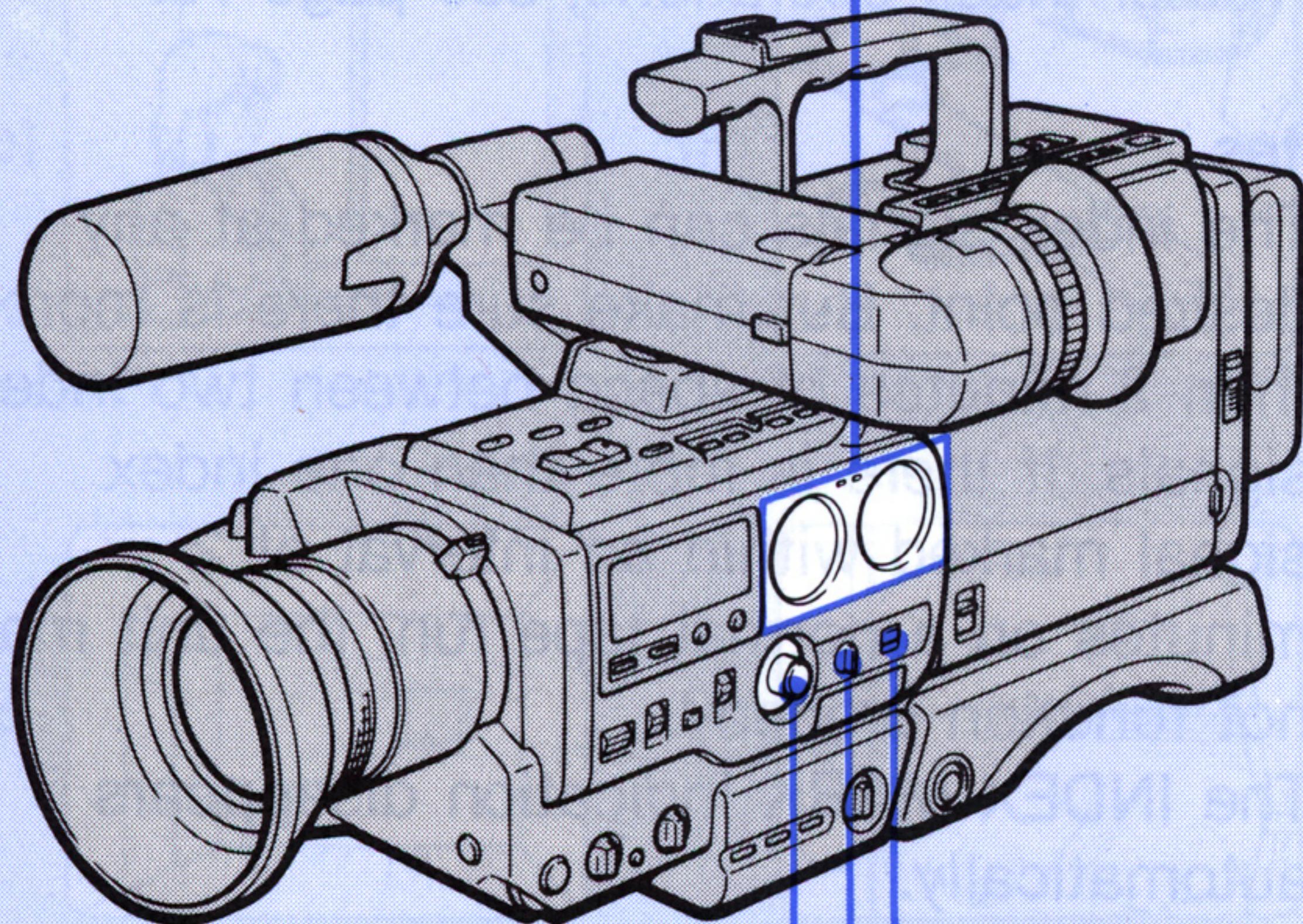


FINAL SECTION OF TRENCH.



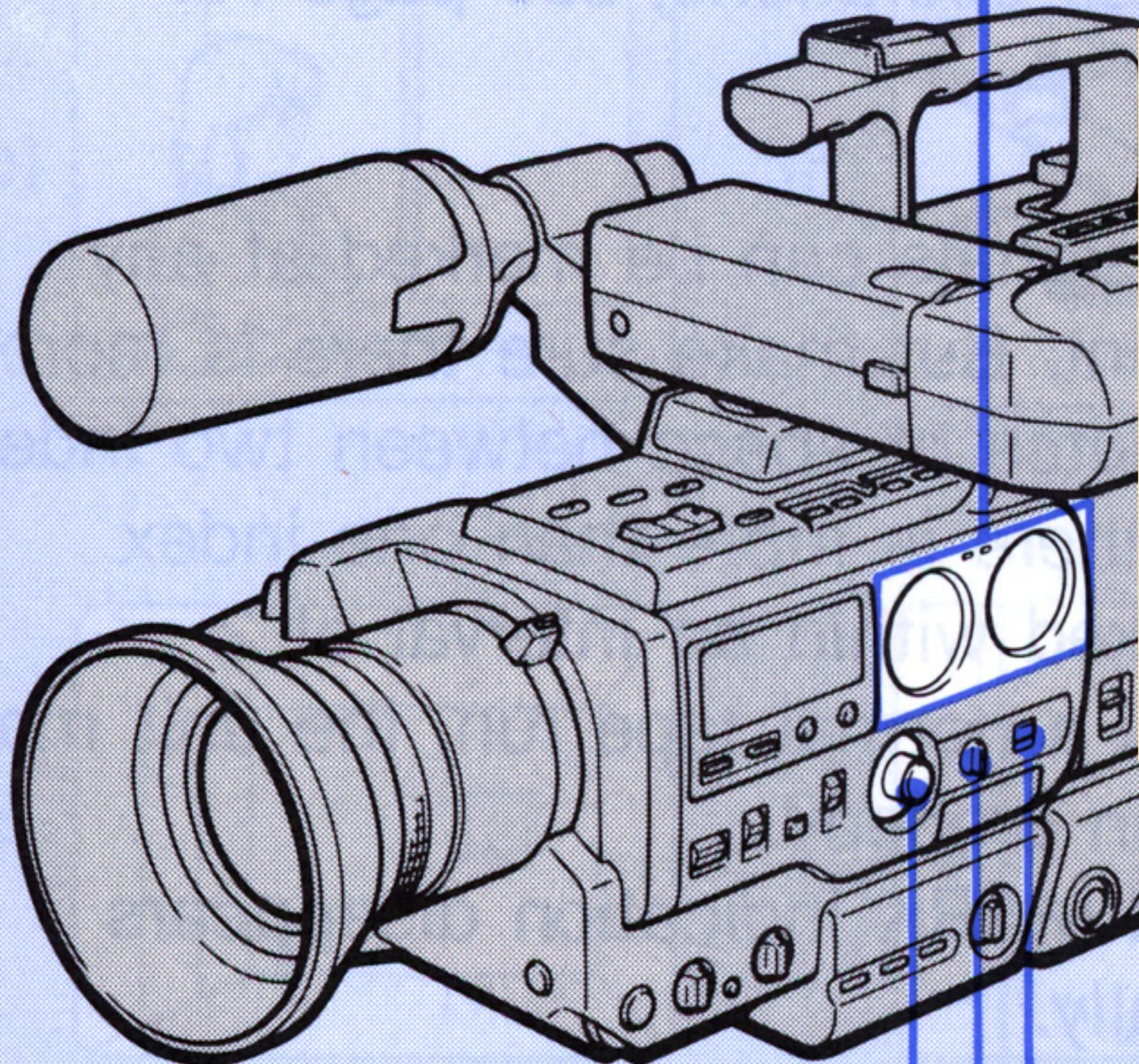
Drawings, but with:

- artificial points of view
- simplification
- labelling of parts
- measurements
- sequence of operations



MIC

BALANCE



Note —
a 'vocabulary'
of line types
and line weights

shading and
highlighting
*(here exploiting
tints and solids
of two ink colours)*

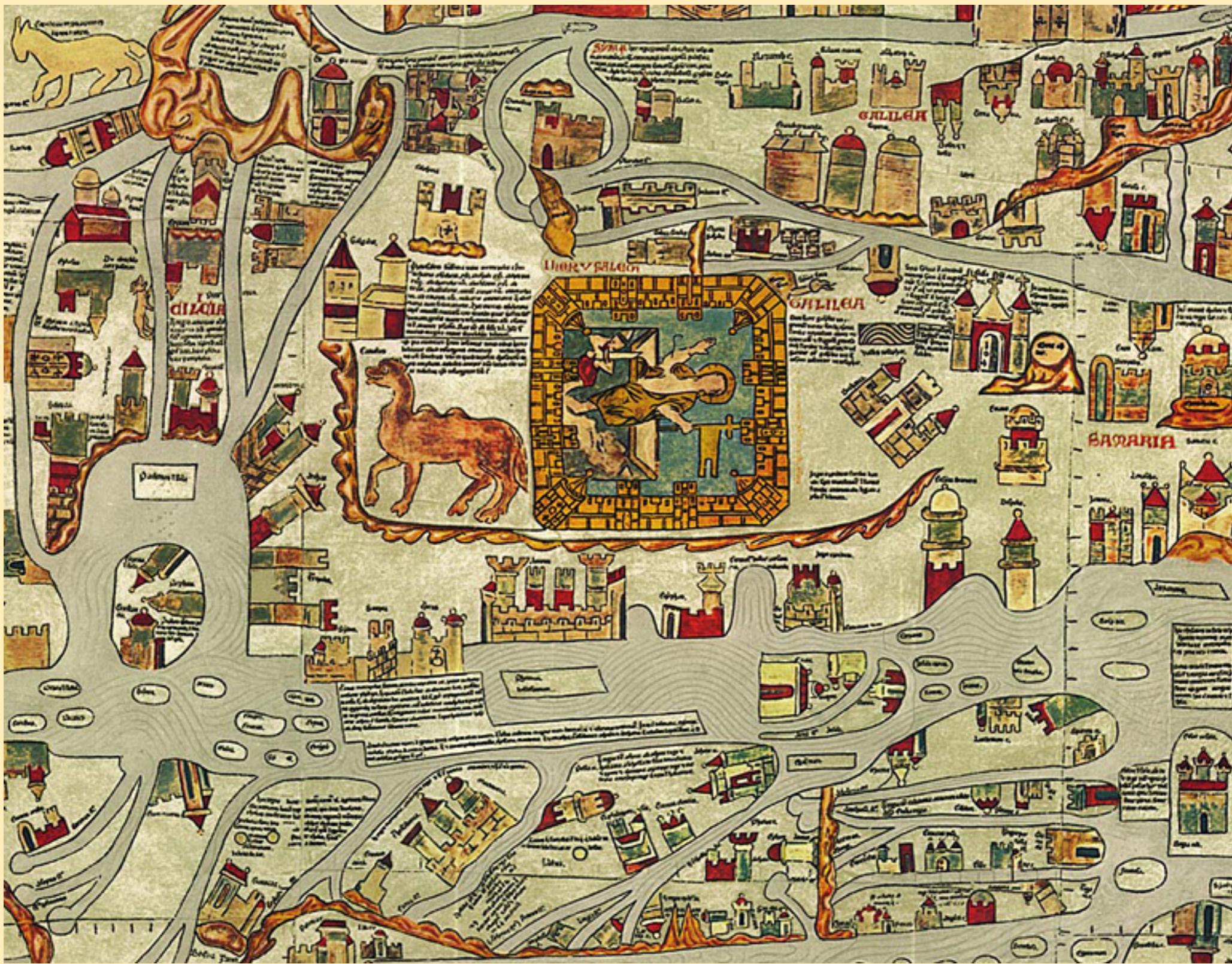
MIC

BALANCE

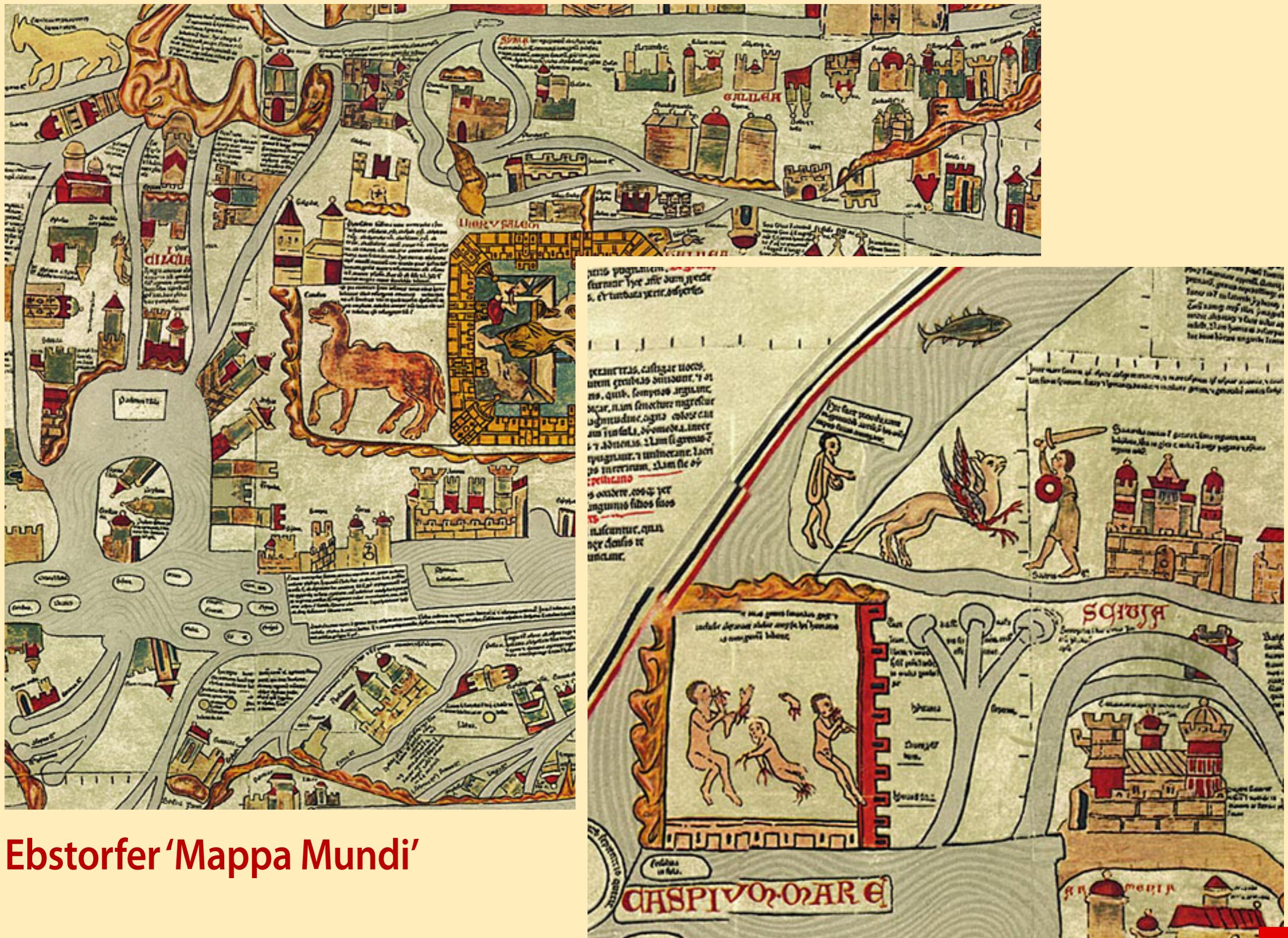


Ebstorfer 'Mappa Mundi'

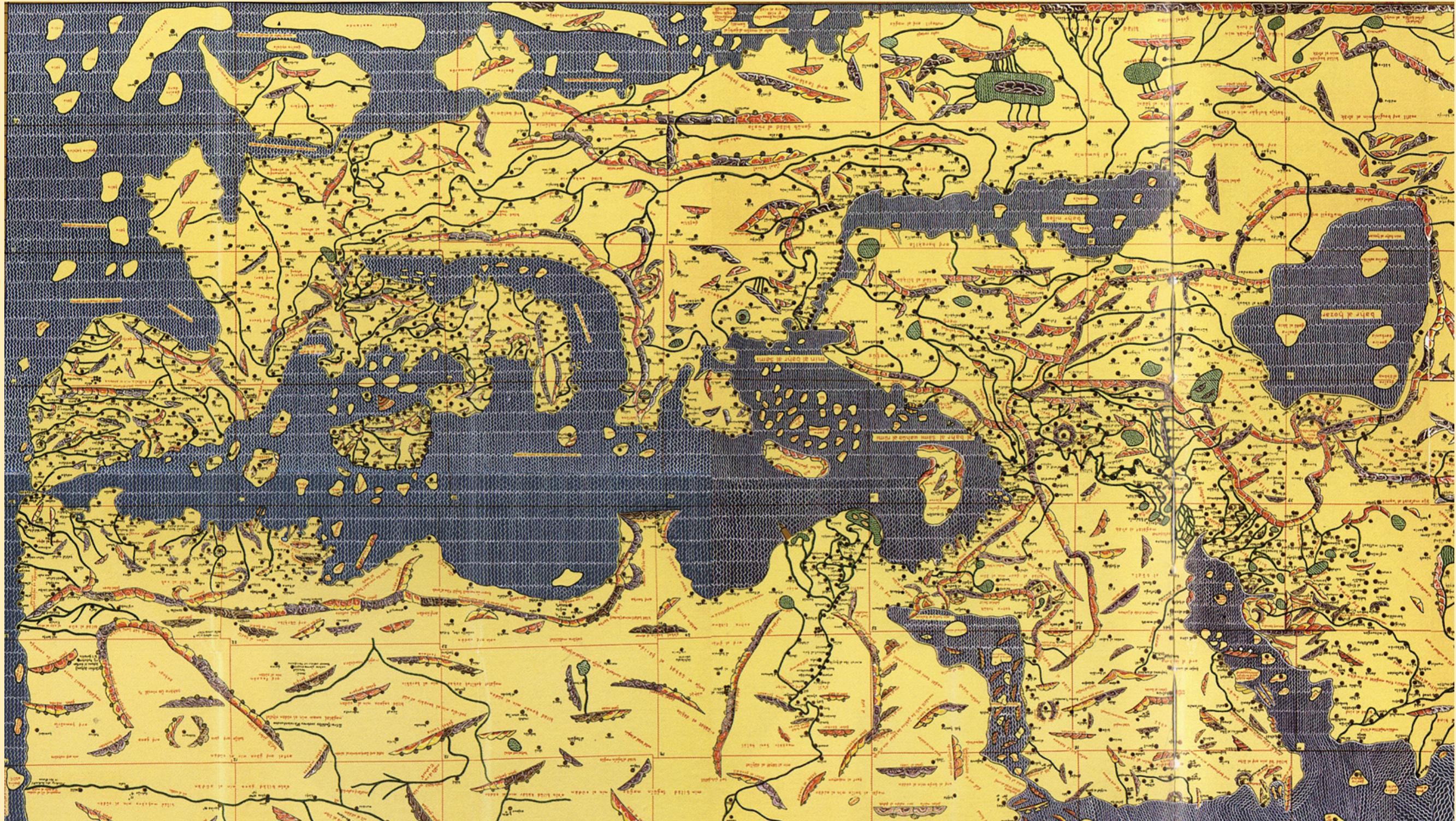
a flat earth,
a surrounding ocean,
centred on Jerusalem



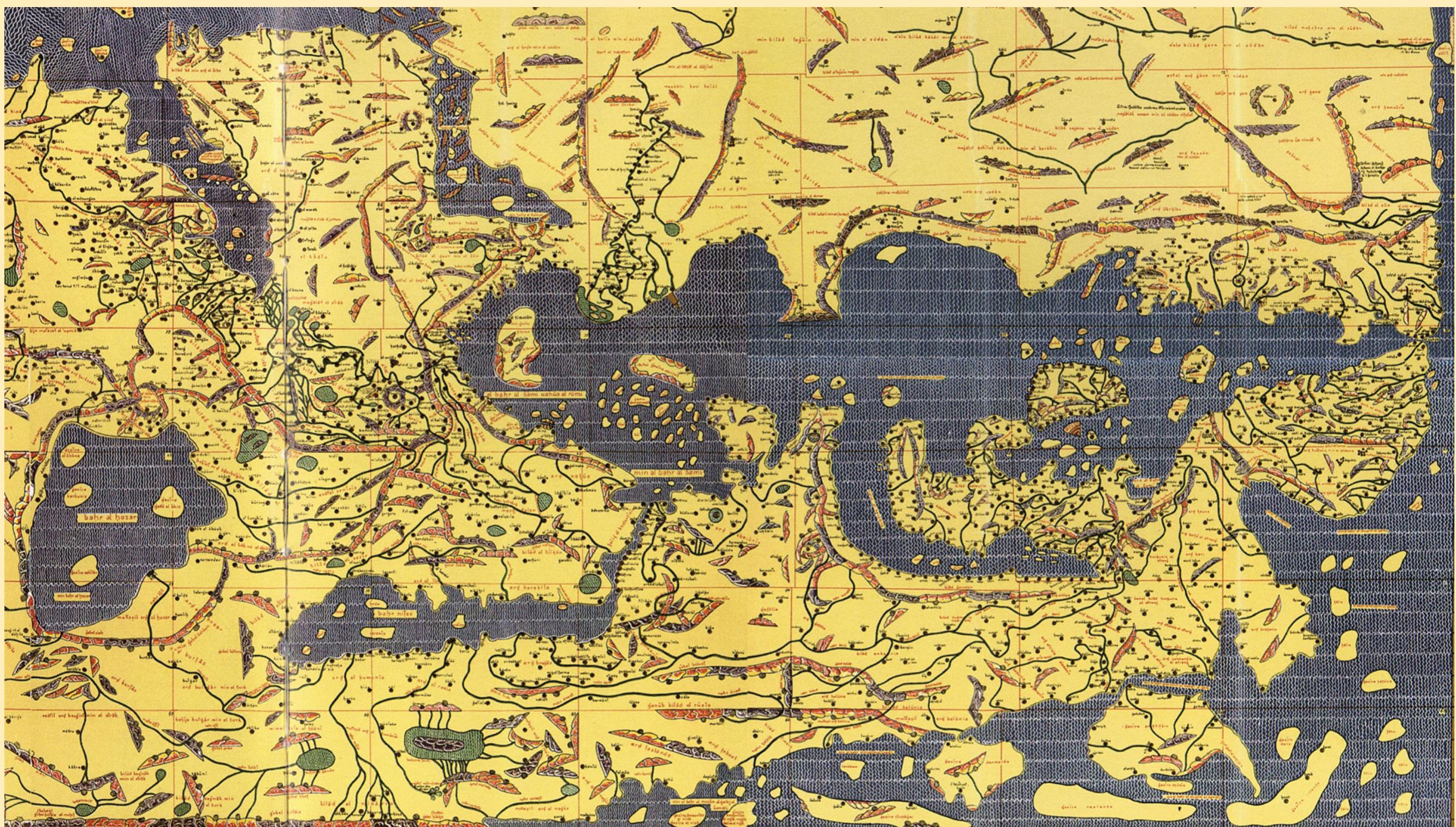
Ebstorfer 'Mappa Mundi'



Ebstorfer 'Mappa Mundi'



**Tabula Rogeriana, drawn 1154
by Mohammad Al-Idrissi, for King Roger II of Sicily**



**Tabula Rogeriana, drawn 1154
by Mohammad Al-Idrissi, for King Roger II of Sicily**



Nicolas Brodu <nicolas.brodu@free.fr>, Astrolab, 2003.

Distribute as you wish. Please contact me for non-personal use.

Astrolabe, an interactive diagram of the heavens

TYPVS ORBIS TERRARVM.

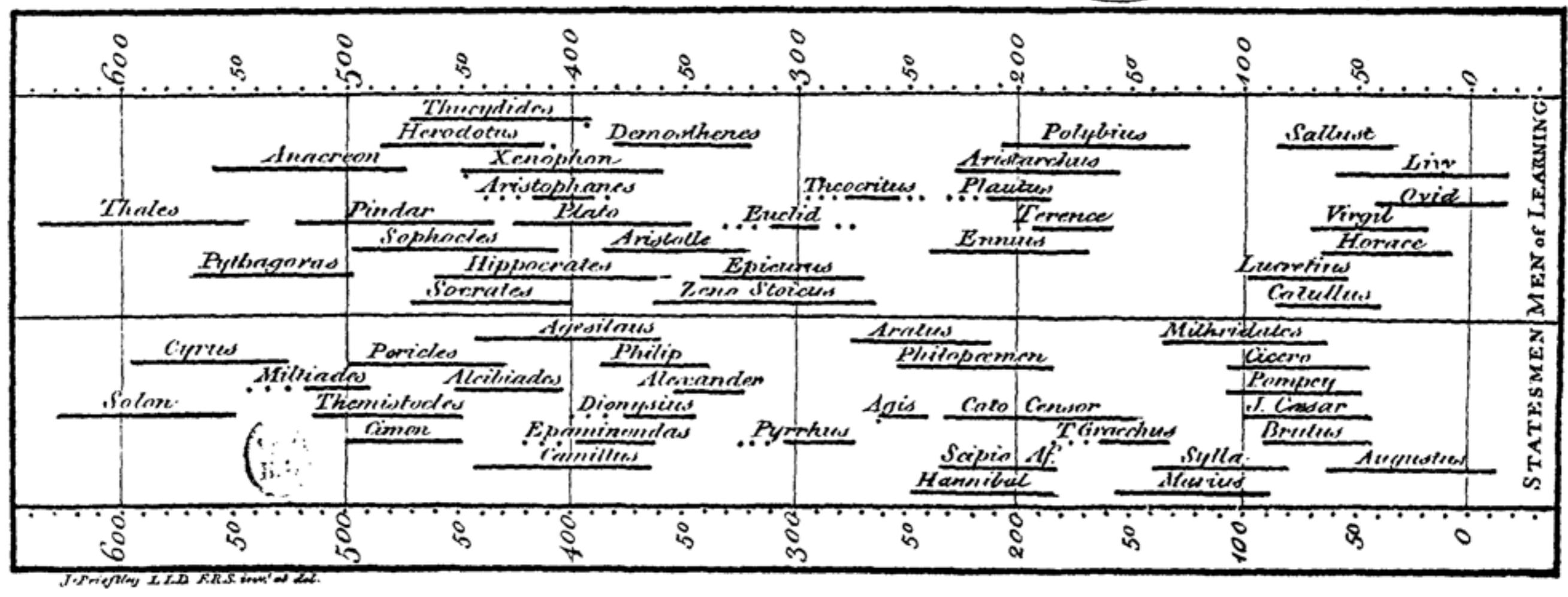
SEPTENTRIO.



Ortelius' Atlas of 1570



A Specimen of a Chart of Biography.

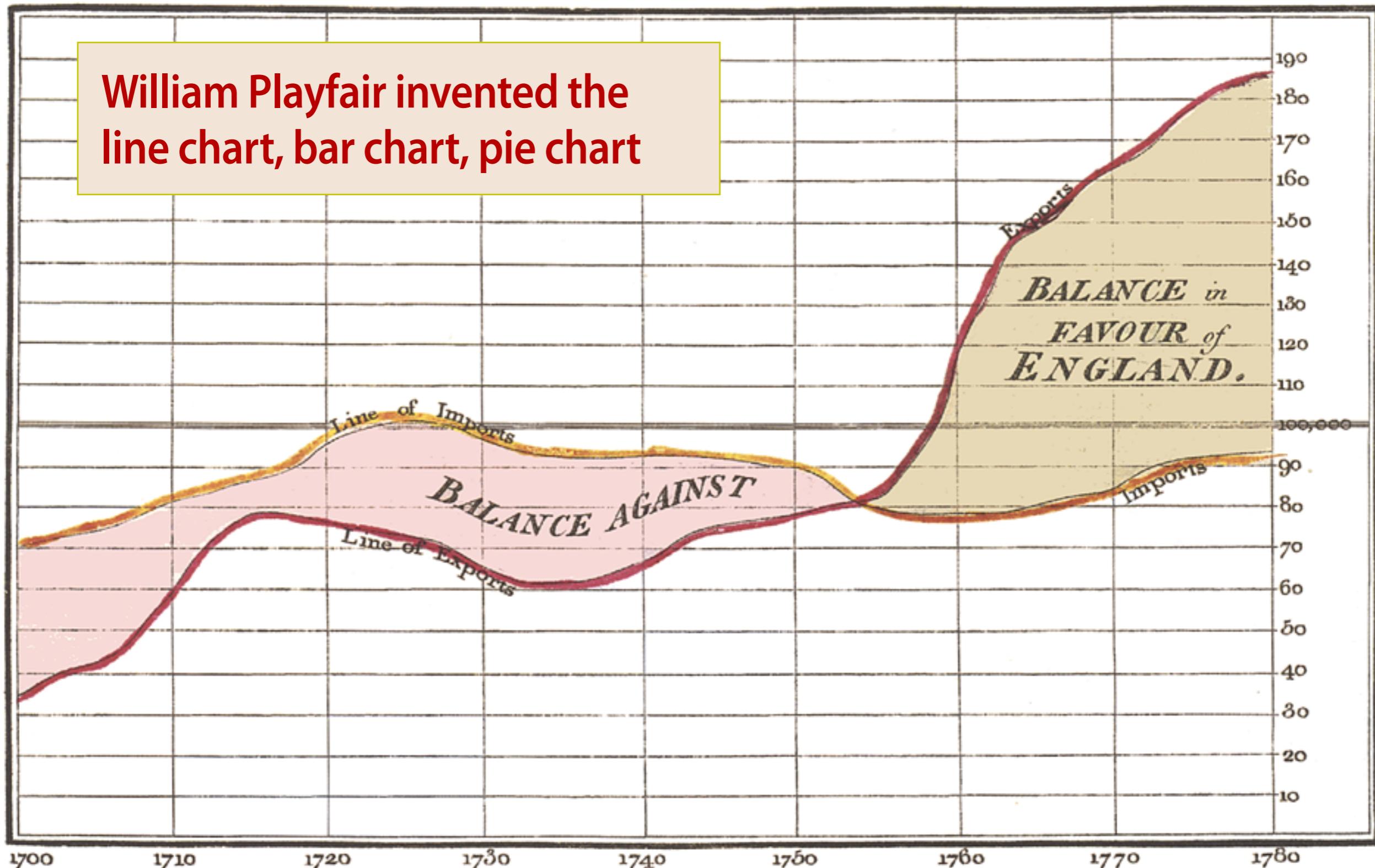


Joseph Priestley — 1760 — ‘Timelines’ of biography, engraved & printed

time as a line...

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

William Playfair invented the line chart, bar chart, pie chart



The Bottom line is divided into Years, the Right hand line into £10,000 each.

Published as the Act directs, 1st May 1786, by W^m Playfair

Neale sculpt 352, Strand, London.

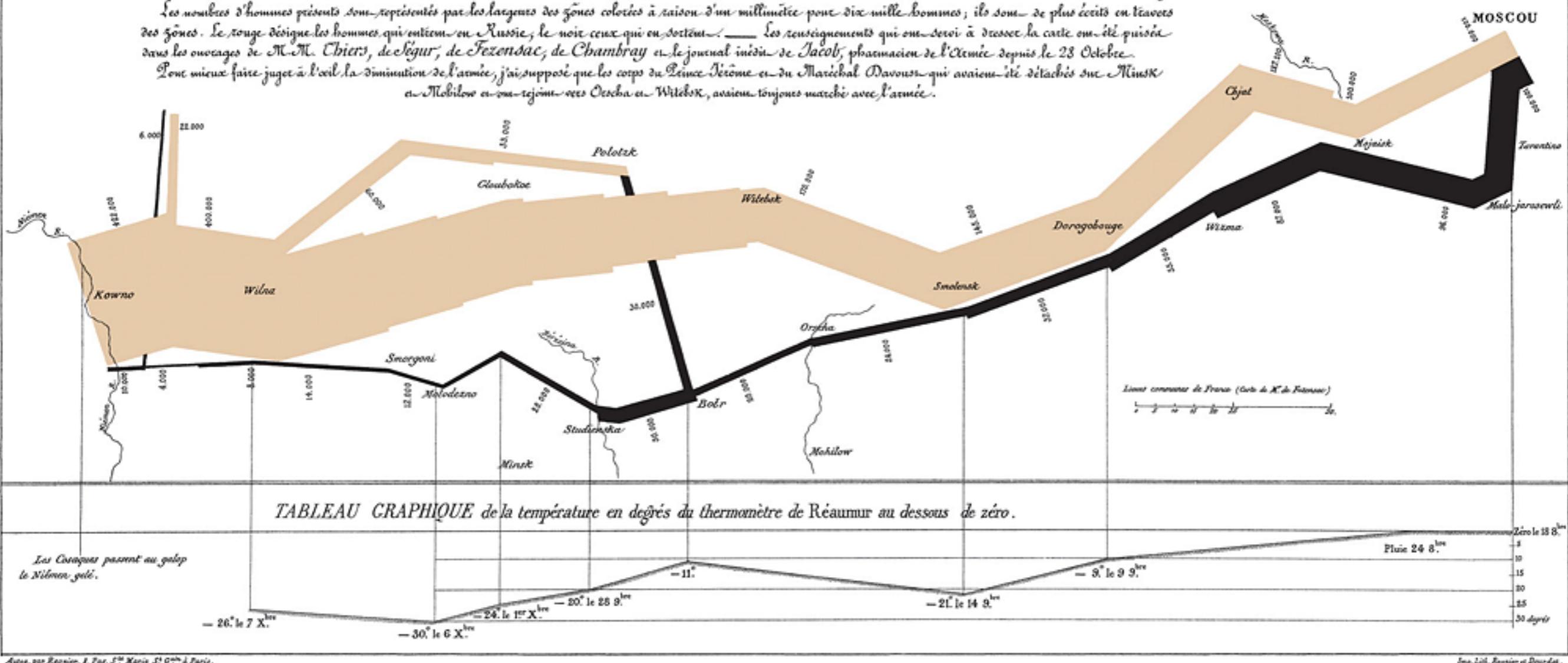
Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite.

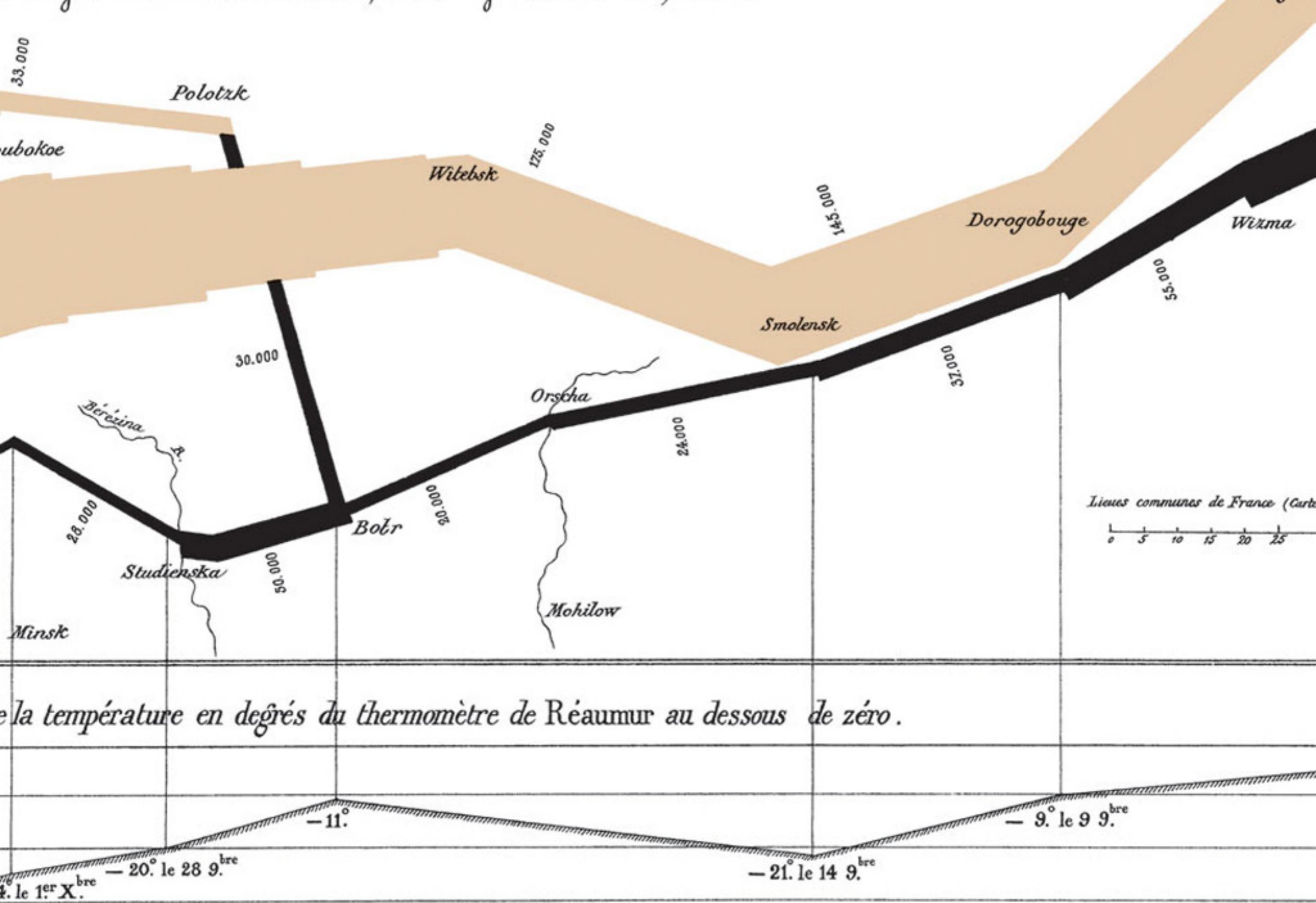
Paris, le 20 Novembre 1869.

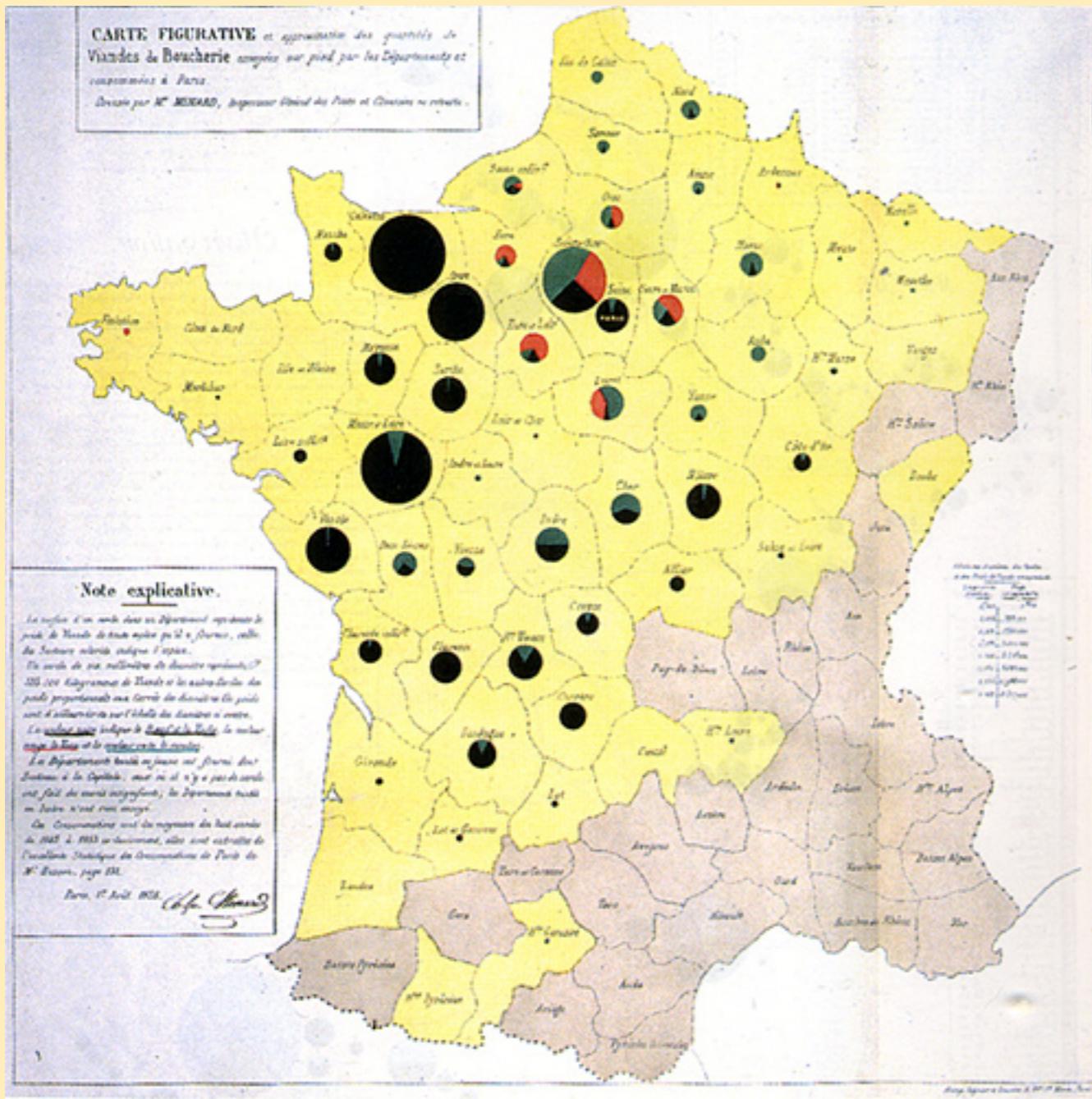
Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres dans les zones. Le rouge désigne les hommes qui ont péri en Russie; le noir ceux qui en sont revenus. — Les renseignements qui ont servi à dresser la carte ont été pris dans les ouvrages de M.-M. Chiers, de Séguir, de Fézerac, 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 Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mogilow et qui rejoignirent Orel et Wileïka, avaient toujours marché avec l'armée.

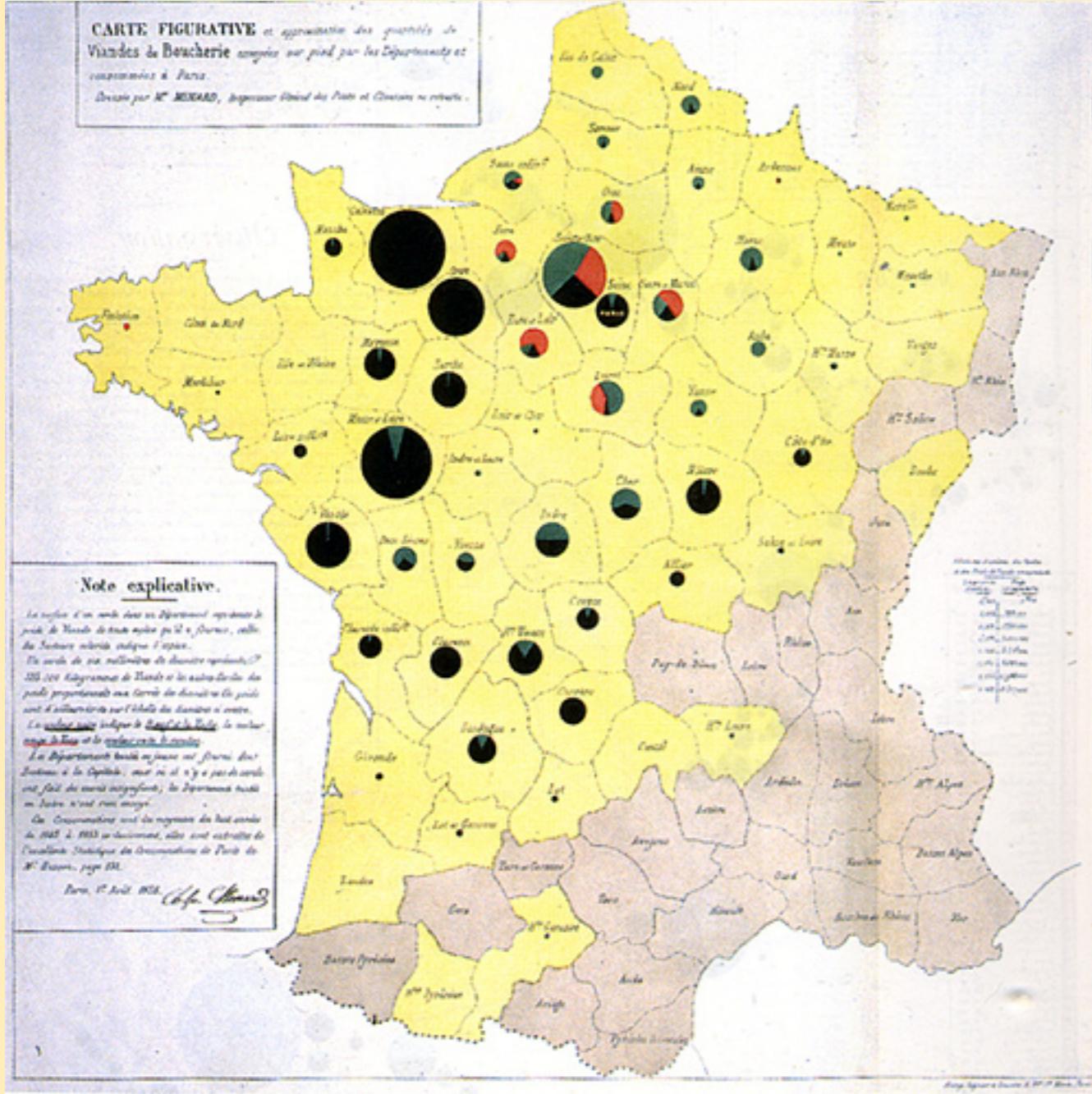


Charles Joseph Minard, 1869:
celebrated multivariable schematic map / timeline diagram
about Napoleon's advance on and retreat from Moscow
in the winter of 1812–1813





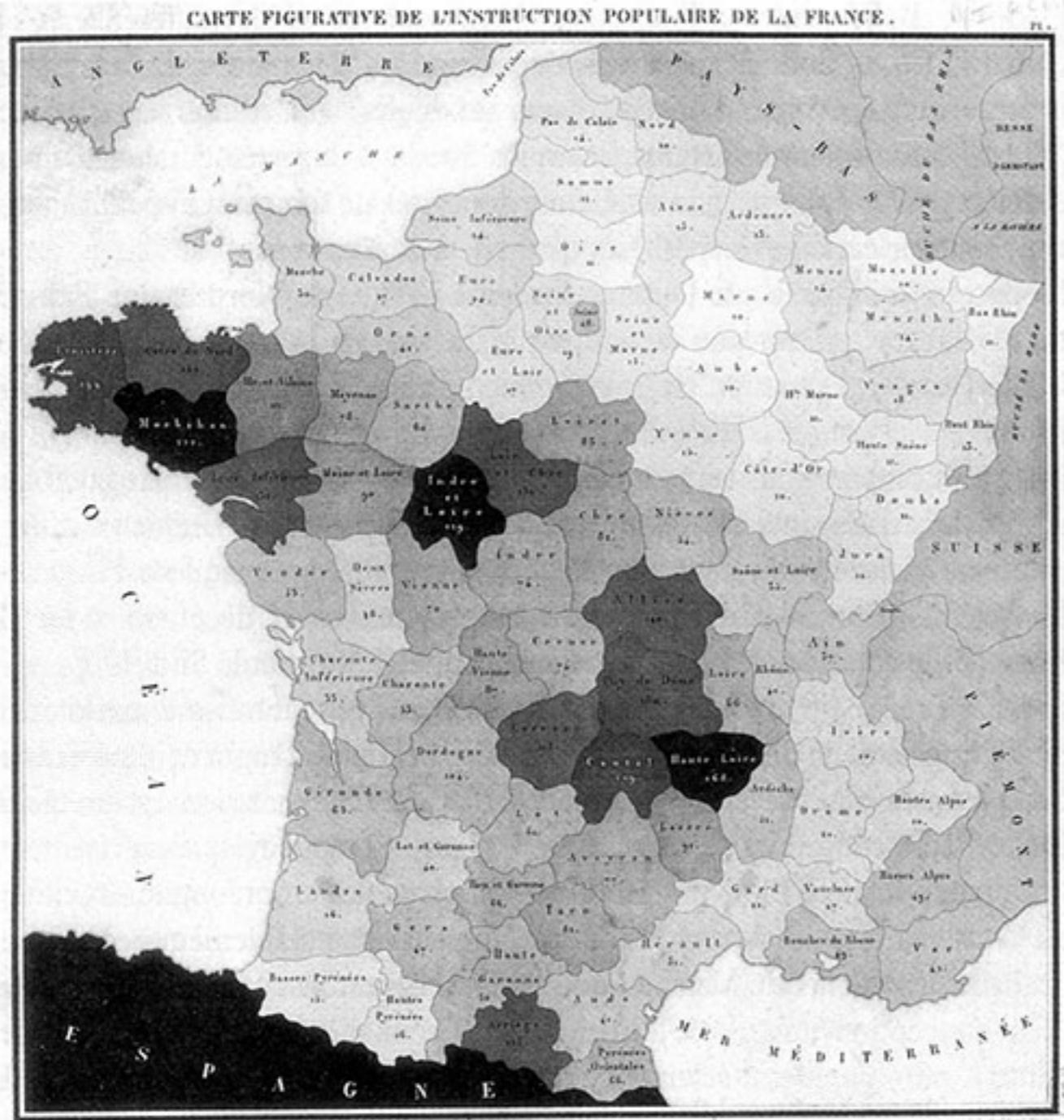
Charles Joseph Minard:
'From where in France does Paris get its supplies of different kinds & quantities of meat?'



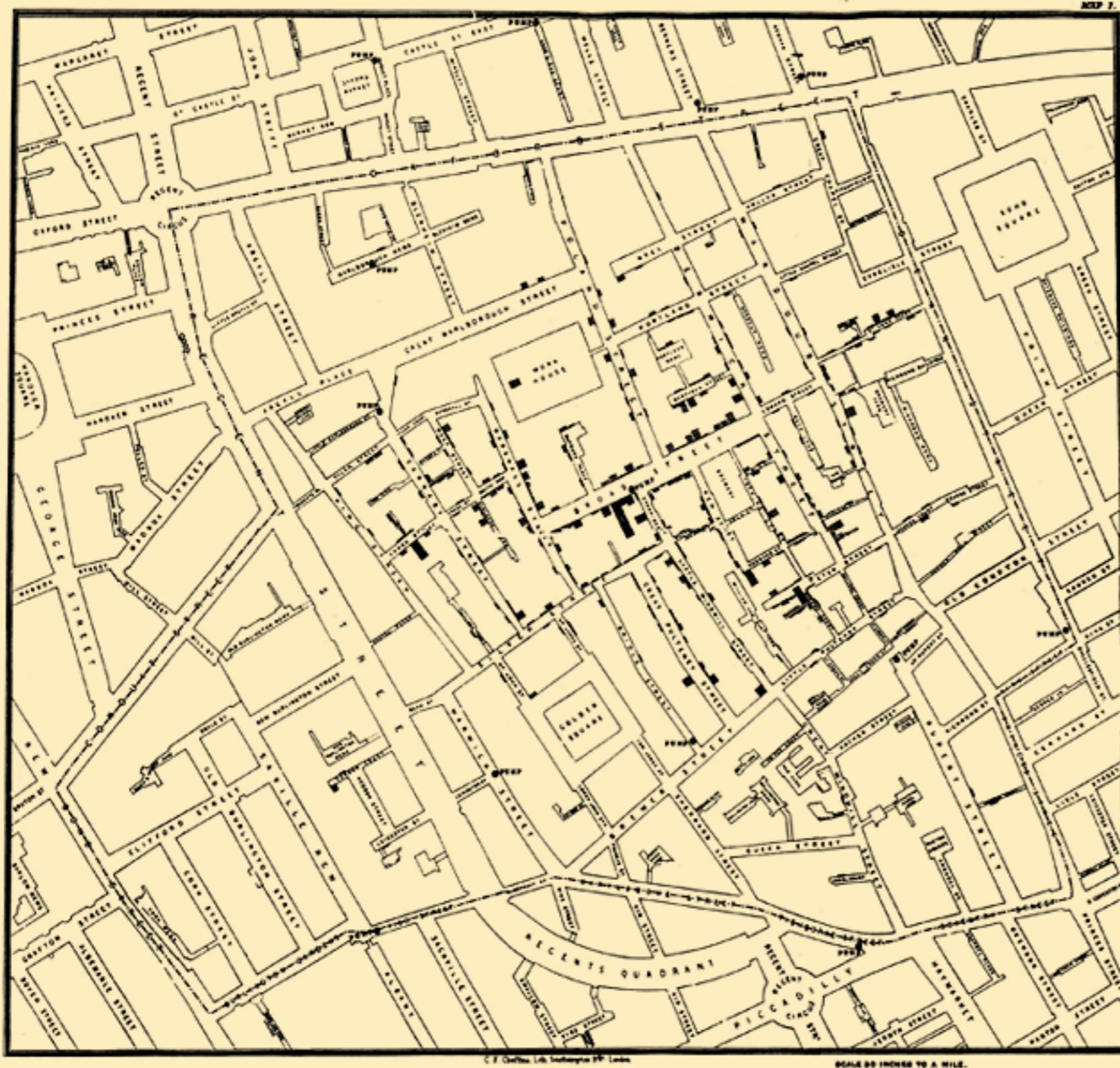
Charles Joseph Minard: 'From where in France does Paris get its supplies of different kinds & quantities of meat?'

- colour identifies which Départements are involved in the trade
- those involved have a 'meat pie chart' associated
- colour divided the pies by proportion of types of meat
- size of pies reflects quantity

CARTE FIGURATIVE DE L'INSTRUCTION POPULAIRE DE LA FRANCE.



Charles Dupin, 1826:
First ever choropleth map,
highlighting regions with
problems of illiteracy



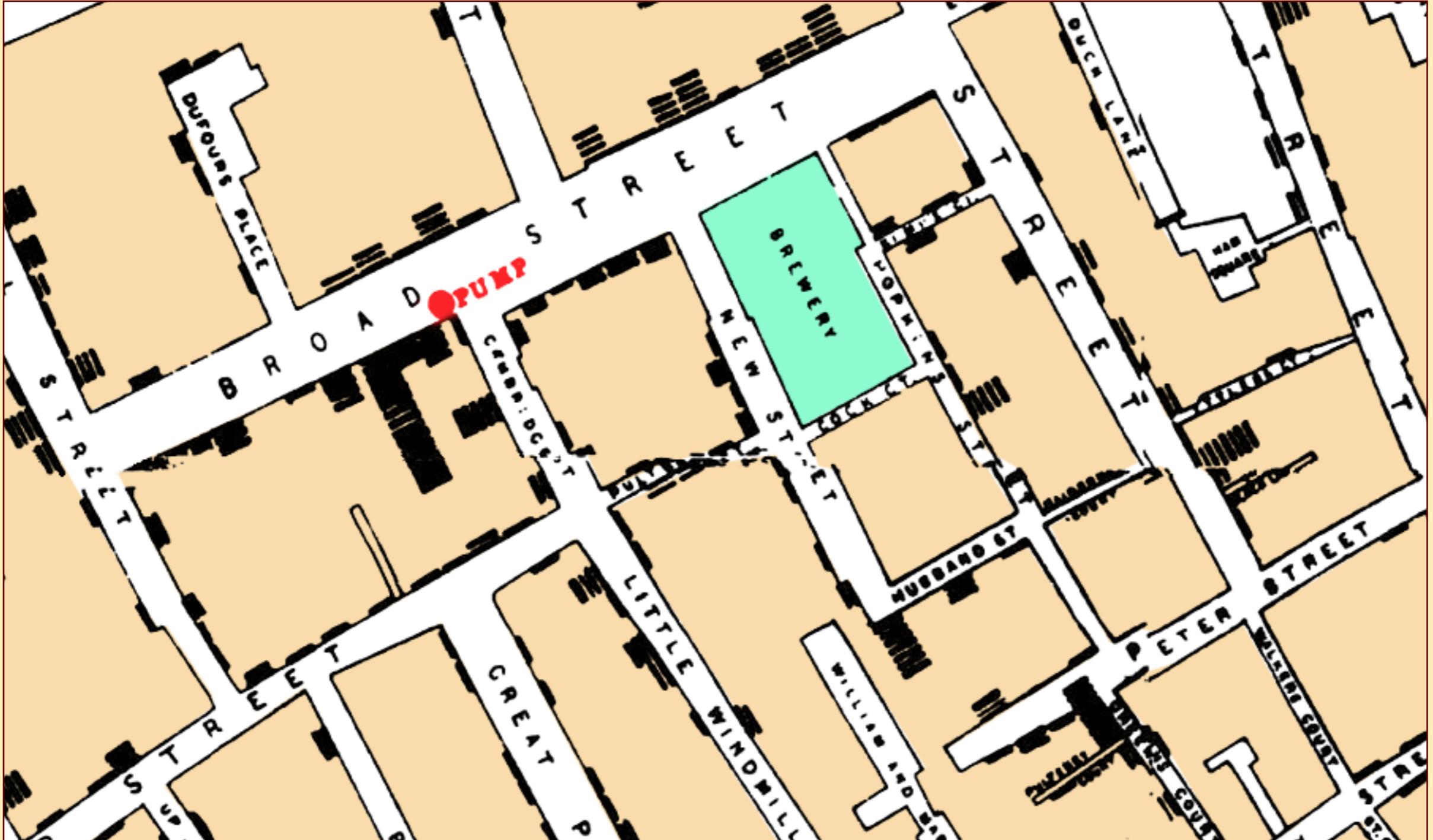
Dr John Snow:

Dot-map of fatalities from cholera in the 1854 outbreak in Soho.

Clustering suggested a link to the Broad St water-pump

Investigation of outliers & anomalies confirmed the link.

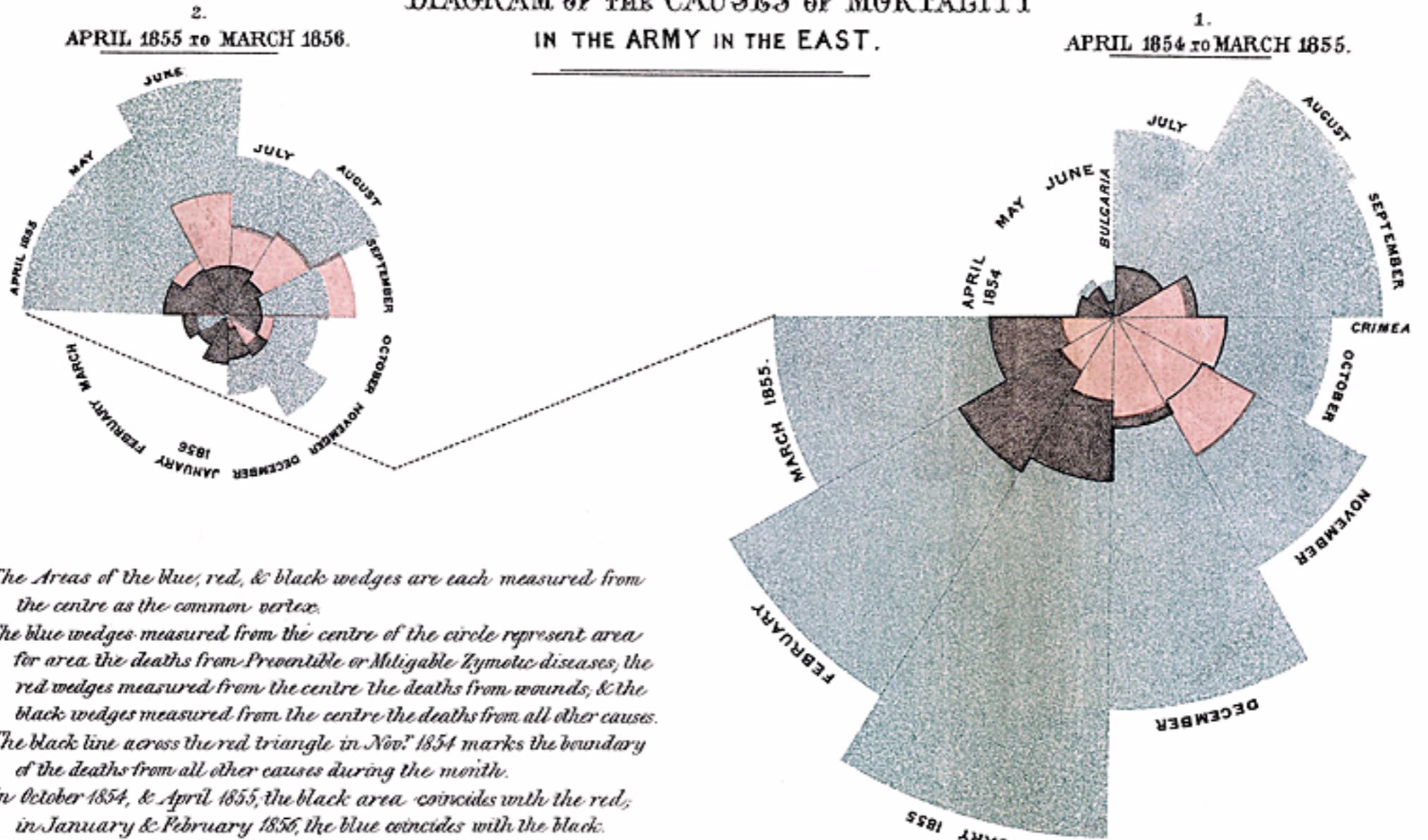
Beginnings of science of epidemiology!



Detail of John Snow's dot map: colour added

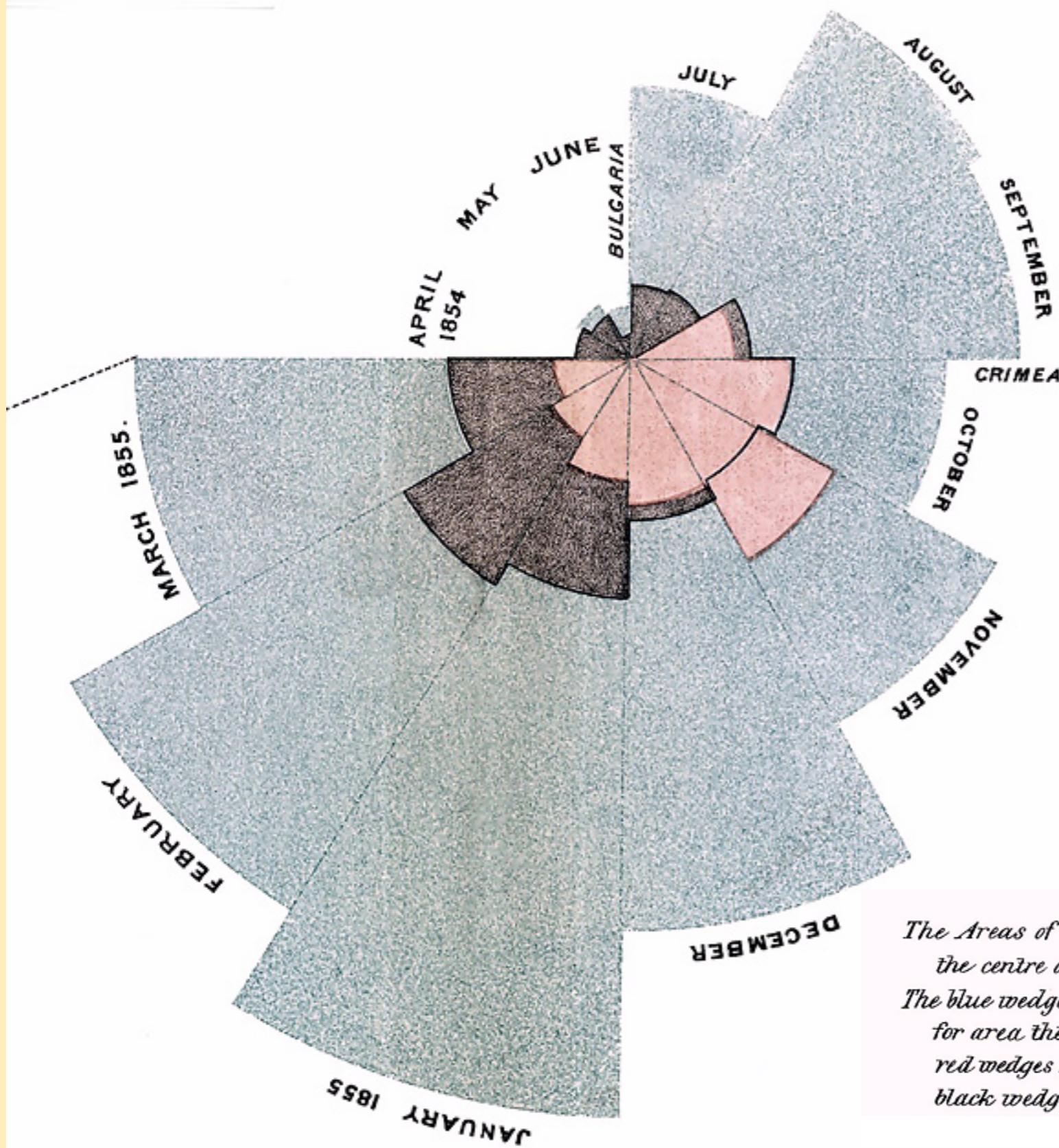


DIAGRAM OF THE CAUSES OF MORTALITY
IN THE ARMY IN THE EAST.



**Florence Nightingale's 'Coxcomb' charts:
causes of mortality among British soldiers in the Crimean War**

1.
APRIL 1854 to MARCH 1855.



Areas are proportionate
to death by cause of:

RED: wounds

BLUE-GREY:

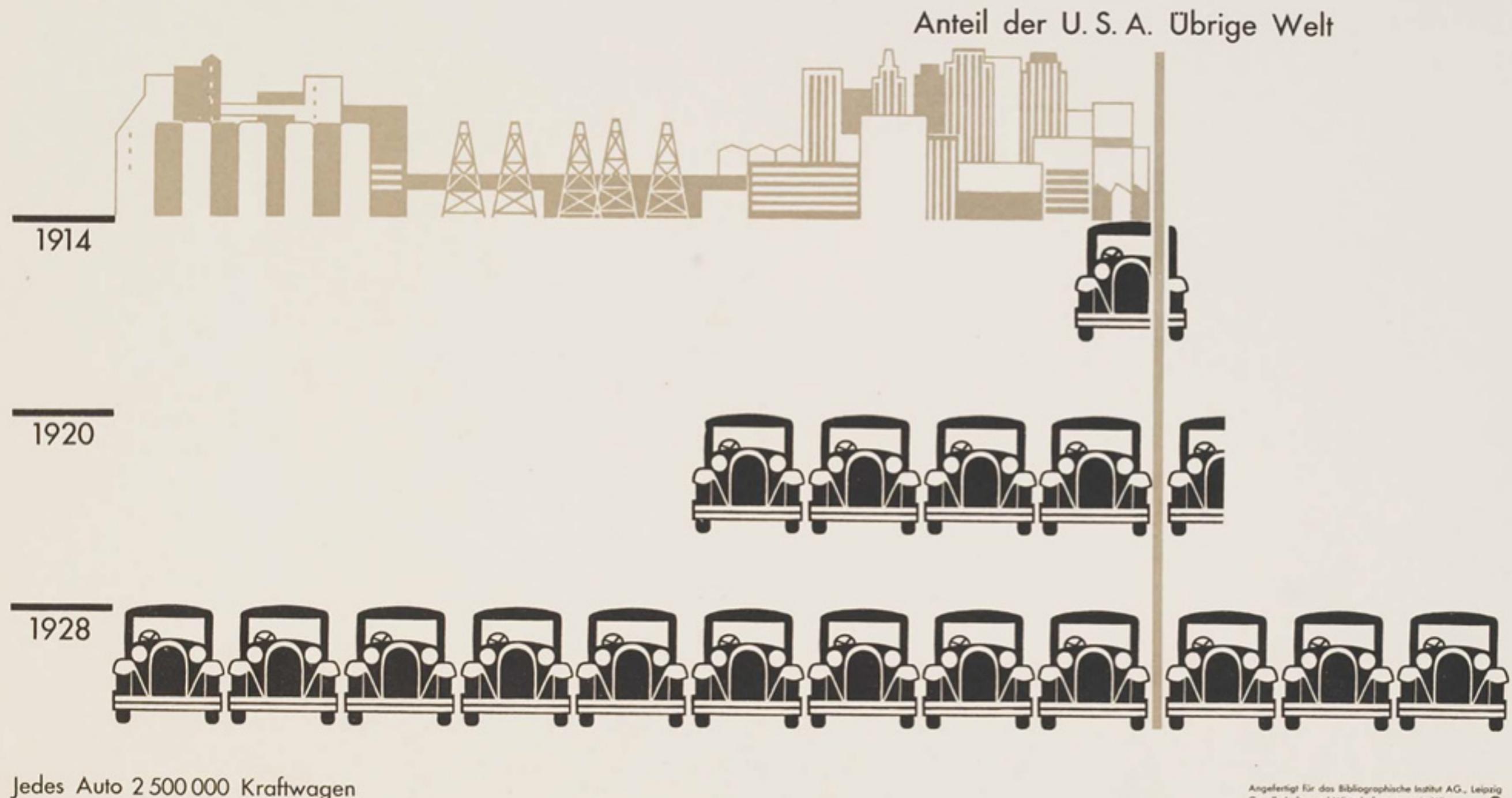
'Preventable or Mitigable
Zymotic diseases'

BLACK: all other causes

The Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.

The blue wedges measured from the centre of the circle represent area for area the deaths from Preventible or Mitigable Zymotic diseases; the red wedges measured from the centre the deaths from wounds, & the black wedges measured from the centre the deaths from all other causes.

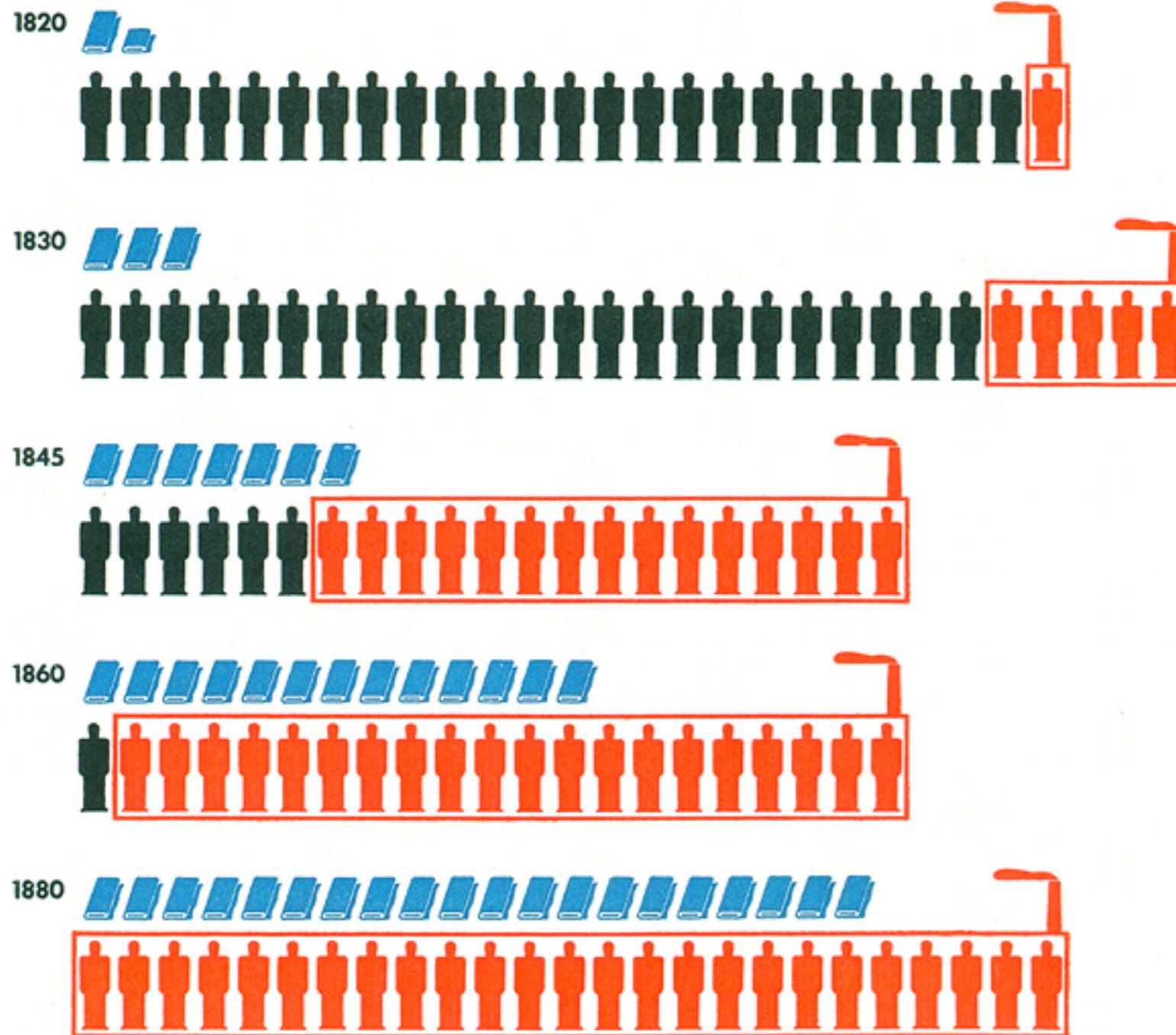
Kraftwagenbestand der Erde



**The ISOTYPE approach to educational quantitative graphics:
Otto and Marie Neurath**

Angefertigt für das Bibliographische Institut AG, Leipzig
Gesellschafts- und Wirtschaftsmuseum in Wien

Home and Factory Weaving in England



Each blue symbol represents 50 million pounds total production

Each black man symbol represents 10,000 home weavers

Each red man symbol represents 10,000 factory weavers

ISOTYPE multiples
of standardised
graphics, largely
designed by
Gerd Arntz



**ISOTYPE multiples
of standardised
graphics, largely
designed by
Gerd Arntz**



Skuravy, c. 1932, cutting out linocut-printed symbols for paste-up assembly into chart artwork



København network diagram for the 'S-Tog' urban rail service

76From
from Tottenham**476**From
Northumberland Park**You are here ►**

numbers along the route
for example 10 mins
indicate typical off-peak
journey times in minutes

Newington Green**Essex Road**
Station**Islington Angel****King's Cross****St. Pancras**
International**Euston****476**
End of
route27 mins
Clerkenwell
Green31 mins
Theobald's Road
Gray's Inn Road

2 mins

8 mins

9 mins

13 mins

16 mins

18 mins

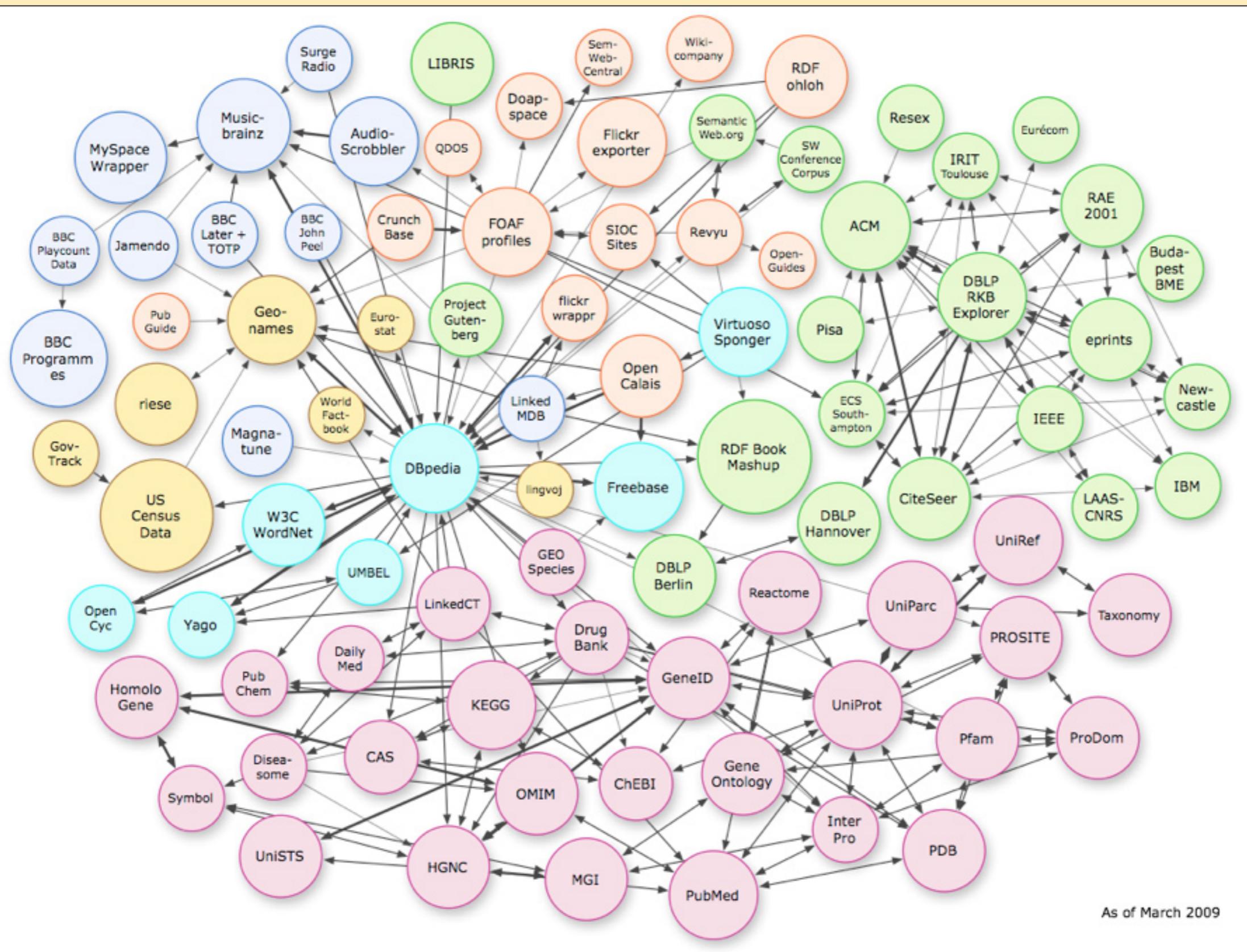
21 mins

29 mins

37 mins

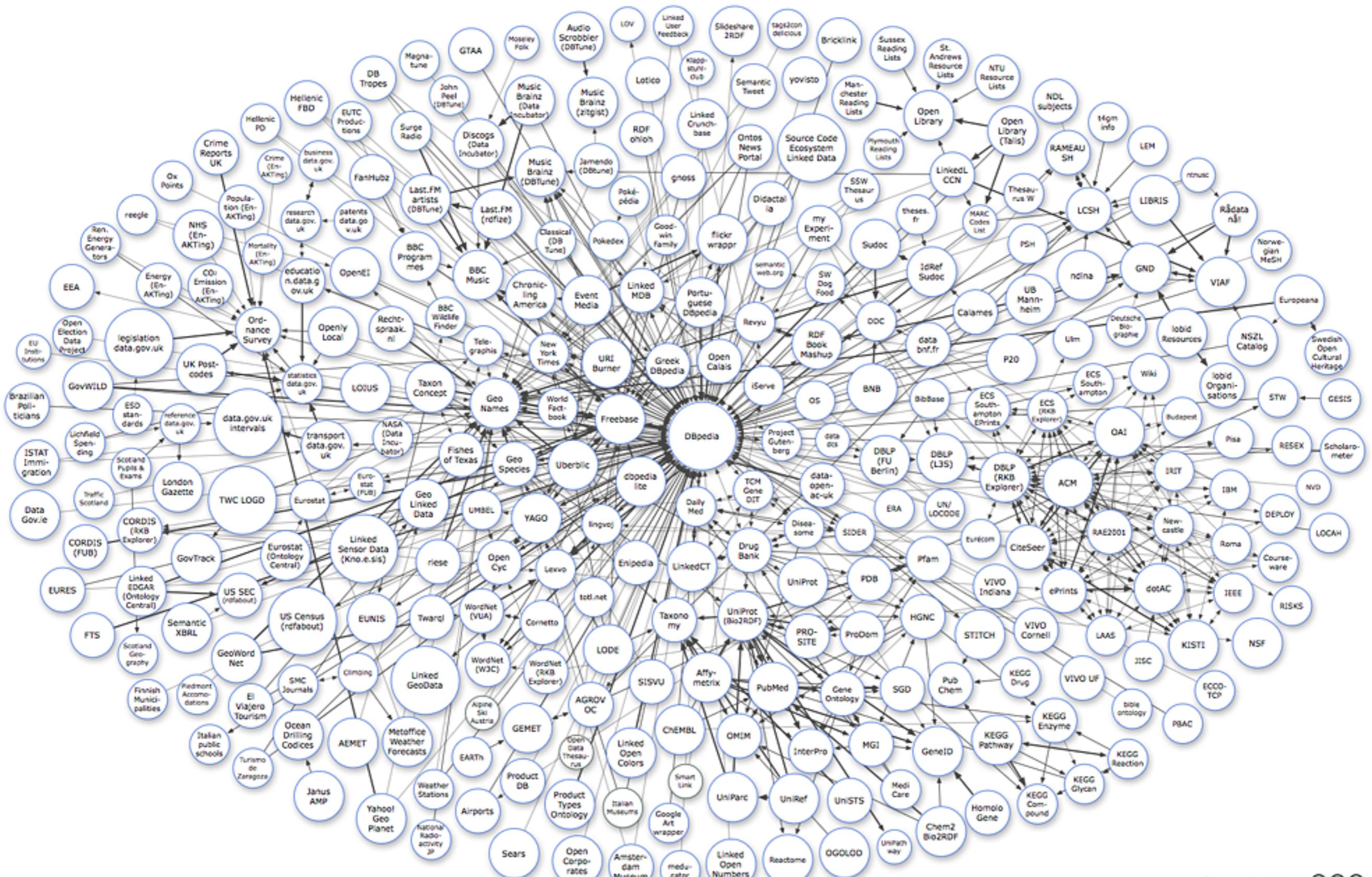
40 mins

149 End of
route25 mins
Moorgate**149** 24 hour
serviceFrom
Edmonton Green**67**From
Wood Green**Lymouth Road****Stoke Newington****Dalston Kingsland****Dalston Junction****Haggerston**
Kingsland Road**Haggerston**
Geffrye Museum for Hoxton Station**Shoreditch Church****Shoreditch High Street****Liverpool**
Street**Monument****London Bridge**
Station**Commercial**
Street**Aldgate****End of**
route**67**



As of March 2009

The 'Linked and Open Data Graph'— which just keeps getting more complicated...



As of September 2011 CC BY-SA

The 'Linked and Open Data Graph' — which just keeps getting more complicated...

**Where is the theory
about what makes
graphic representations
of knowledge and data
WORK?**

literature review *(& personalities)*

Jan V White
'Charts and Graphs'
1980

Edward Tufte
'The Visual Display of
Quantitative
Information'
1998

Gene Zelazny
'Say it with Charts'
1985

Jacques Bertin
'La Sémiologie
Graphique'
1967

Doig Simmonds, Ed
'Charts and Graphs'
1980

Clive Richards
'Diagrammatics'
1998

Michael Twyman
'Schema for Study of
Graphic Languages'
1979

B Tversky
'Cognitive Origins of
Graphic Conventions'
1995

Jan V White
'Charts and Graphs'
1980

Edward Tufte
'The Visual Display of
Quantitative
Information'
1998

**Card, Mackinlay,
Schneidermann (Eds)**
'Information
Visualization'
1999

Gene Zelazny
'Say it with Charts'
1985

Robert Horn
'Visual Language'
1998

Jacques Bertin
'La Sémiologie
Graphique'
1967

Doig Simmonds, Ed
'Charts and Graphs'
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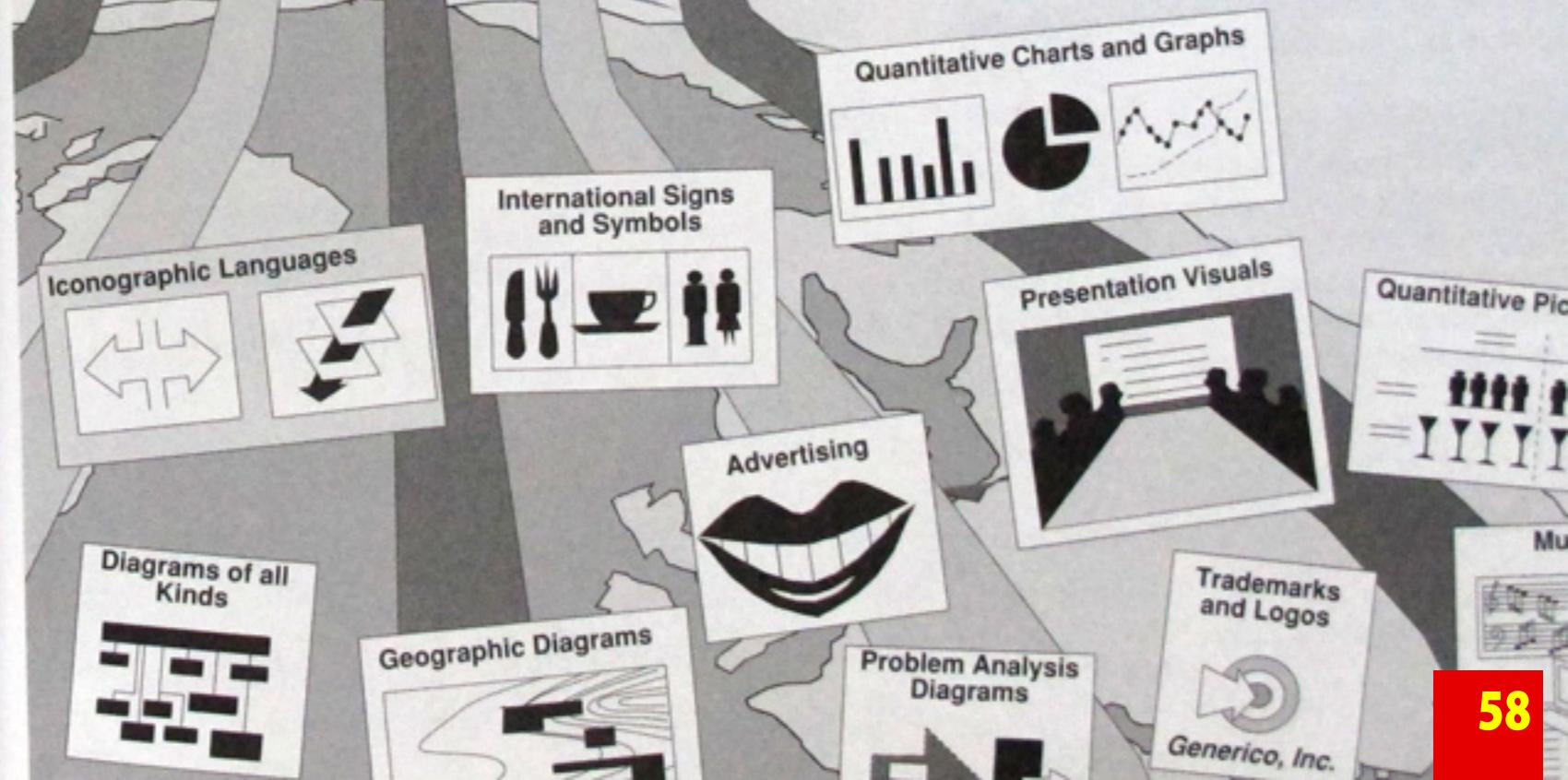
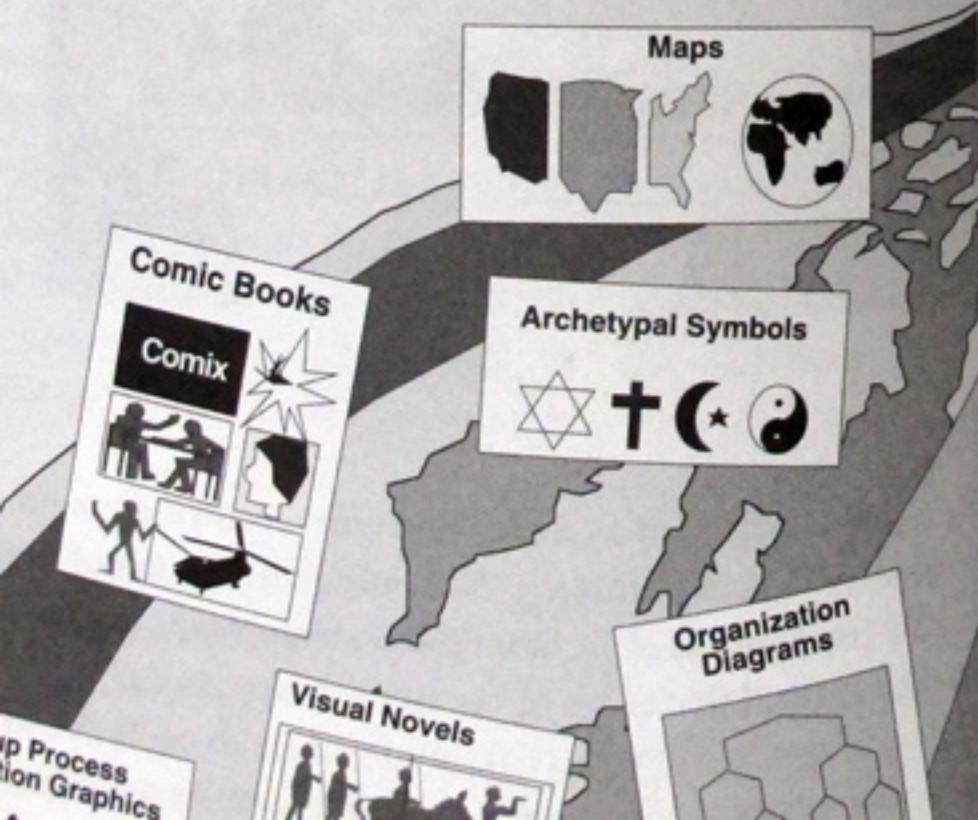
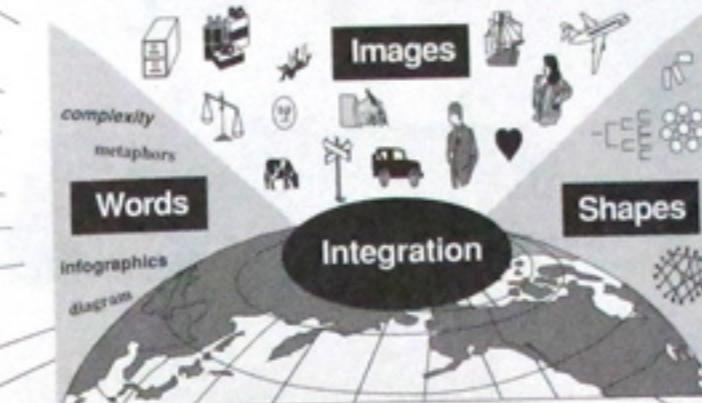
Clive Richards
'Diagrammatics'
1998

Michael Twyman
'Schema for Study of
Graphic Languages'
1979

B Tversky
'Cognitive Origins of
Graphic Conventions'
1995

L Wilkinson
'The Grammar of
Graphics'
1999

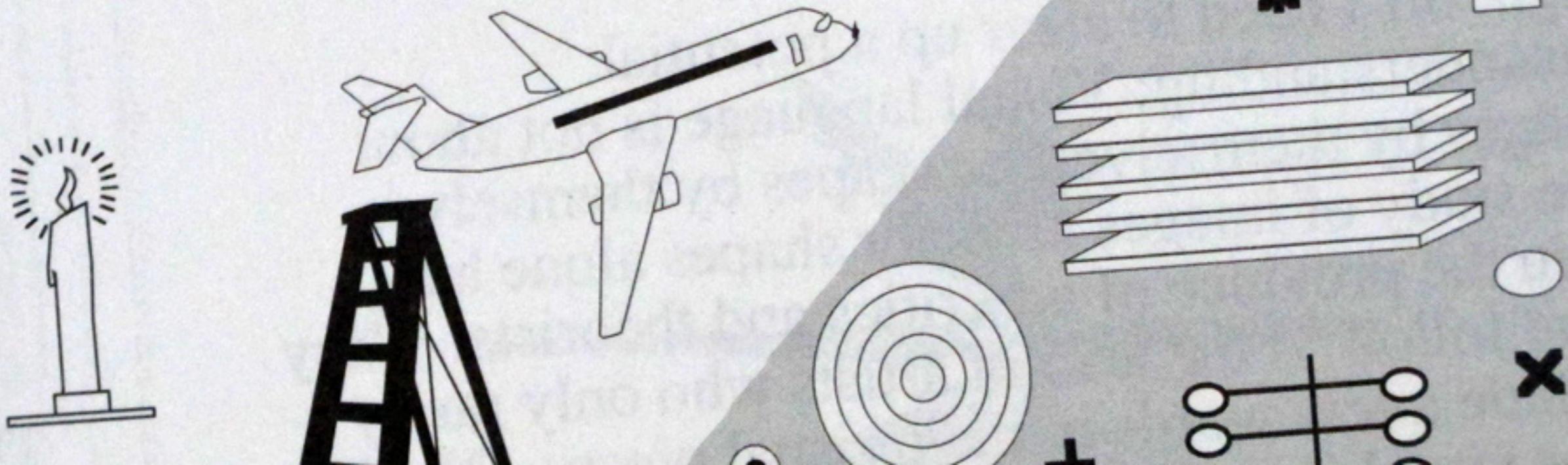
Visual Language



Definition

vis • u • al lan • guage /n/

1. the integration of words, images, and shapes into a single communication unit. 2. the use of words and images or words and shapes to form a single communication unit.



Jan V White
'Charts and Graphs'
1980

Edward Tufte
'The Visual Display of
Quantitative
Information'
1998

**Card, Mackinlay,
Schneidermann (Eds)**
'Information
Visualization'
1999

Gene Zelazny
'Say it with Charts'
1985

Robert Horn
'Visual Language'
1998

David McCandless
'Information Is
Beautiful'
200?

Jacques Bertin
'La Sémiologie
Graphique'
1967

Doig Simmonds, Ed
'Charts and Graphs'
1980

Clive Richards
'Diagrammatics'
1998

Alan MacEachren
'How Maps Work'
2000

Colin Ware
'Information
Visualization'
2000

Michael Twyman
'Schema for Study of
Graphic Languages'
1979

B Tversky
'Cognitive Origins of
Graphic Conventions'
1995

L Wilkinson
'The Grammar of
Graphics'
1999

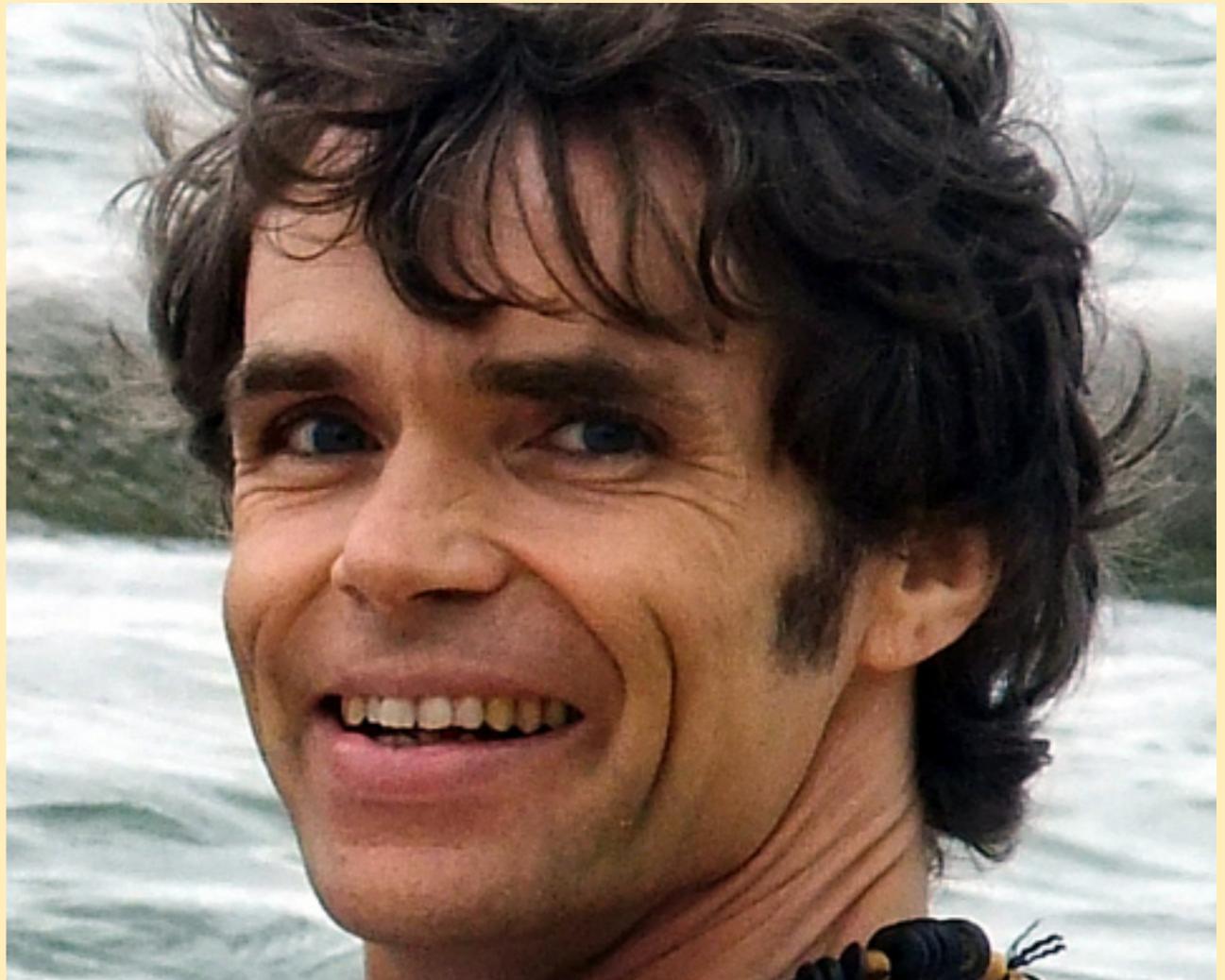
Yuri Engelhardt
'The Language of
Graphics'
2002

Yuri Engelhardt

The Language of Graphics

*a framework for the analysis
of syntax and meaning
in maps, charts and diagrams*

**University of Amsterdam
Institute for Logic, Language and
Computation**



definitions,
analyses

Graphic representation:

*a visible artifact
on a more or less flat surface
that was created in order
to express information*

Yuri Engelhardt

Graphic representation:

*a visible artifact
on a more or less flat surface
that was created in order
to express information*

Yuri Engelhardt



Compositionality of meaning

*Part of what a sentence means
depends upon its separate words,
and part depends on how
those words are arranged*

Marvin Minsky

Compositionality of meaning

*Part of what a sentence means
depends upon its separate words,
and part depends on how
those words are arranged*

Marvin Minsky



'Frege's Principle'

after the mathematician, logician & philosopher
Friedrich Ludwig Gottlob Frege

Compositionality of meaning

*A grammar is the set of rules
for combining symbols,
whether the symbols are
words or pictures.*

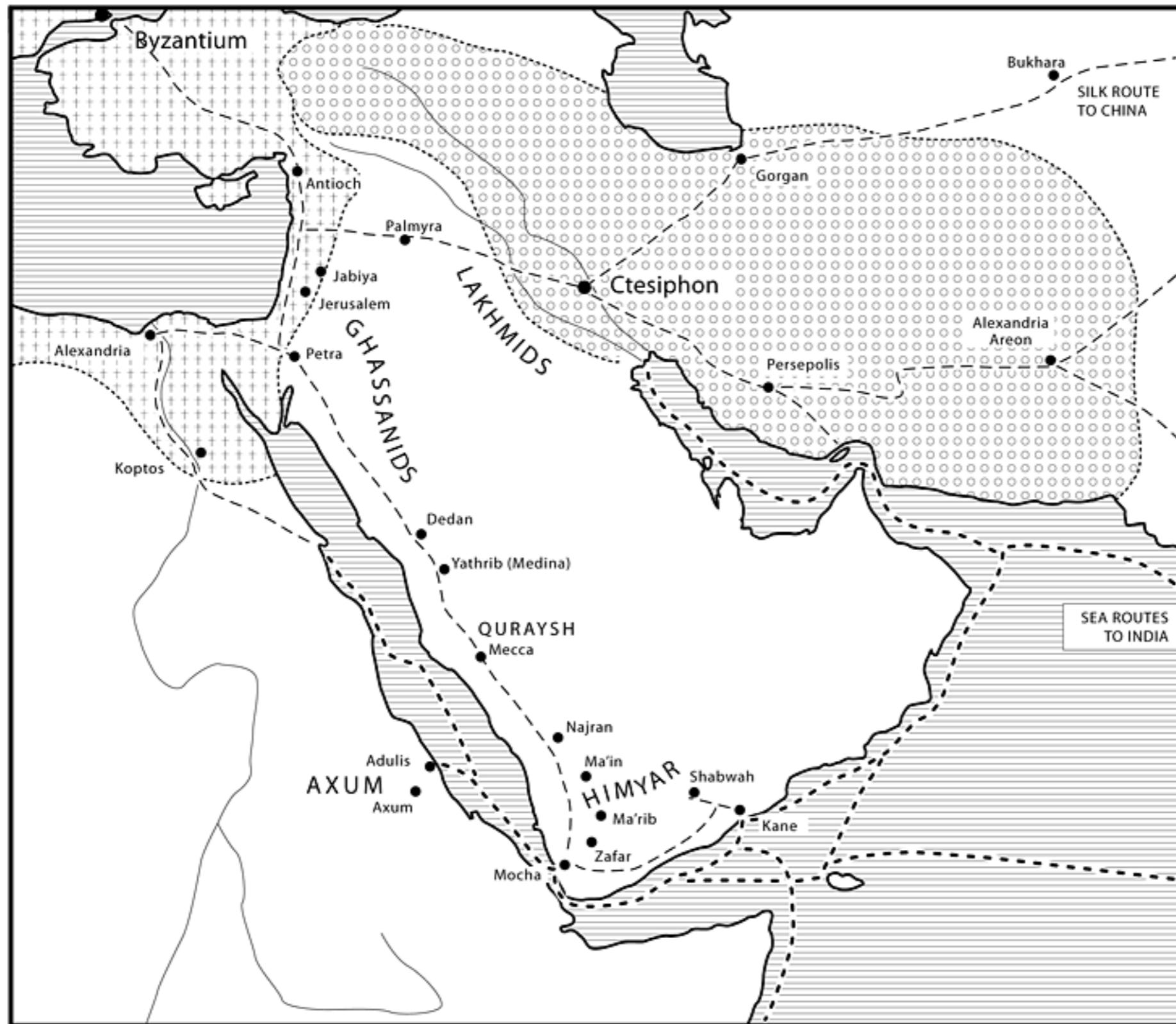
W K Horton (1994)

*The Icon Book: Visual Symbols for
computer systems and documentation*

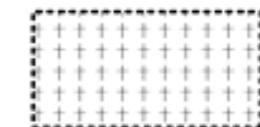
Composite graphic objects: three samples

- *a map with information overlay*
- *a graph of quantitative data*
- *a network diagram*

Arabia and its neighbours around the year 570 CE



Byzantine Empire:

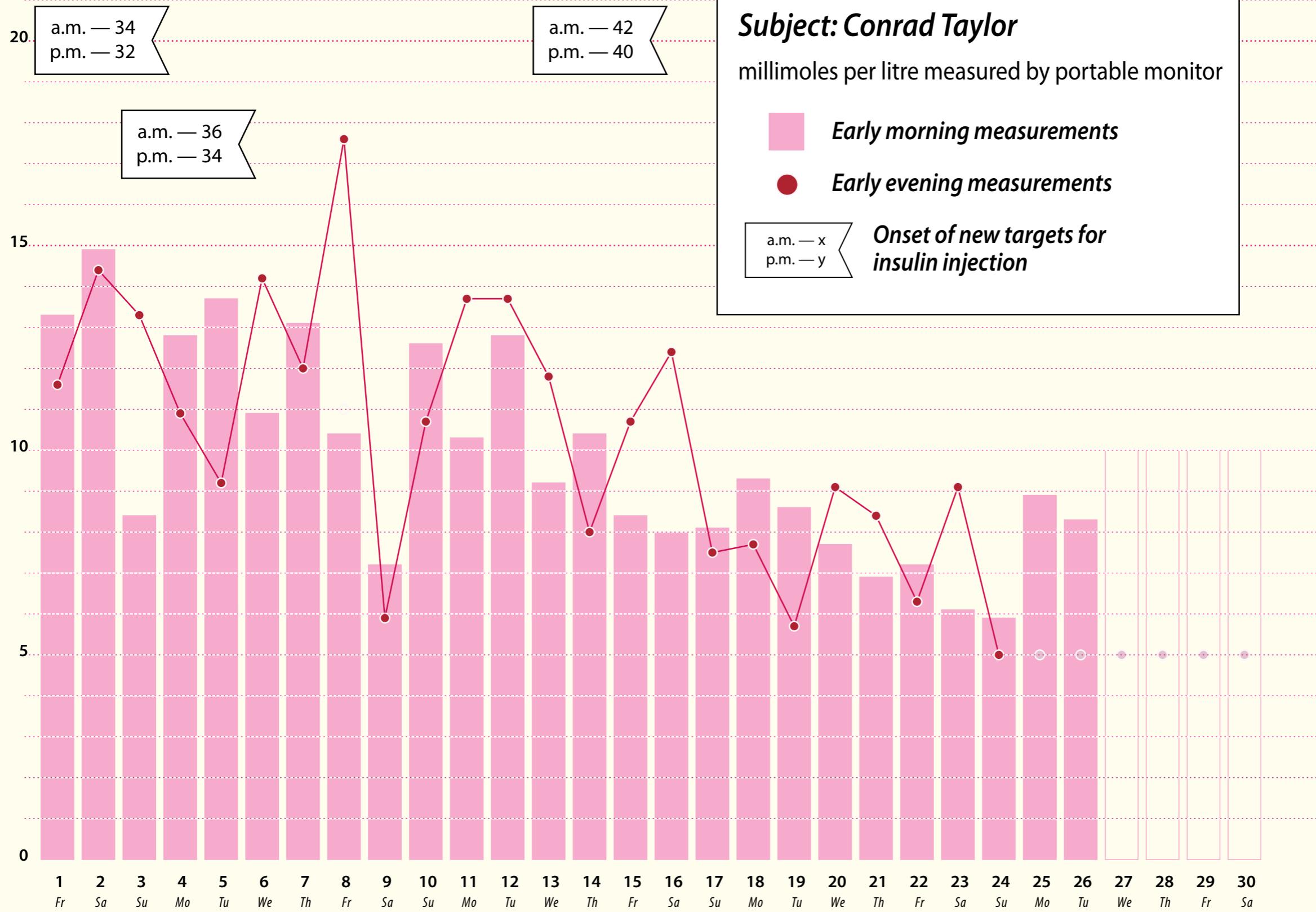


Sāsānid Empire:



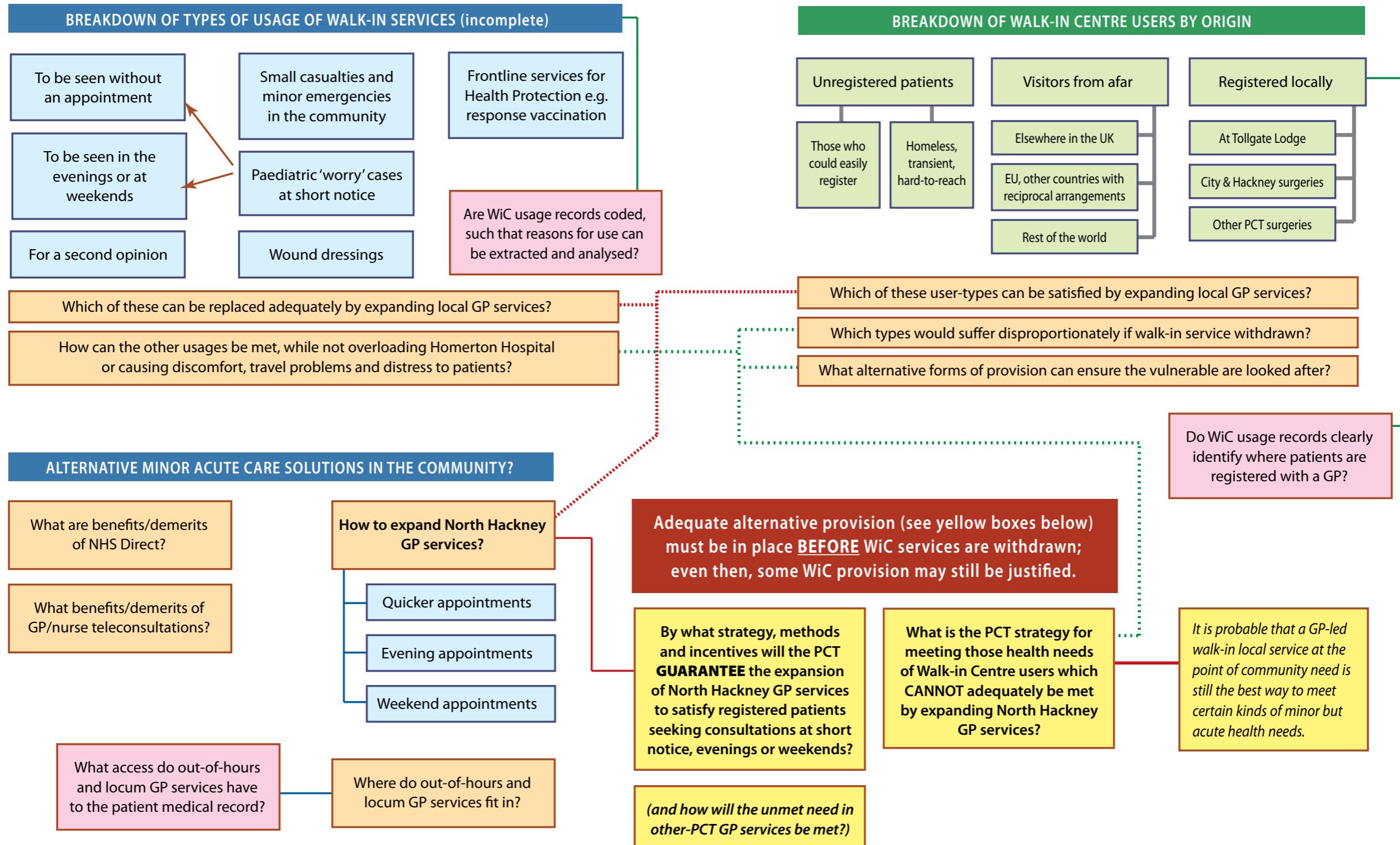
Mapping: Conrad Taylor

June 2012



PCT proposal to remove the Walk-in Centre service at Tollgate Lodge Healthcare Centre – an issues map

prepared by Conrad Taylor to assist discussion



a composite graphic object

consists of

a graphic space

graphic objects

graphic relations

a composite graphic object

consists of

a graphic space

graphic objects

graphic relations

object-to-object relations

object-to-space relations

a composite graphic object

consists of

a graphic space

graphic objects

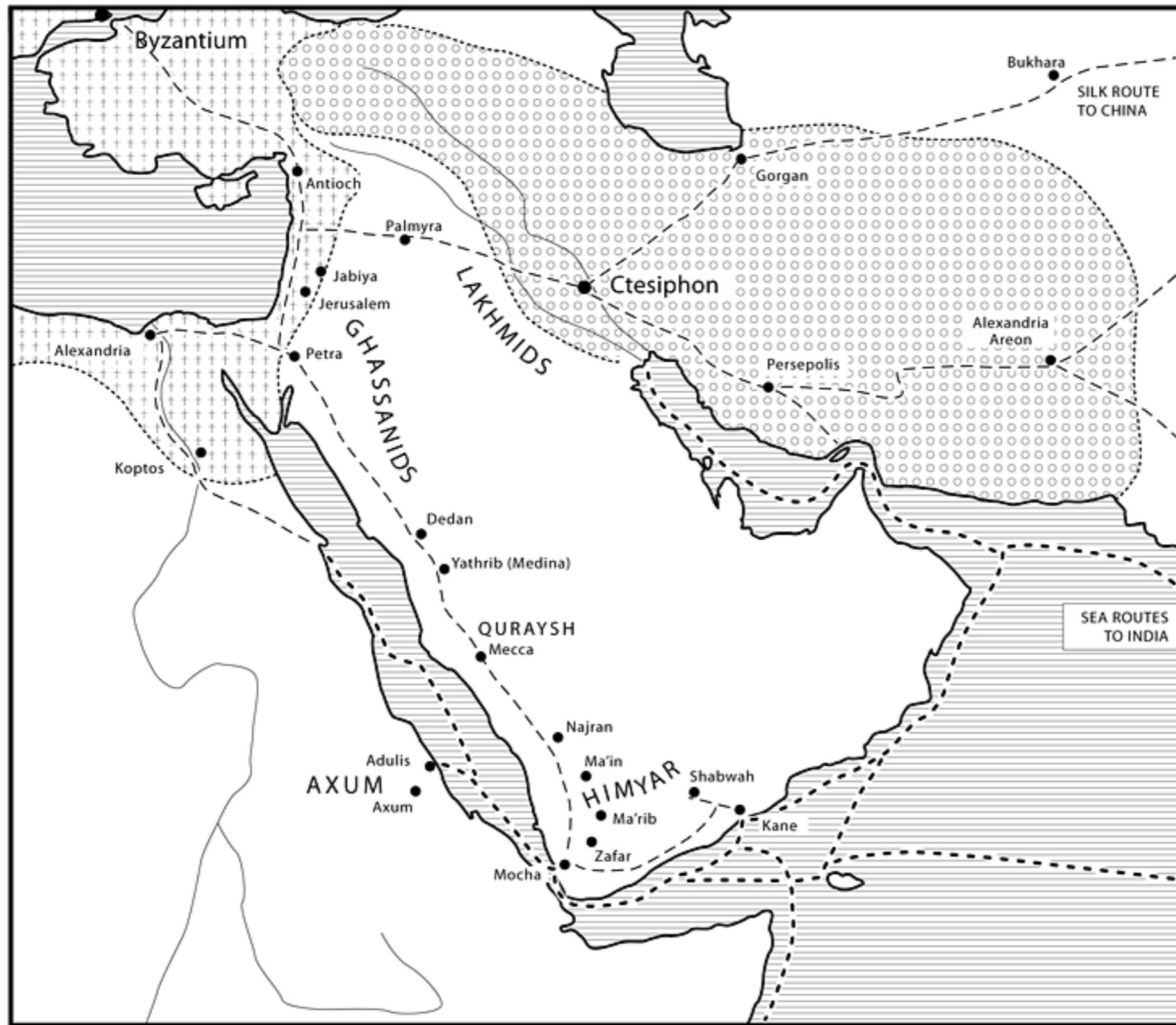
graphic relations

object-to-object relations

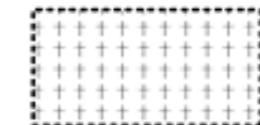
object-to-space relations

Relations are achieved (represented) visually using 'gestalt principles' and techniques such as **proximity**, **similarity**, **common region (enclosure)**, **connectedness**, **good continuation (alignment)**, **assumed closure**

Arabia and its neighbours around the year 570 CE



Byzantine Empire:

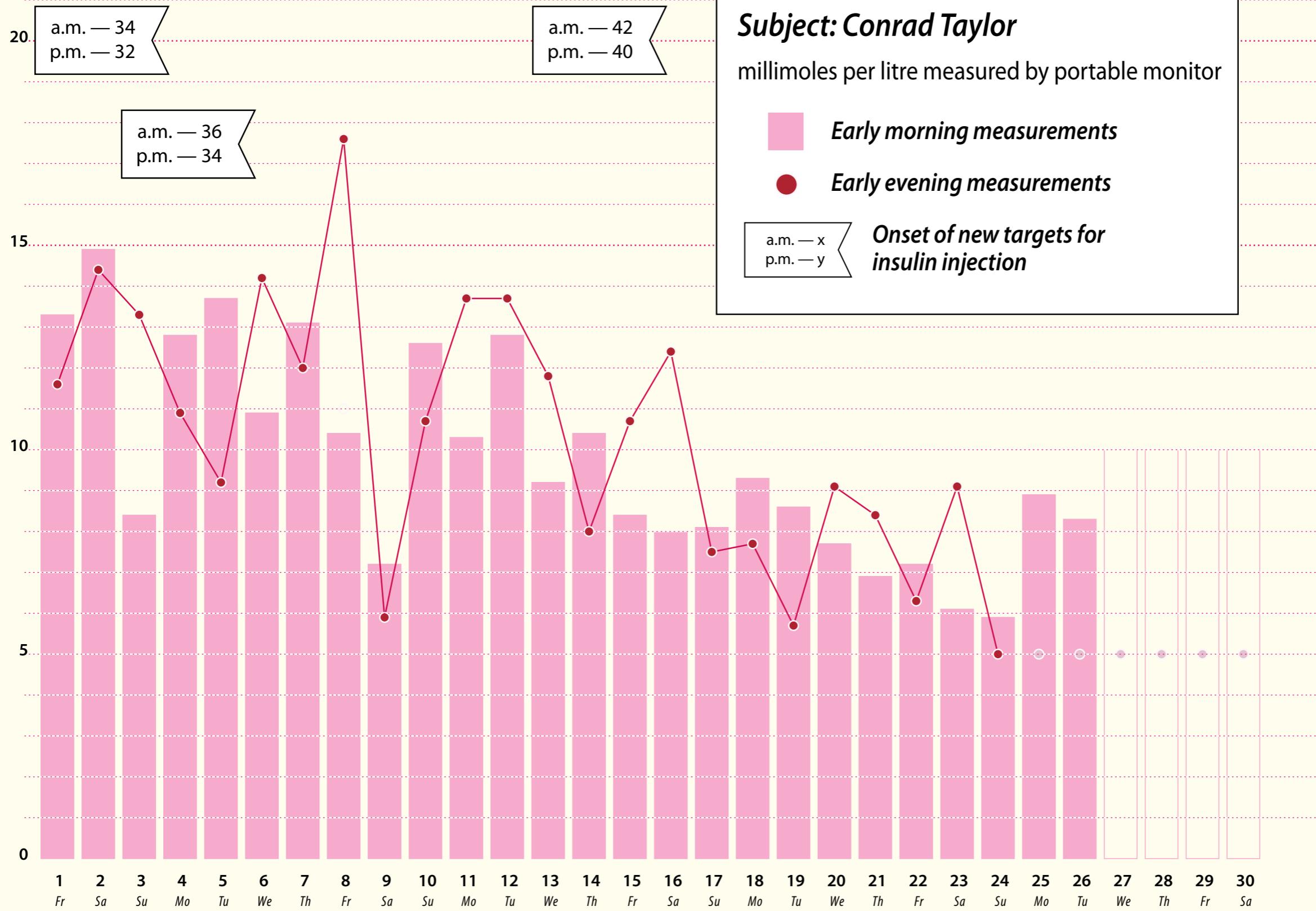


Sāsānid Empire:



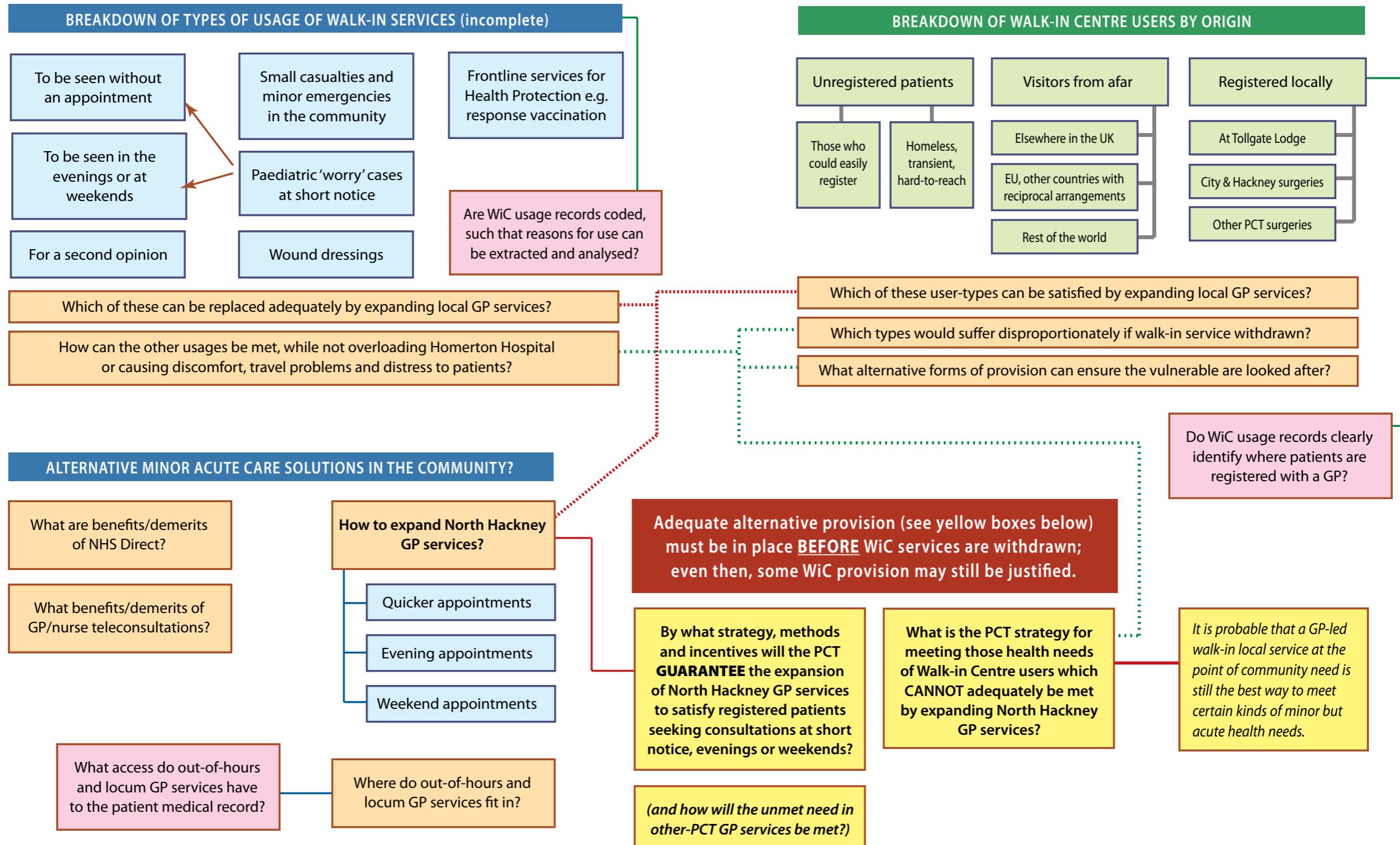
Mapping: Conrad Taylor

June 2012



PCT proposal to remove the Walk-in Centre service at Tollgate Lodge Healthcare Centre – an issues map

prepared by Conrad Taylor to assist discussion

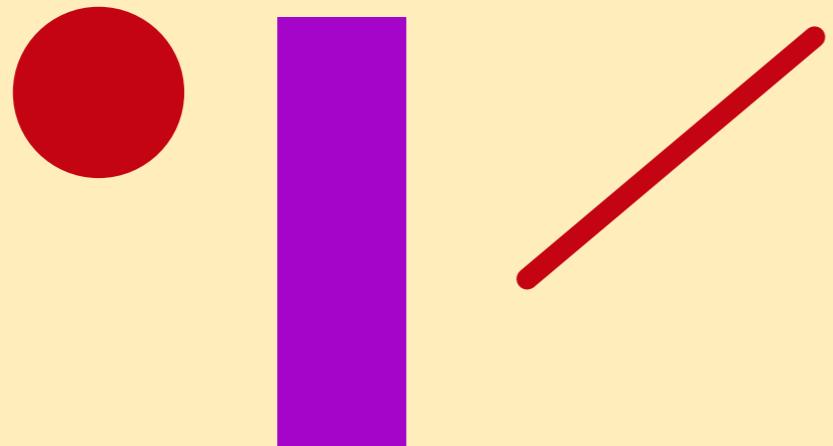


'Symbology'

*the search for the visual morpheme,
the 'primitive graphic object'*

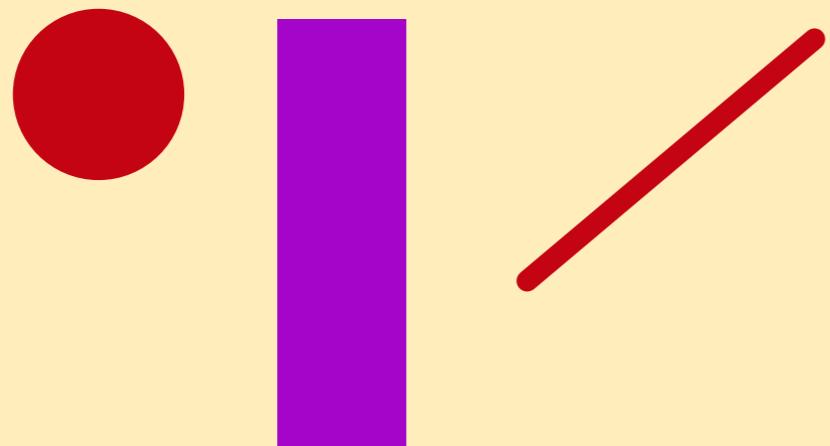
'Symbology'

*the search for the visual morpheme,
the 'primitive graphic object'*



'Symbology'

*the search for the visual morpheme,
the 'primitive graphic object'*







West Lake



No dogs



No fishing



No swimming



Deep water



Sudden drop



Rowing area

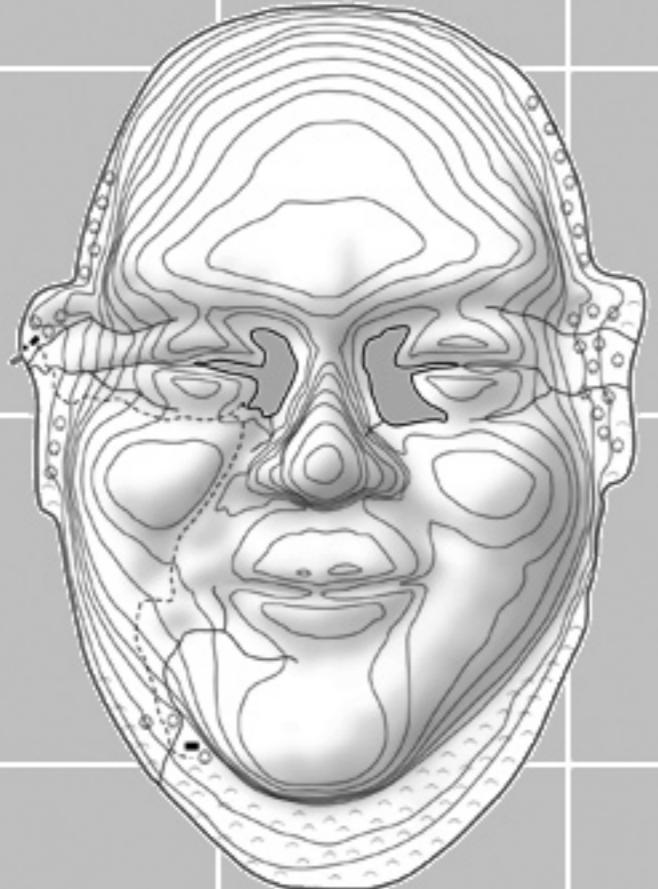
Dial 999 in emergency

Call 020 8985 5699 for information



**signification-
carrying
variables**

JACQUES BERTIN

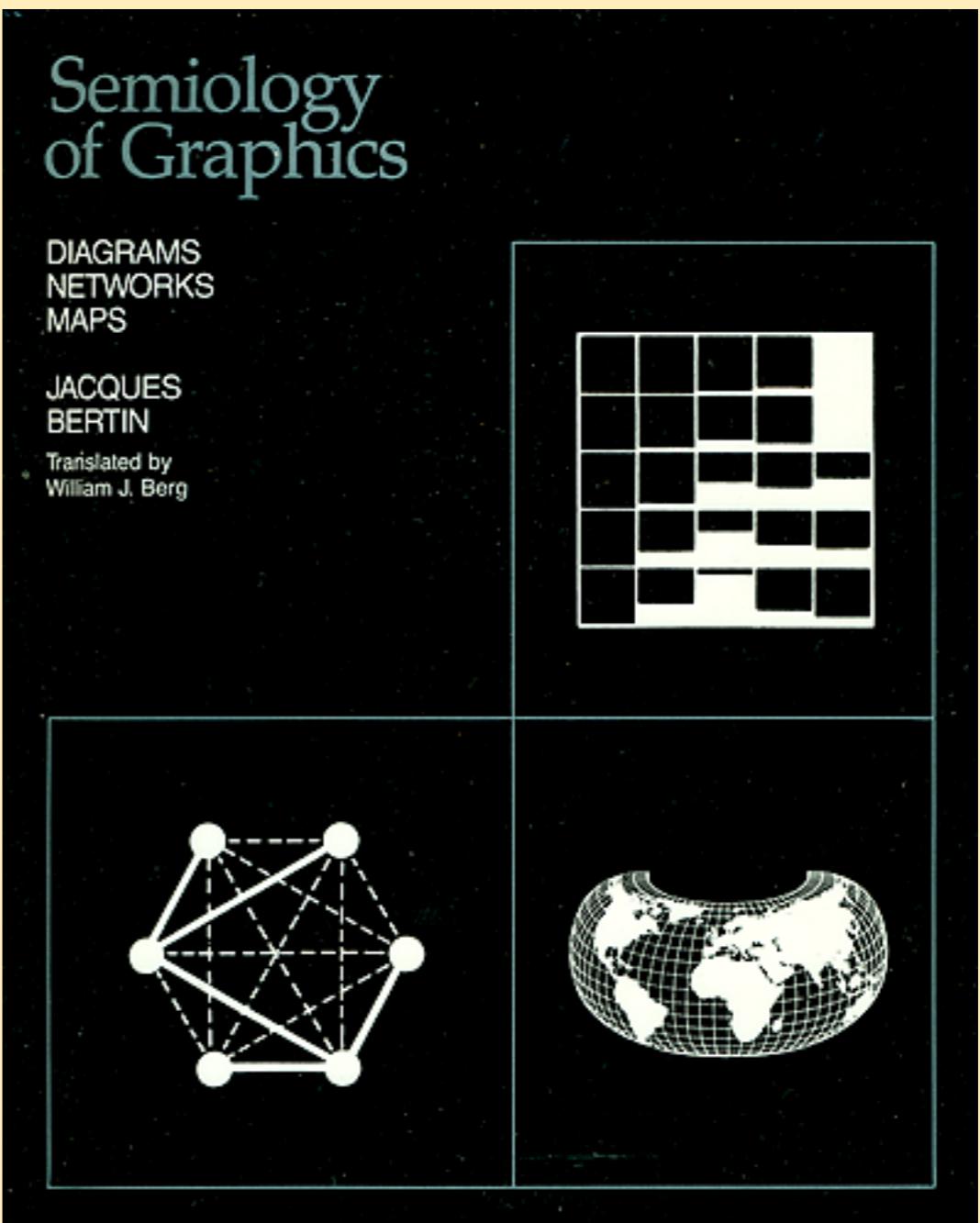


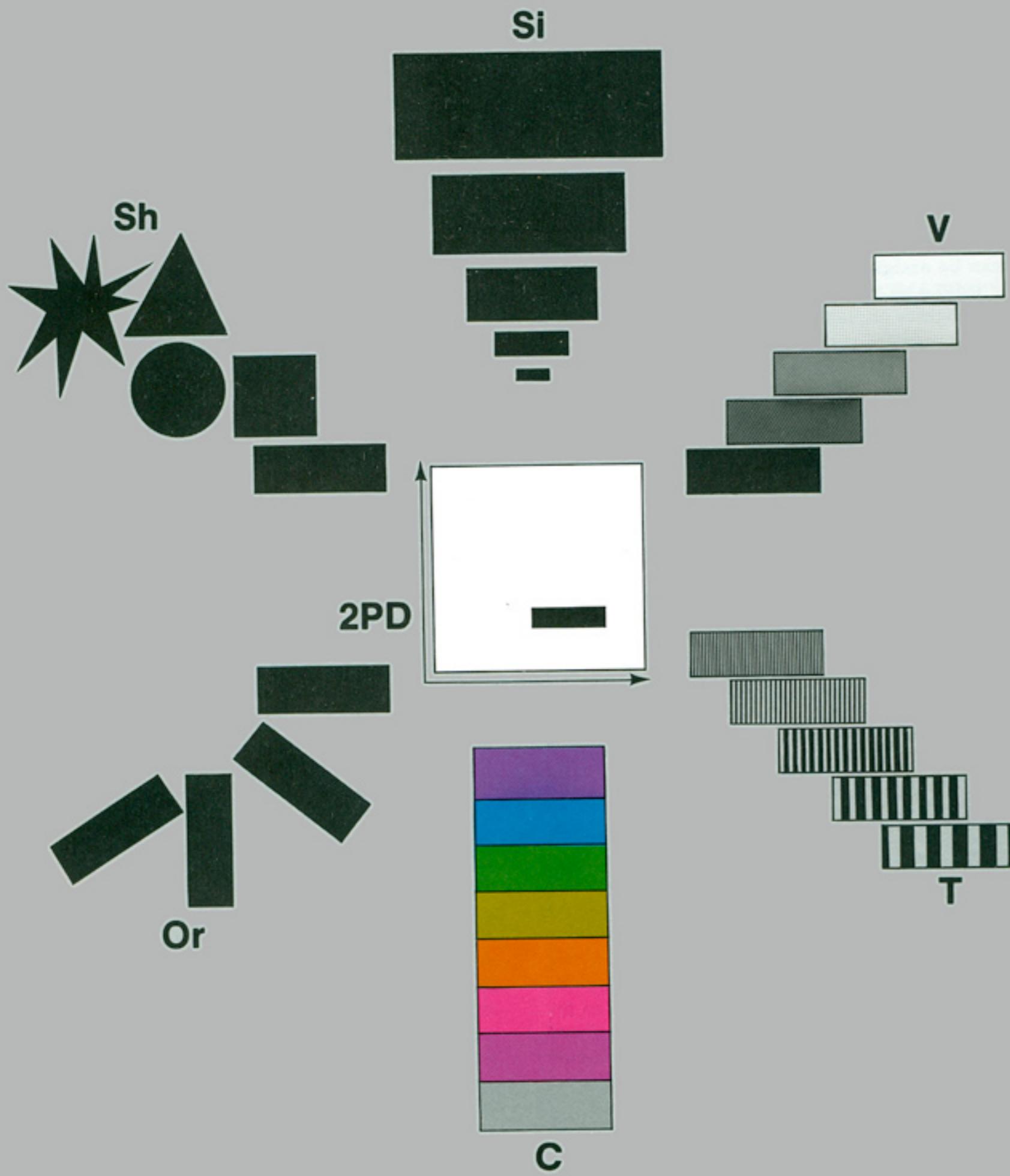
CHARTING *a* CONTRIBUTION

English edition
Translated by William J Berg
University of Wisconsin Press
1983

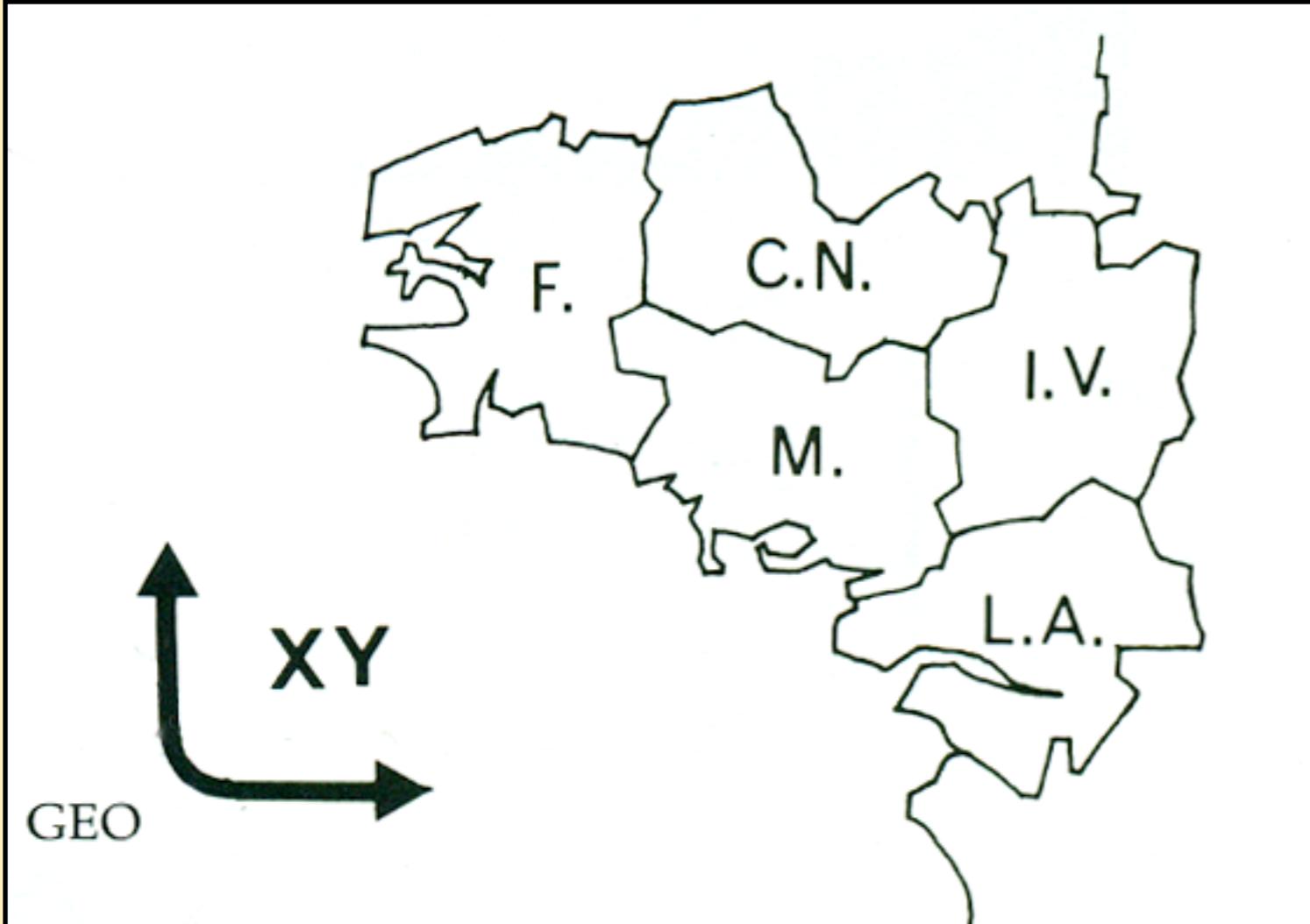
Jacques Bertin
La Semiologie Graphique

1967



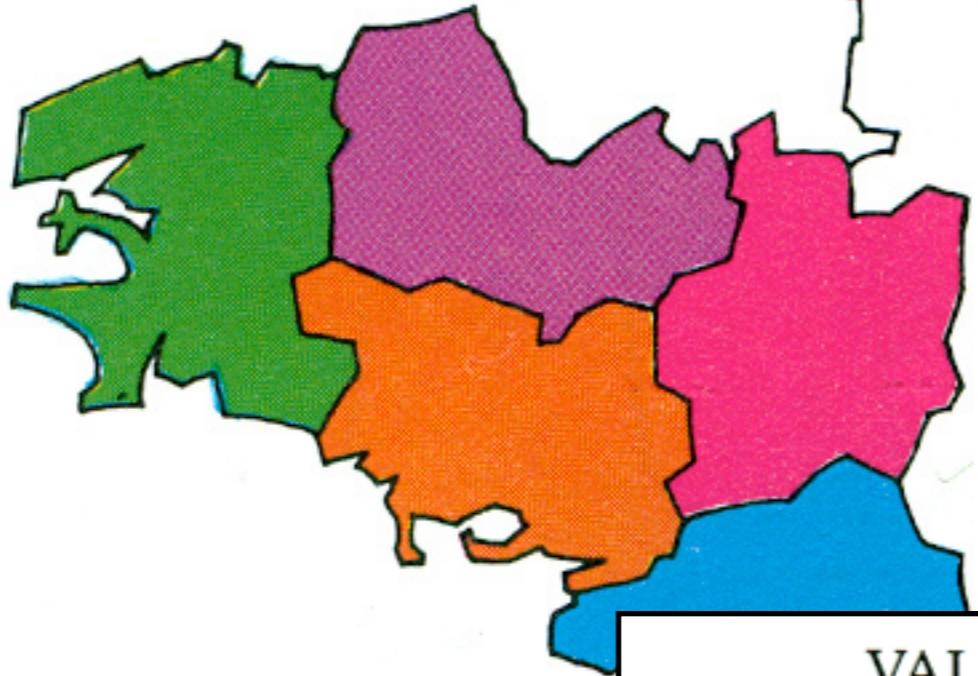


Jacques Bertin's retinal variables



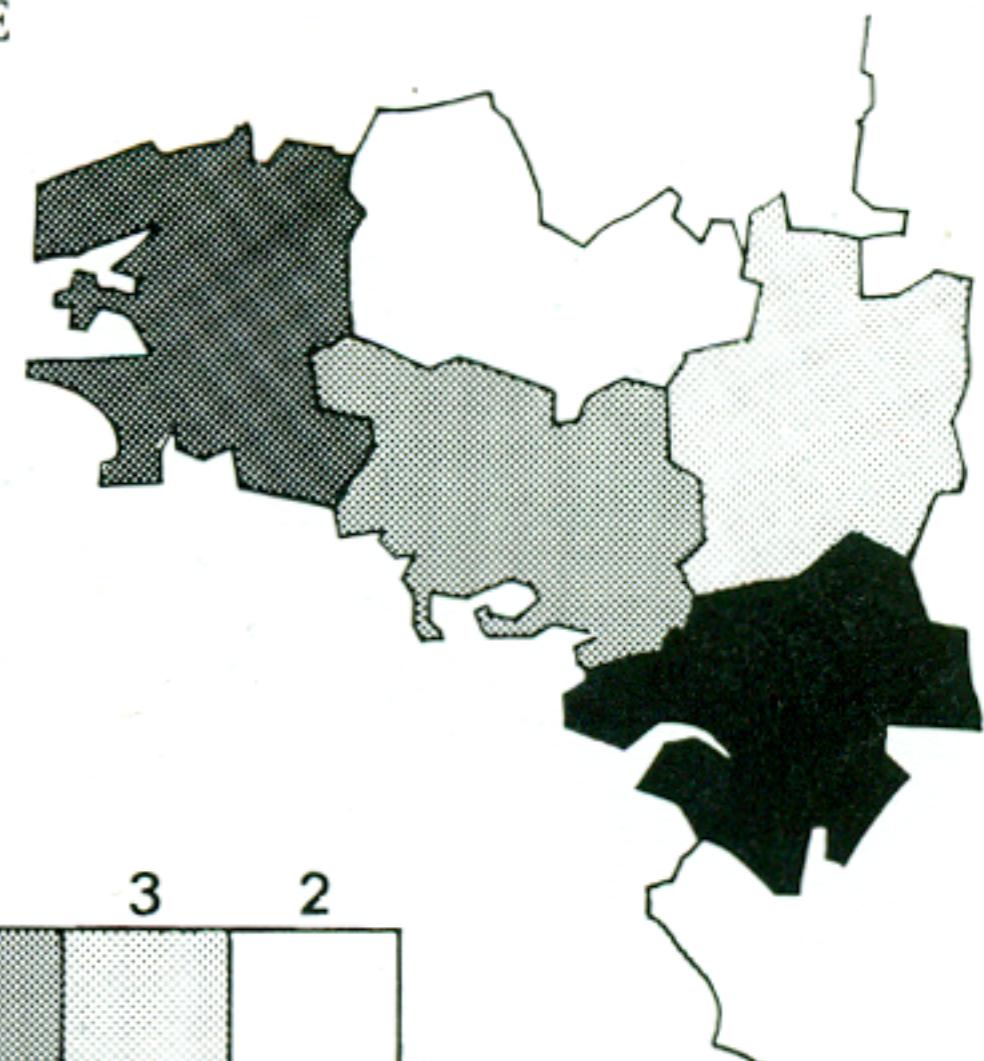
Bertin's positional variable

COLOR



37 9 6 3 2

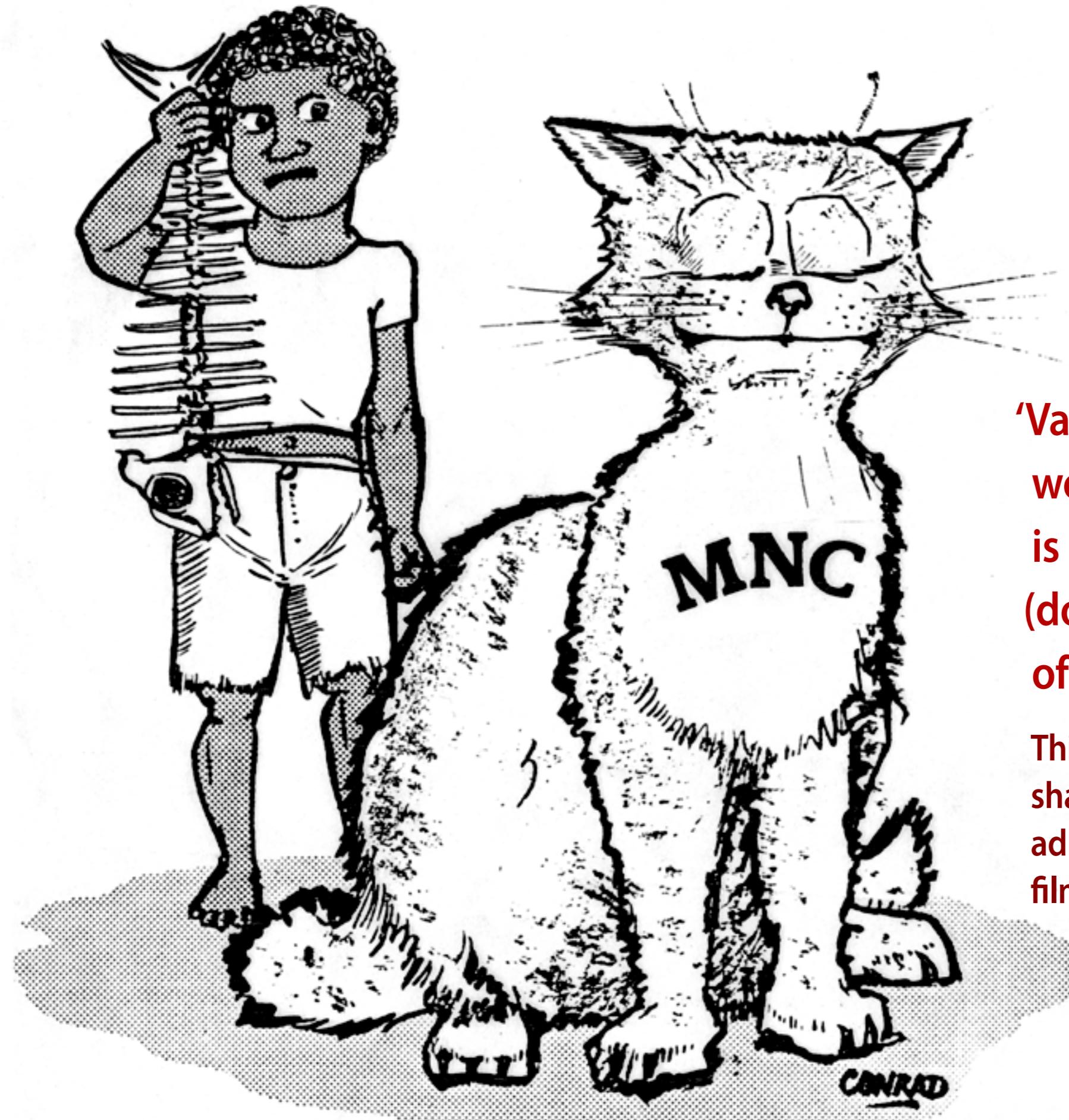
VALUE



37 9 6 3 2

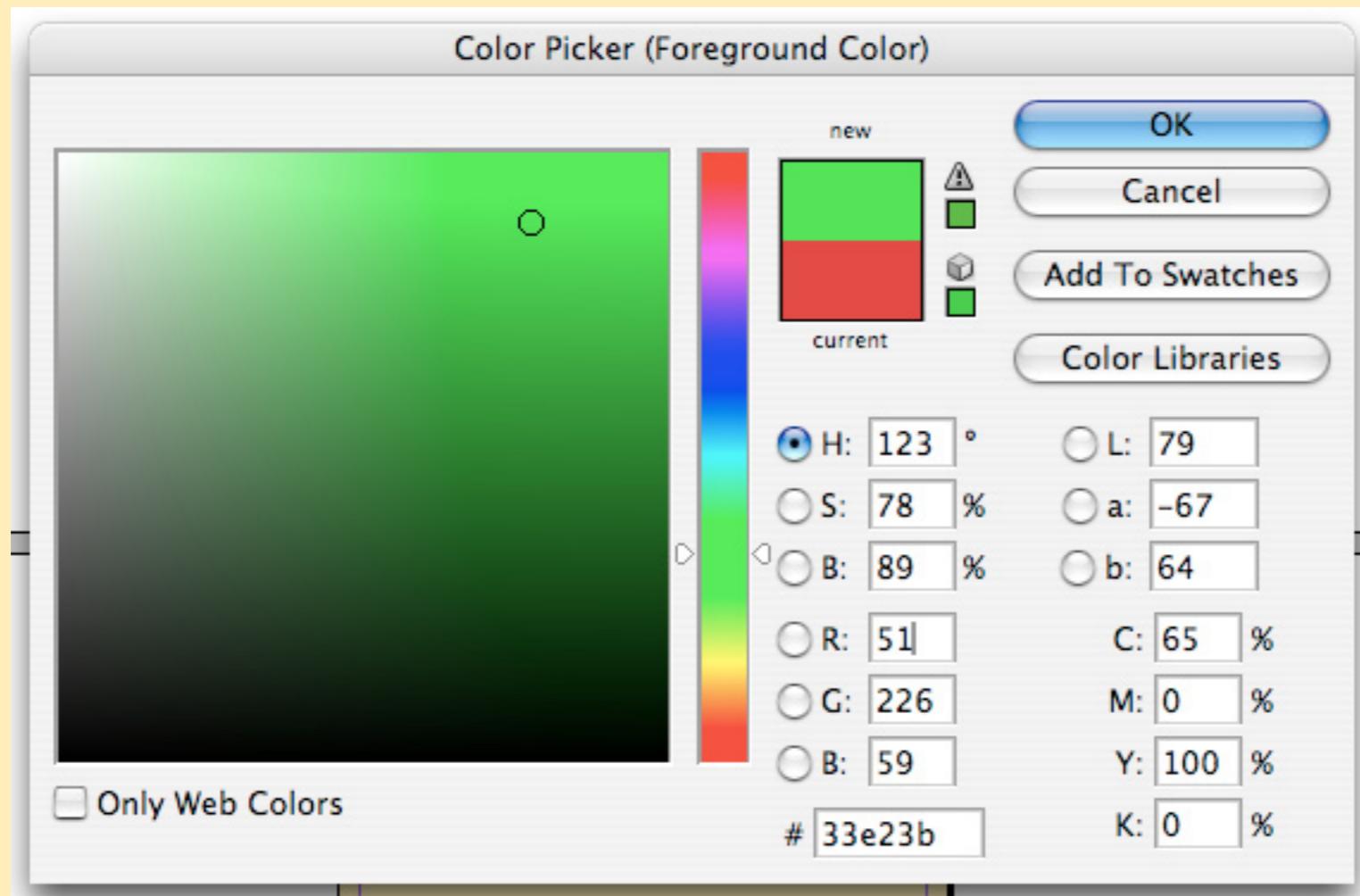
**'Colour' and
'Value'...**

a distinction that is
behind the times?



'Value' in the
world of print
is made of tints
(dot patterns &c)
of the ink colour.

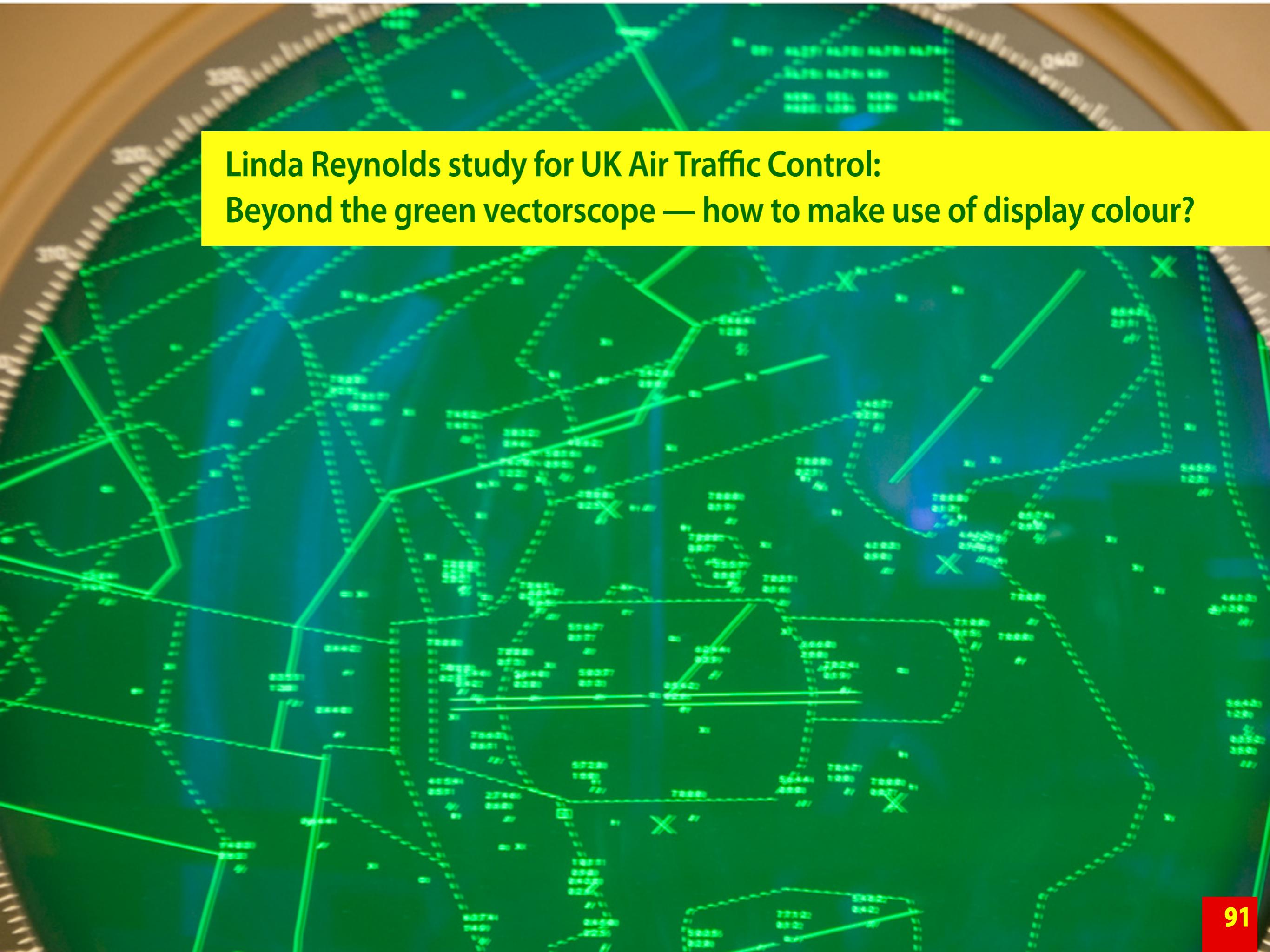
This cartoon was
shaded with tinted
adhesive 'Letratone'
films.

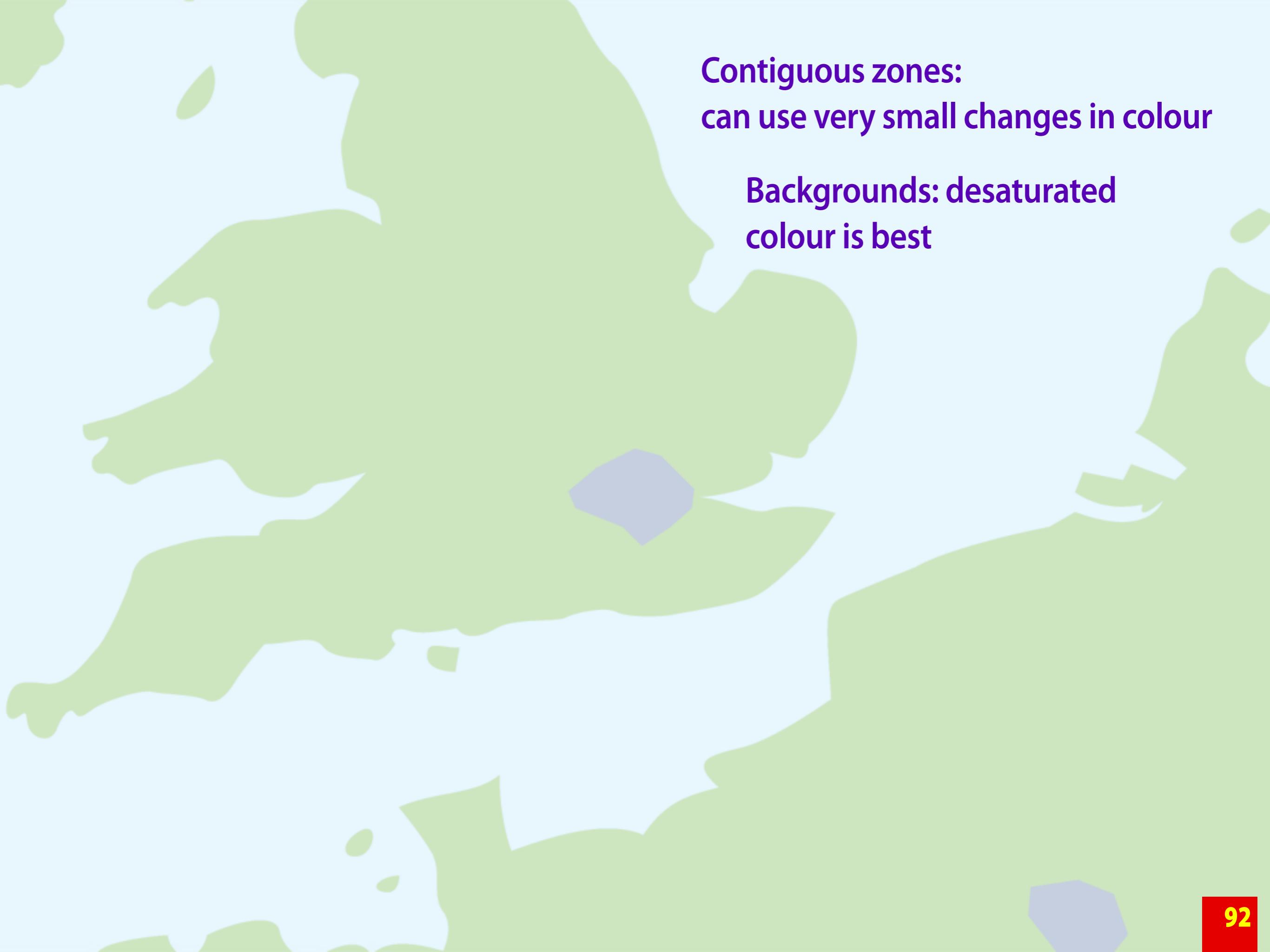


24-bit RGB
= 16,777,216 colours

**Colour and value
replaced by Hue and
Brightness and
Saturation...**

Linda Reynolds study for UK Air Traffic Control: Beyond the green vectorscope — how to make use of display colour?



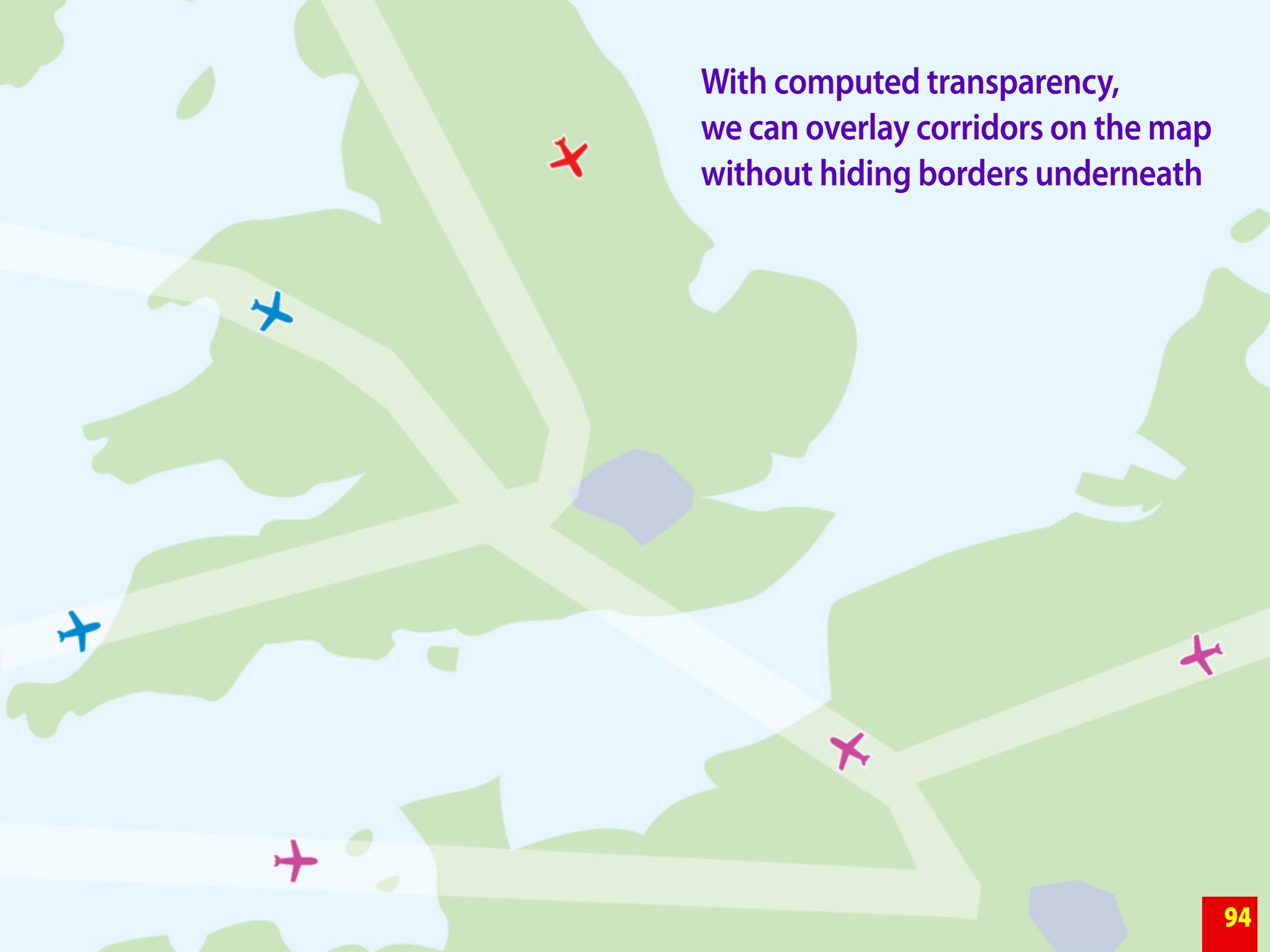


Contiguous zones:
can use very small changes in colour

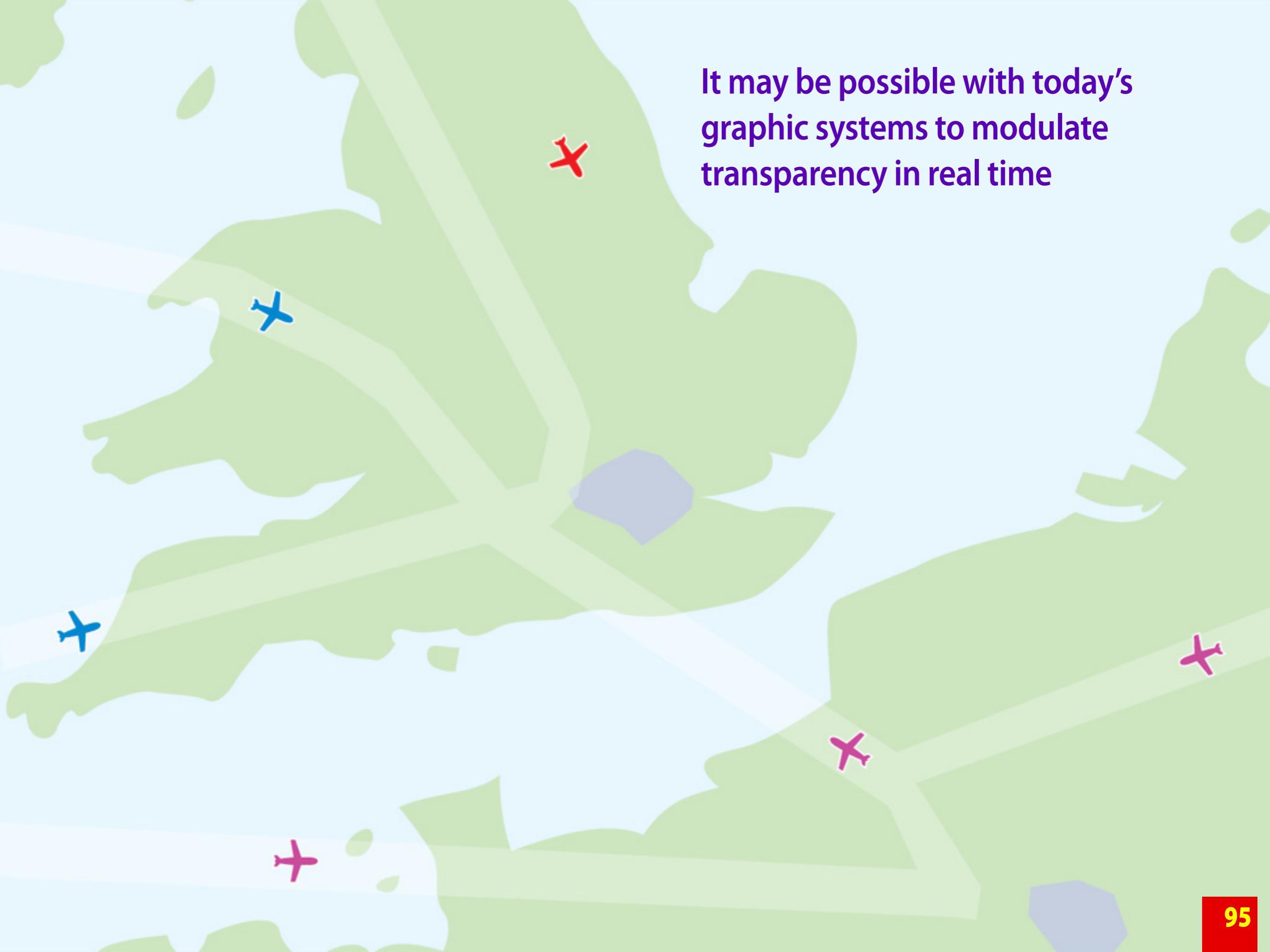
Backgrounds: desaturated
colour is best



Colour for identification of
foreground objects:
few, well-differentiated colours



With computed transparency,
we can overlay corridors on the map
without hiding borders underneath



It may be possible with today's graphic systems to modulate transparency in real time



A map of the United States with various flight paths highlighted by dashed lines. Five specific flight routes are marked with yellow circular icons containing airplane symbols, each connected by a thin black line to a small dark grey dot. The icons are colored blue, red, green, purple, and orange. A single red 'X' symbol is also present on the map, indicating a point of interest or a dismissed feature.

Optional display features
can be called up or dismissed
as the need requires



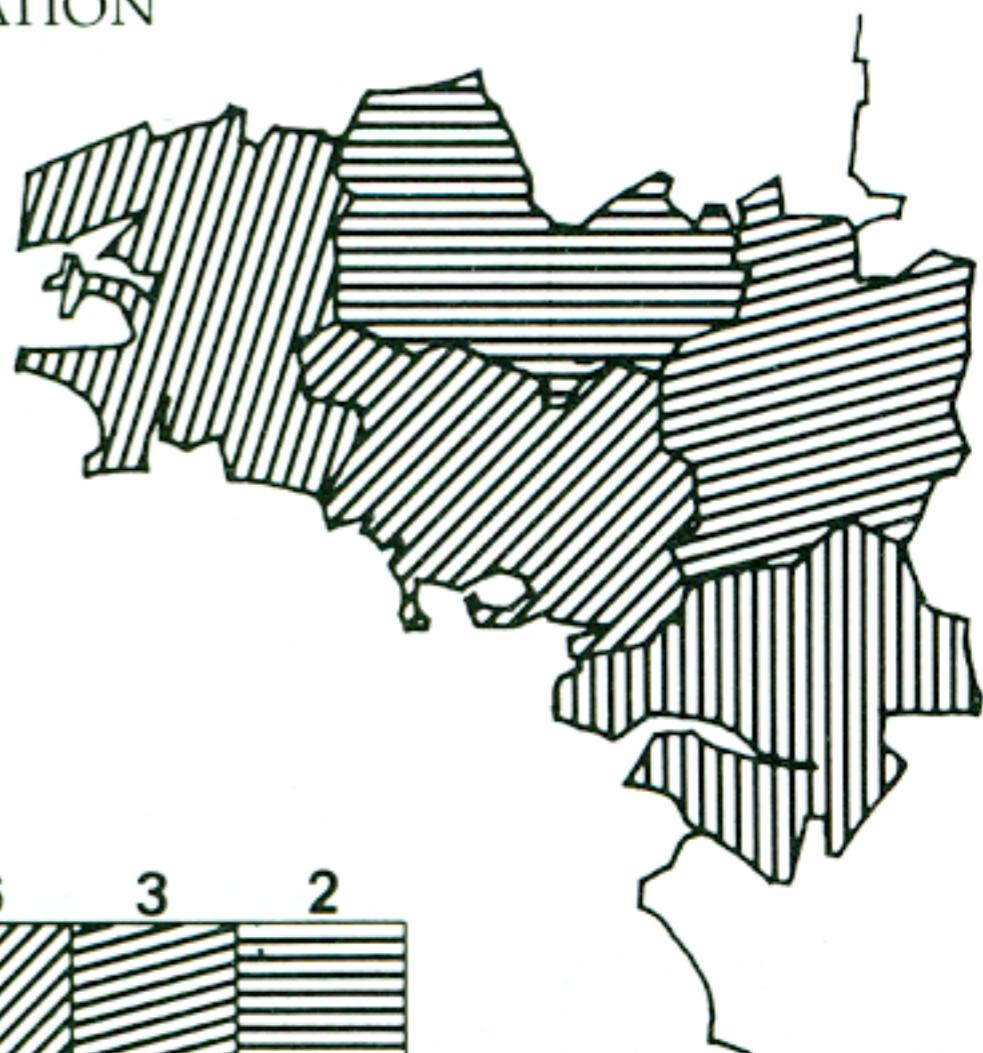
Linda Reynolds :
***Colour Displays and how to make
the most of them***

[http://www.ingenia.org.uk/ingenia/
articles.aspx?Index=106](http://www.ingenia.org.uk/ingenia/articles.aspx?Index=106)

TEXTURE



ORIENTATION

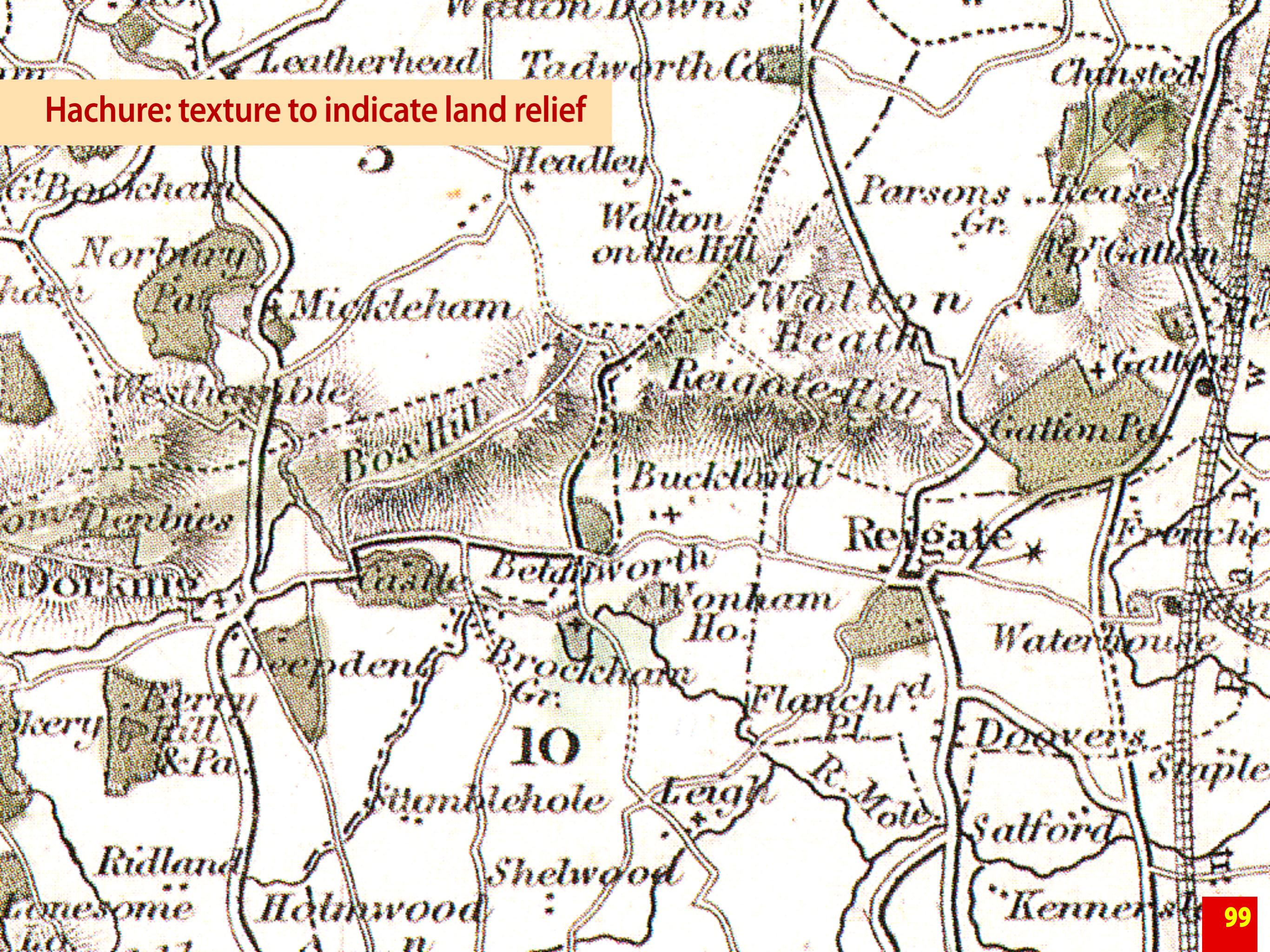


Orientation:
more significant as symbols
(e.g. for wind direction)
than as shadings

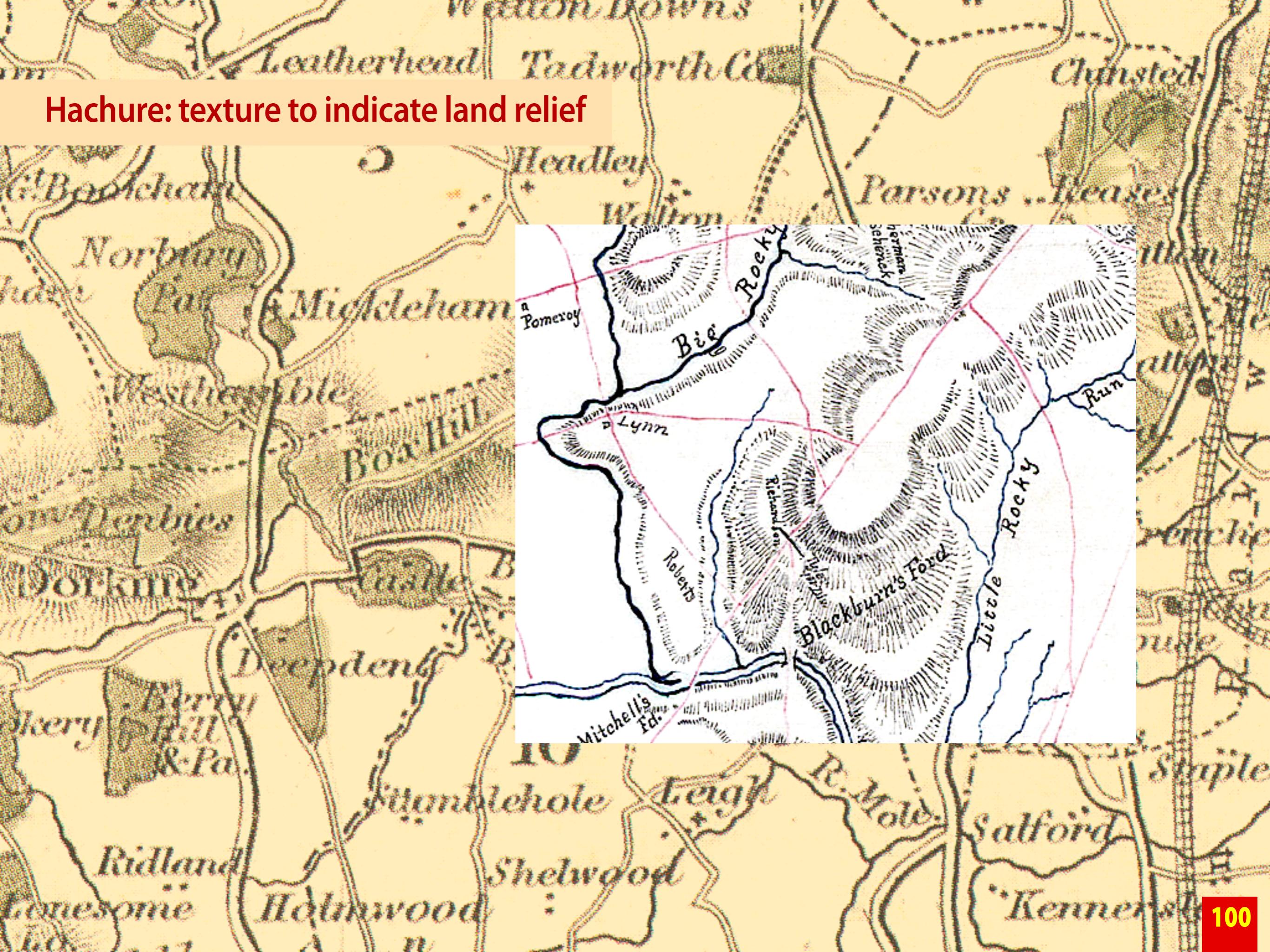
'Texture' and 'Orientation'...

'Texture' may be a
mis-translation of
Bertin's 'grain'

Hachure: texture to indicate land relief



Hachure: texture to indicate land relief





Texture used in
colour map printing
using 'special' colours
(not CMYK process)

HEIGHTS
IN FEET

3000

1500

600

300

SEA LEVEL

Depression

80

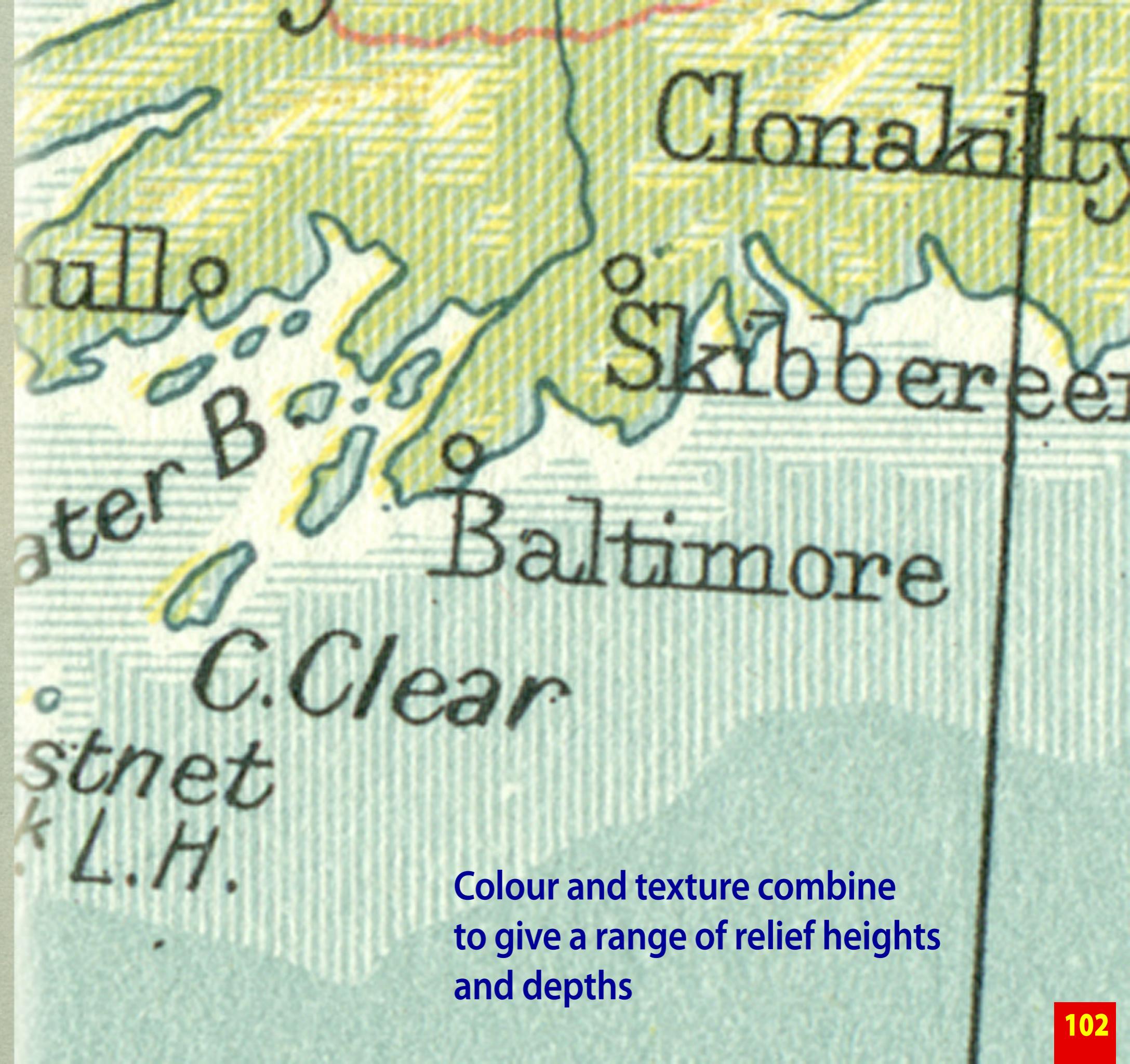
150

300

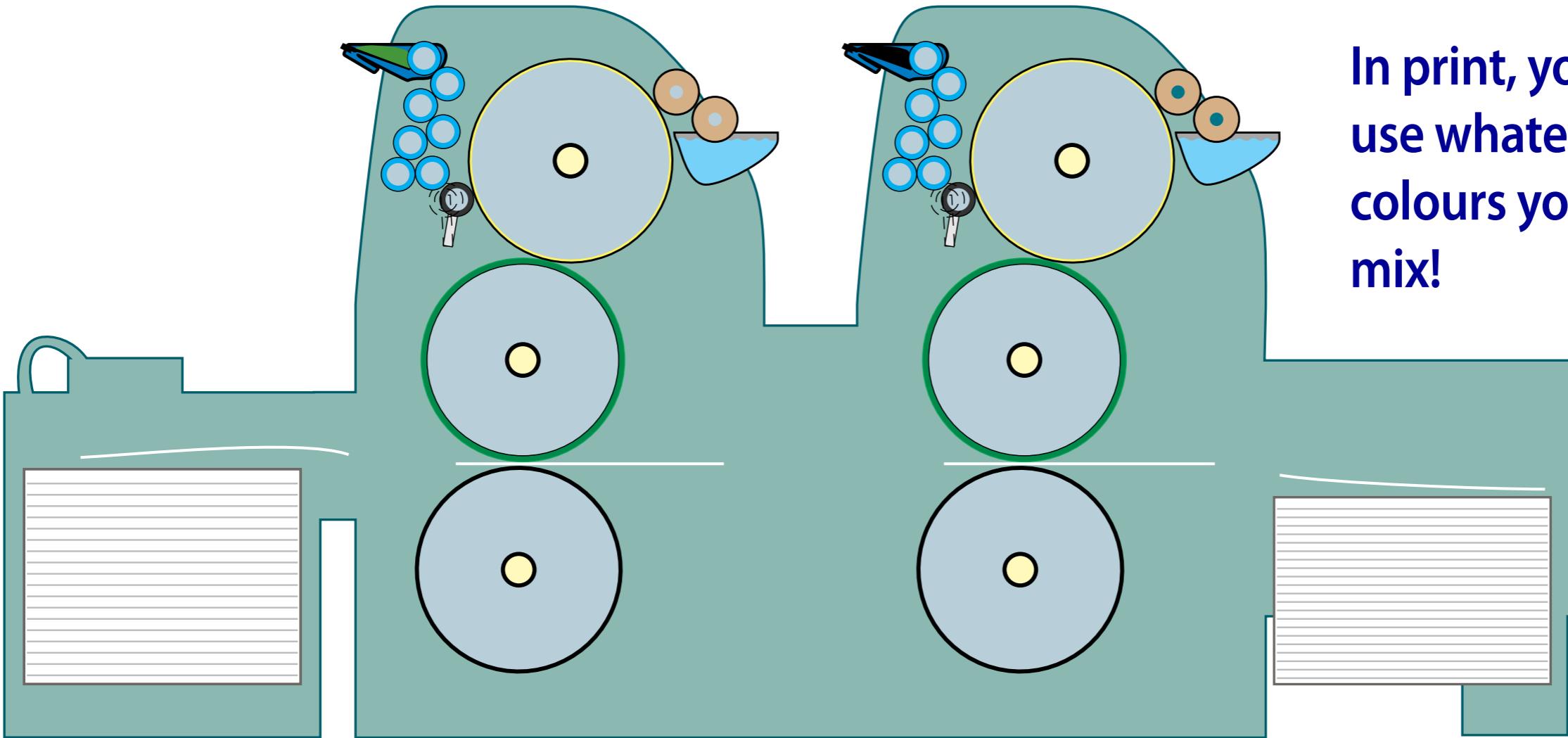
600

3000

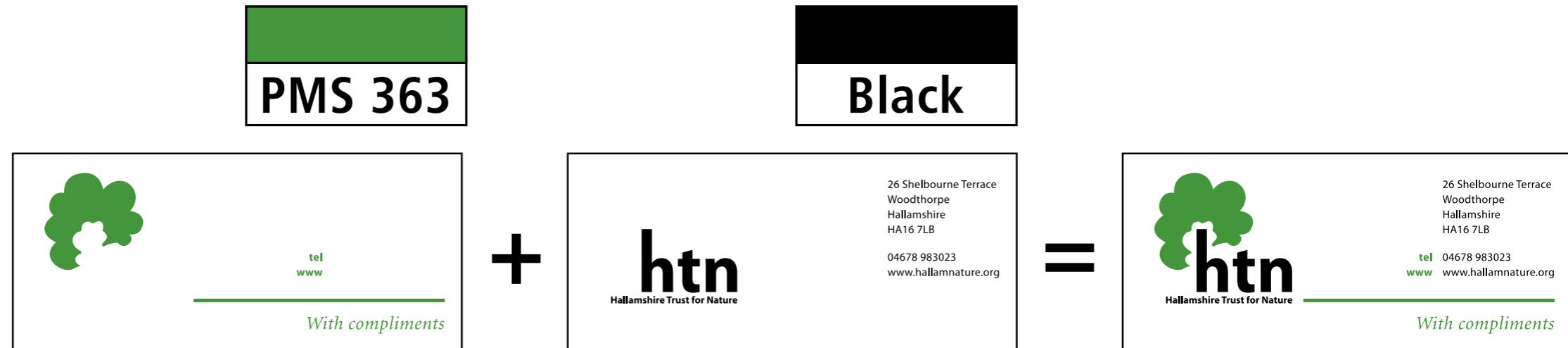
DEPTHS
IN FEET



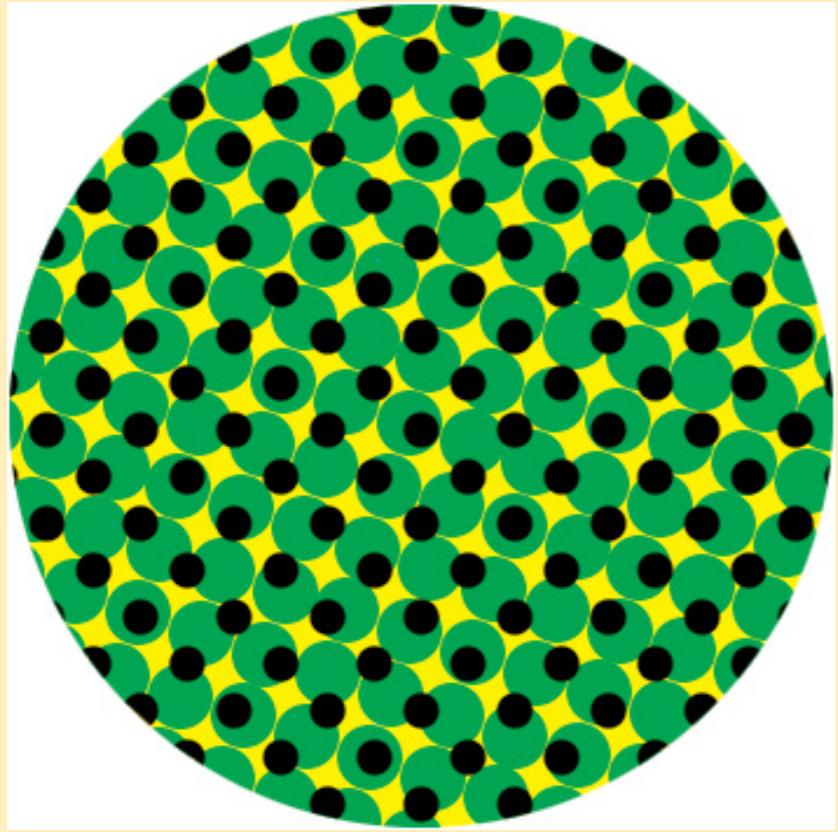
Colour and texture combine
to give a range of relief heights
and depths



In print, you can use whatever colours you can mix!



...in this example, Black plus a special Green defined as Pantone 363

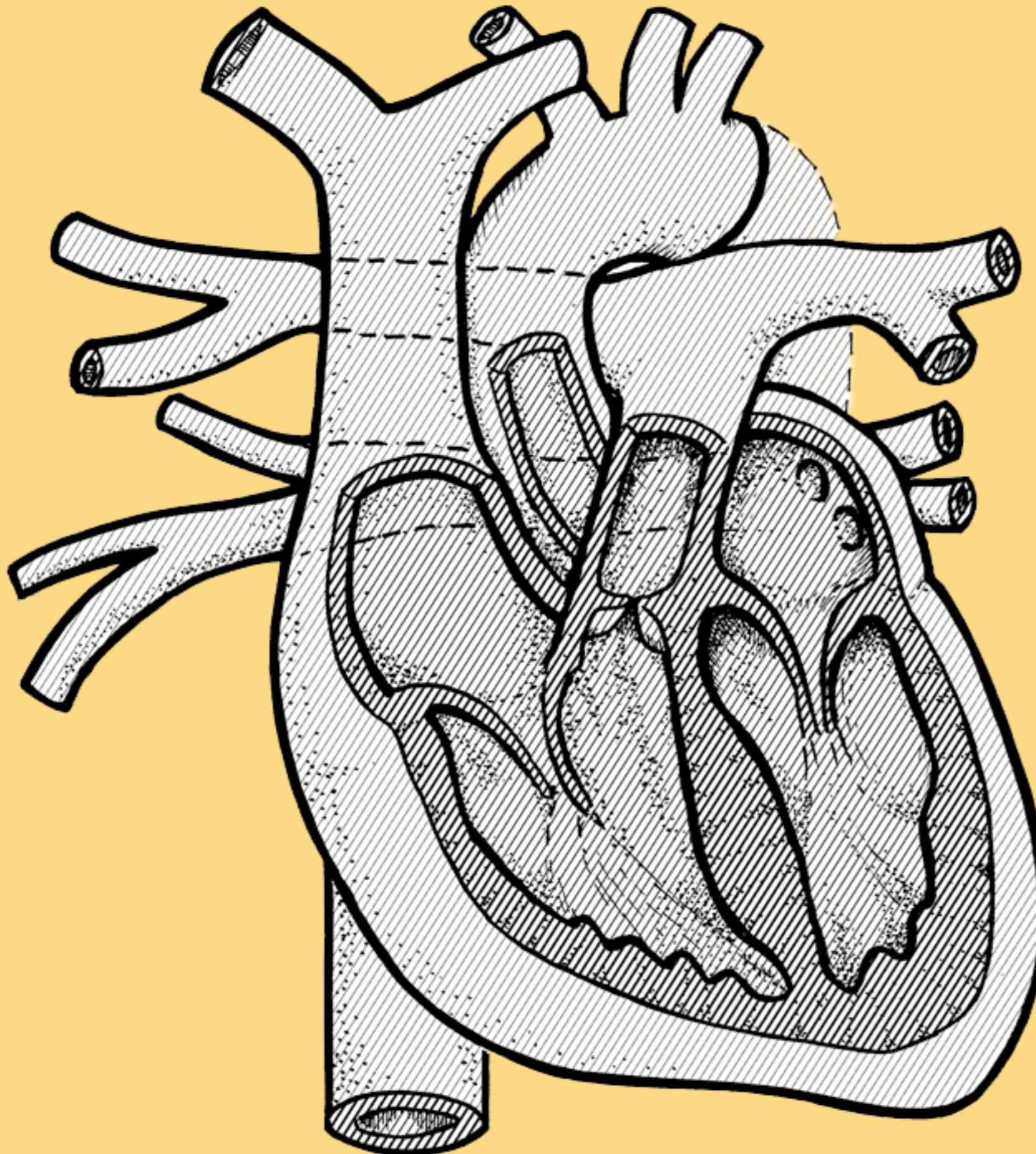


Some reprographic systems will represent Bertin's Value and Colour using overlaid dot-tints or 'screens' from component ink systems such as CMYK



Displaying solid colours, not tints, preserves the ability to render fine details

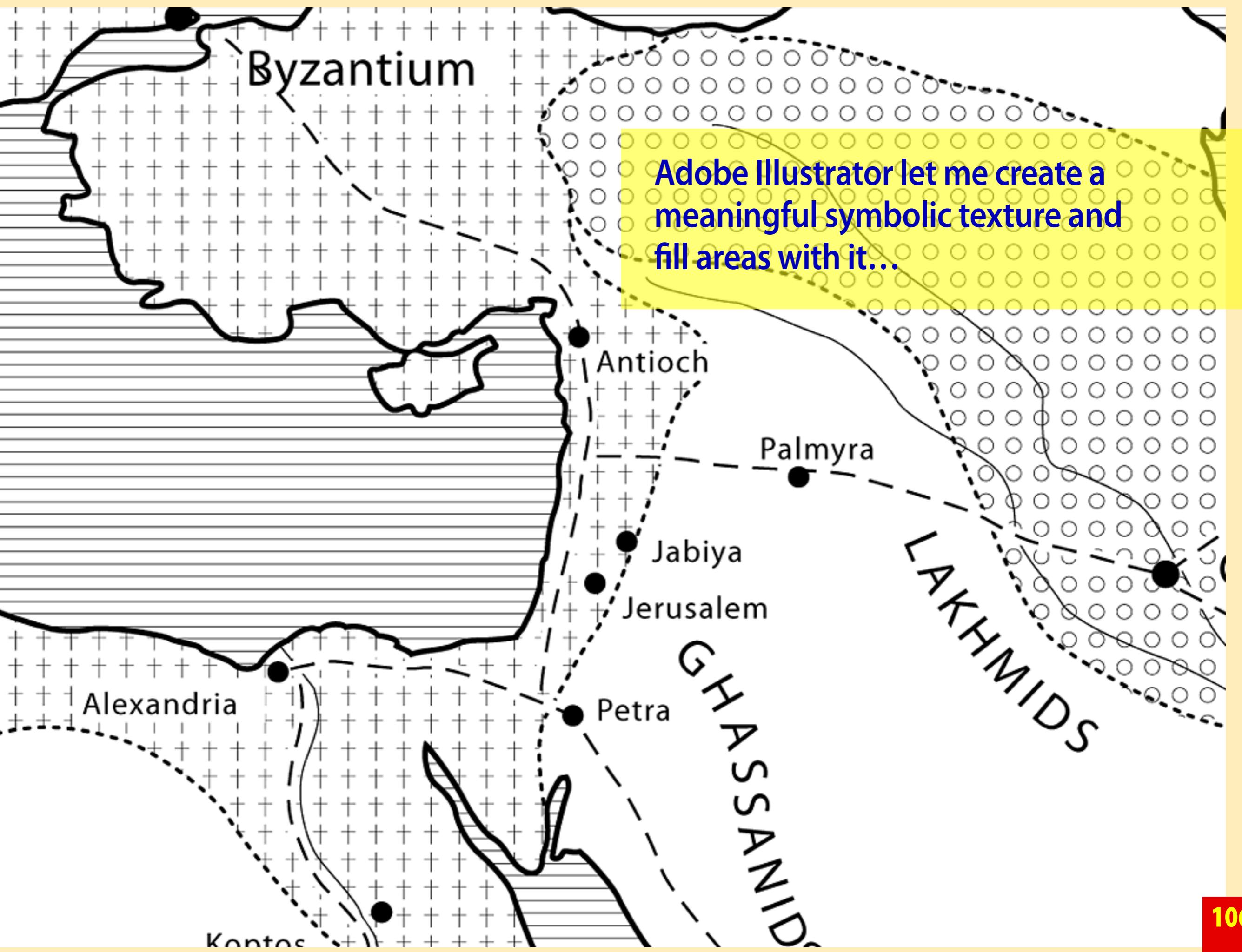
**Coarse textures
useful for coarse
print techniques!**



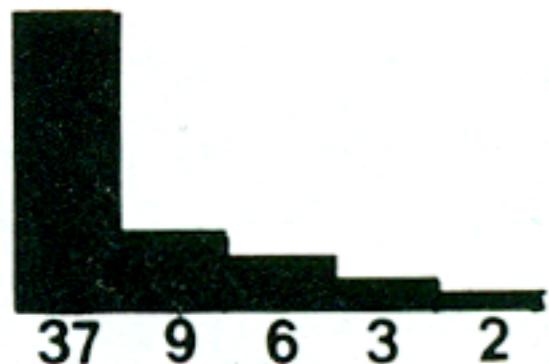
Sectional diagram of heart

by Conrad Taylor

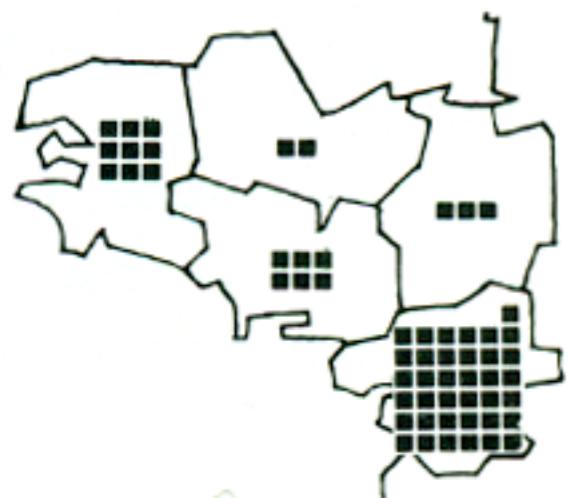
*to print with account
of a lecture by
Dr Suresh Pandya FRCS*



SIZE



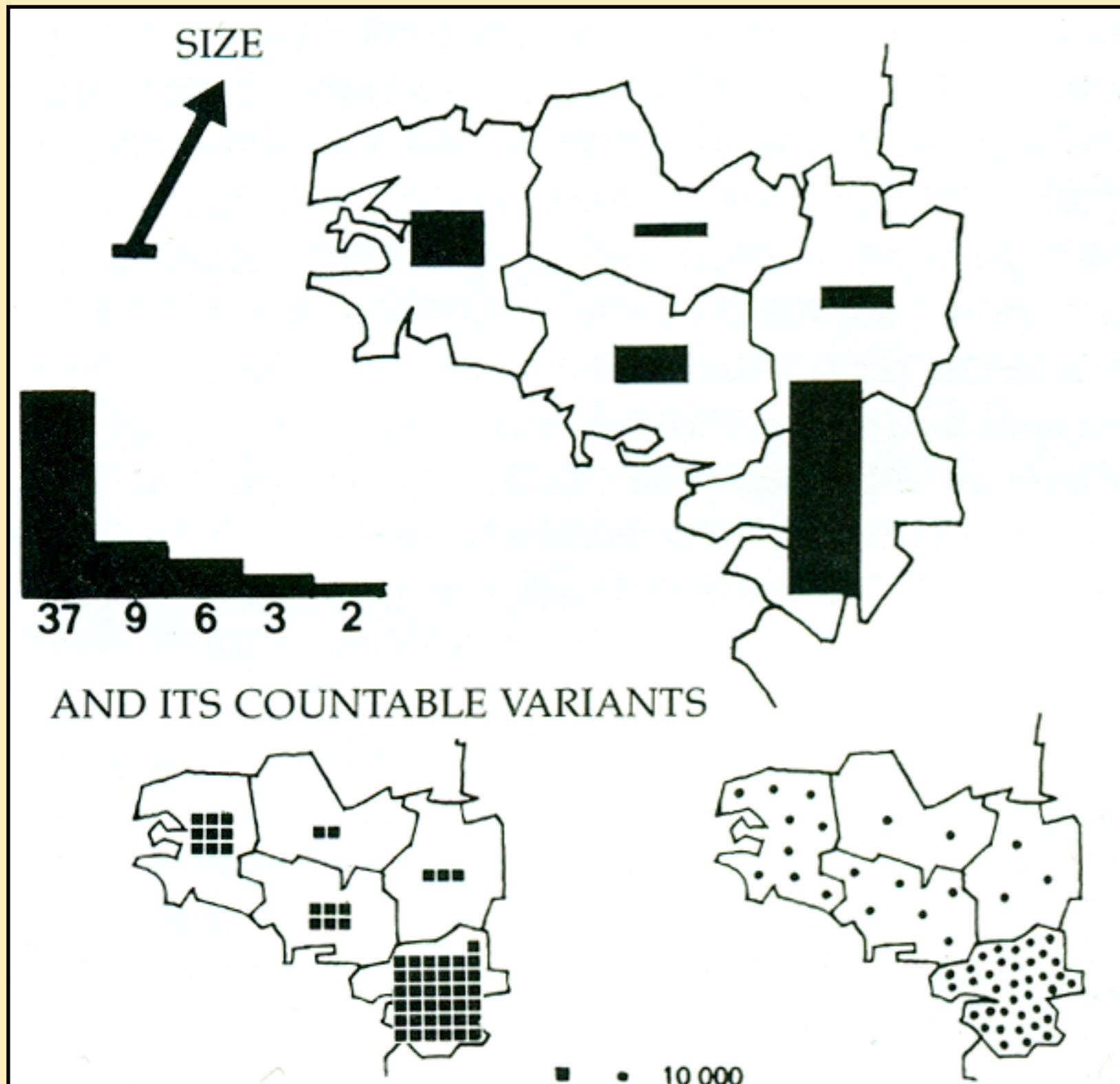
AND ITS COUNTABLE VARIANTS



■ . 10 000



'Size'...

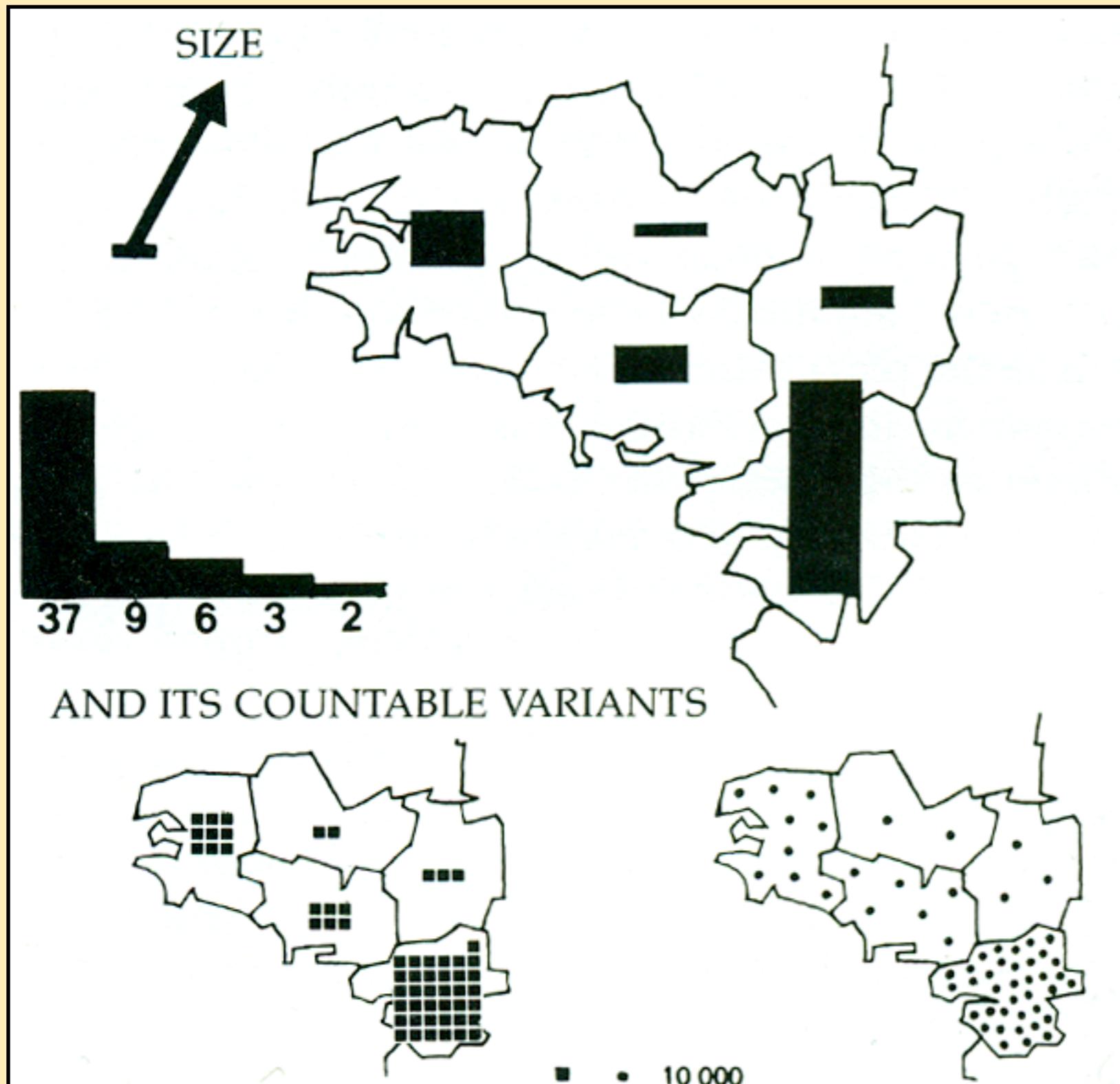


Size as a signifier:

not without its problems

do we compare area
or height?

how to relate a large
height-significant
component to a
small location?



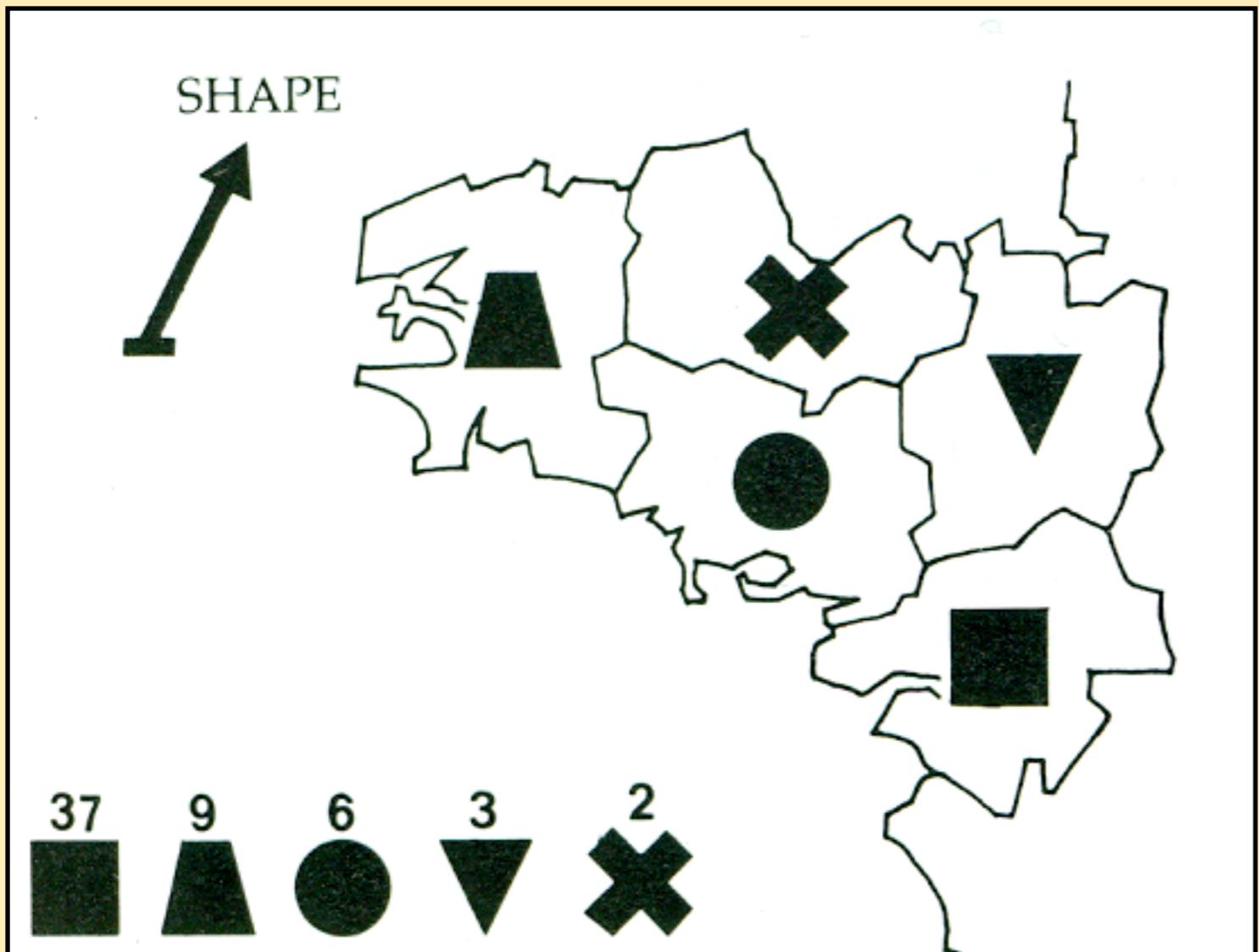
Size as a signifier:

not without its problems
do we compare area
or height?
how to relate a large
height-significant
component to a
small location?

'Countable variants':

ISOTYPE-style array
can also have problems
of 'fitting'

Might the 'spread-out'
version be confused for
a proper dot-map?



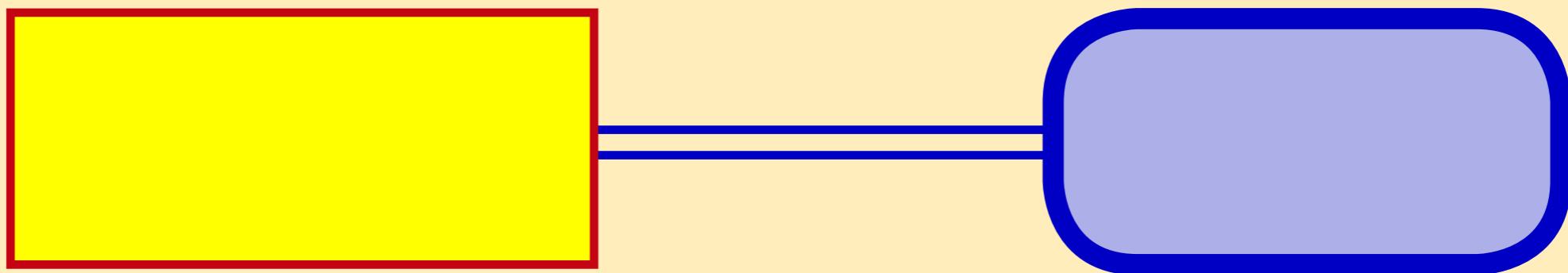
Shapes are poor signifiers of value, but work well as distinguishable symbols

Simmonds, et al. warn against symbols that are hard to distinguish in normal reading conditions



What is Texture and what is Symbol?

The stuff that connects things!



Particularly important for qualifying
linkages in network diagrams:

- Mind maps
- Organisation charts
- File plans
- Hierarchical taxonomies
- Ontologies
- Debate / argument maps
- Entity–Relationship Diagrams
- State diagrams ... *and more...*

'Retinal variables' for lines?



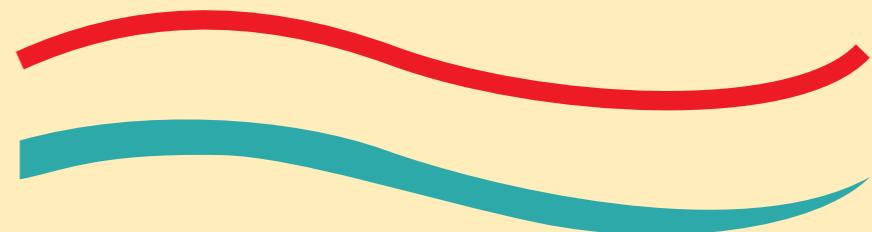
Line thickness and colour



Duplication



Various dot patterns

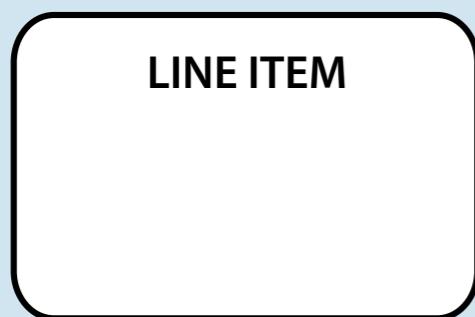


Shape, direction of line

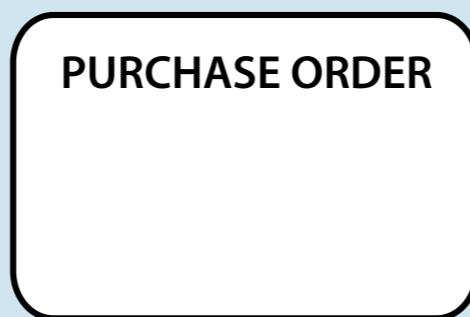


'Terminals'

CASE*Method data model, using Ellis-Barker notation



LINE ITEM

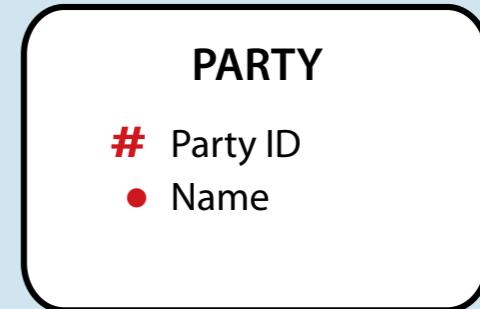
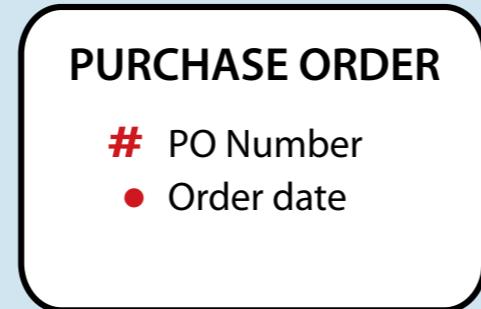
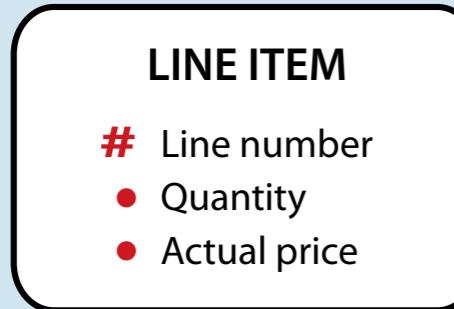


PURCHASE ORDER

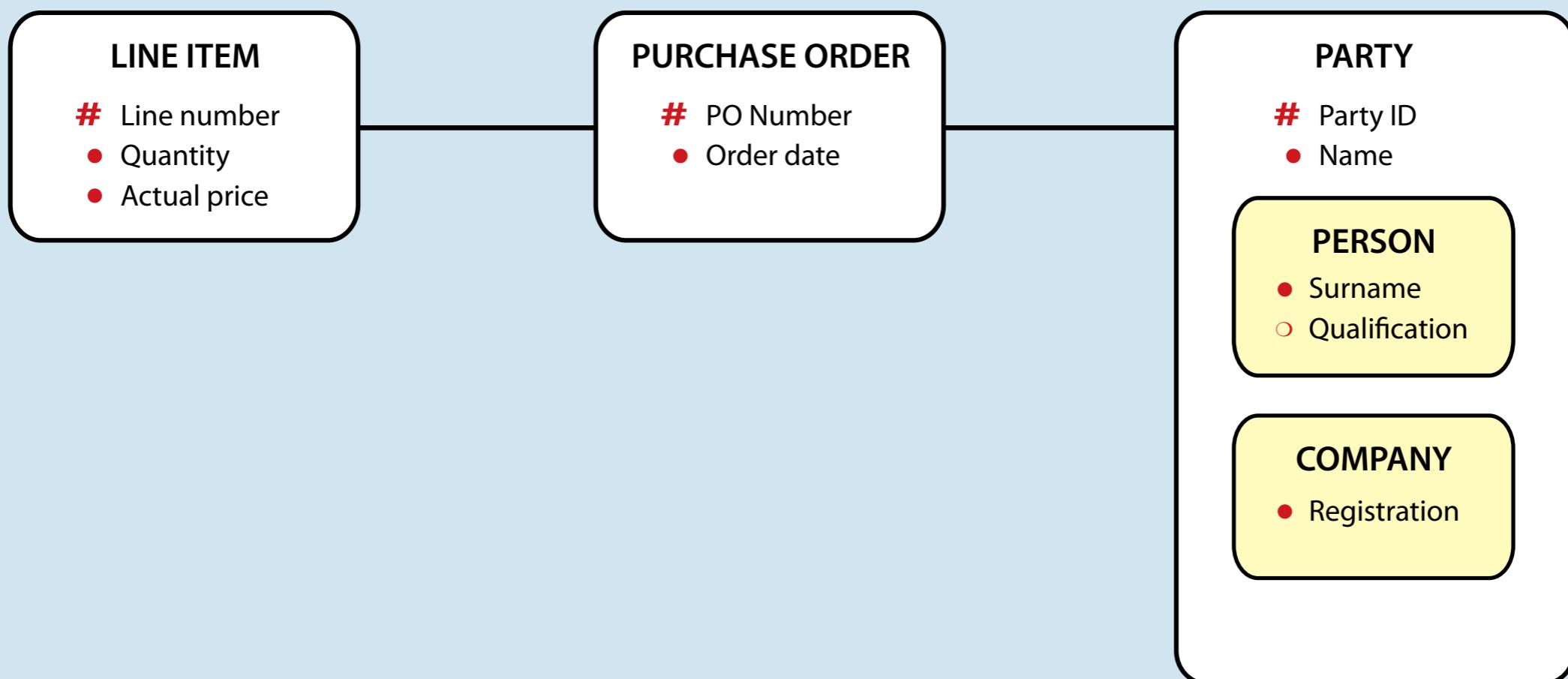


PARTY

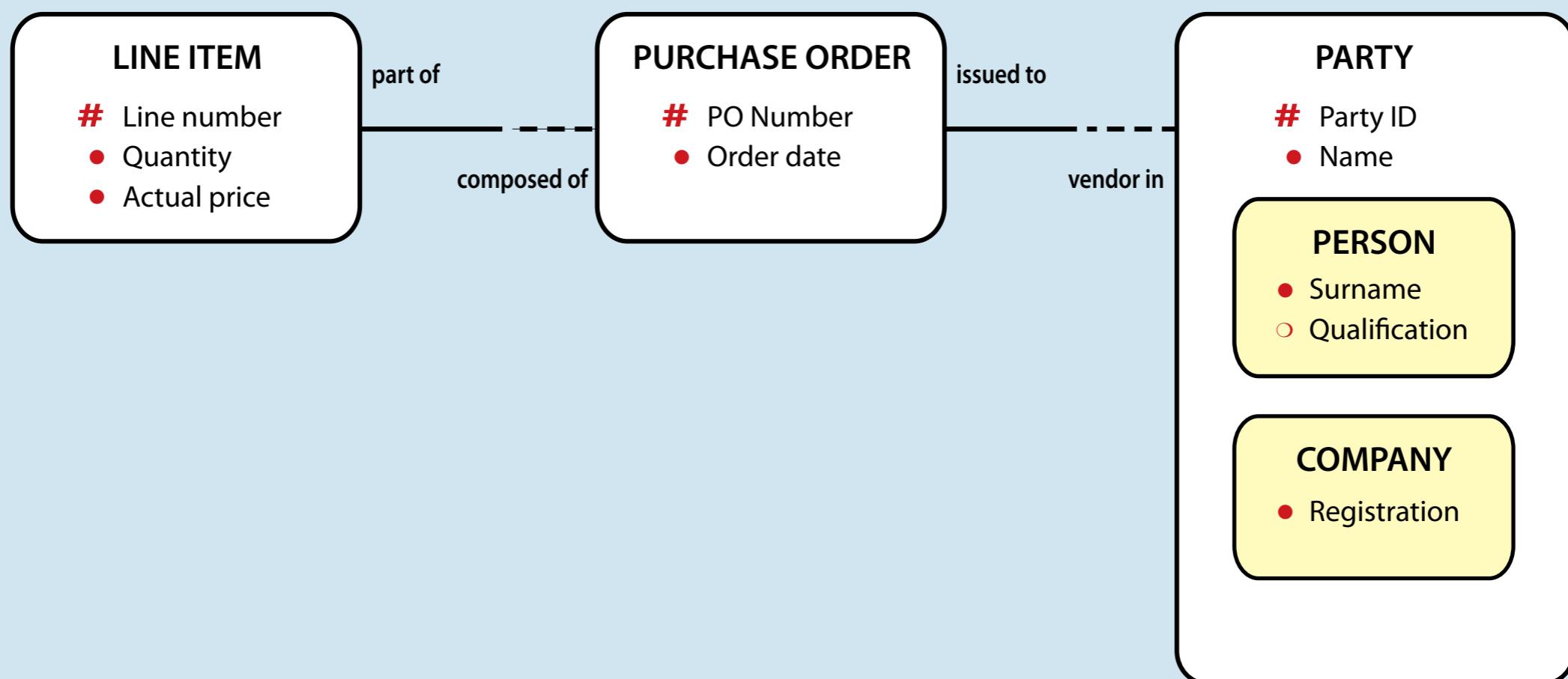
CASE*Method data model, using Ellis-Barker notation



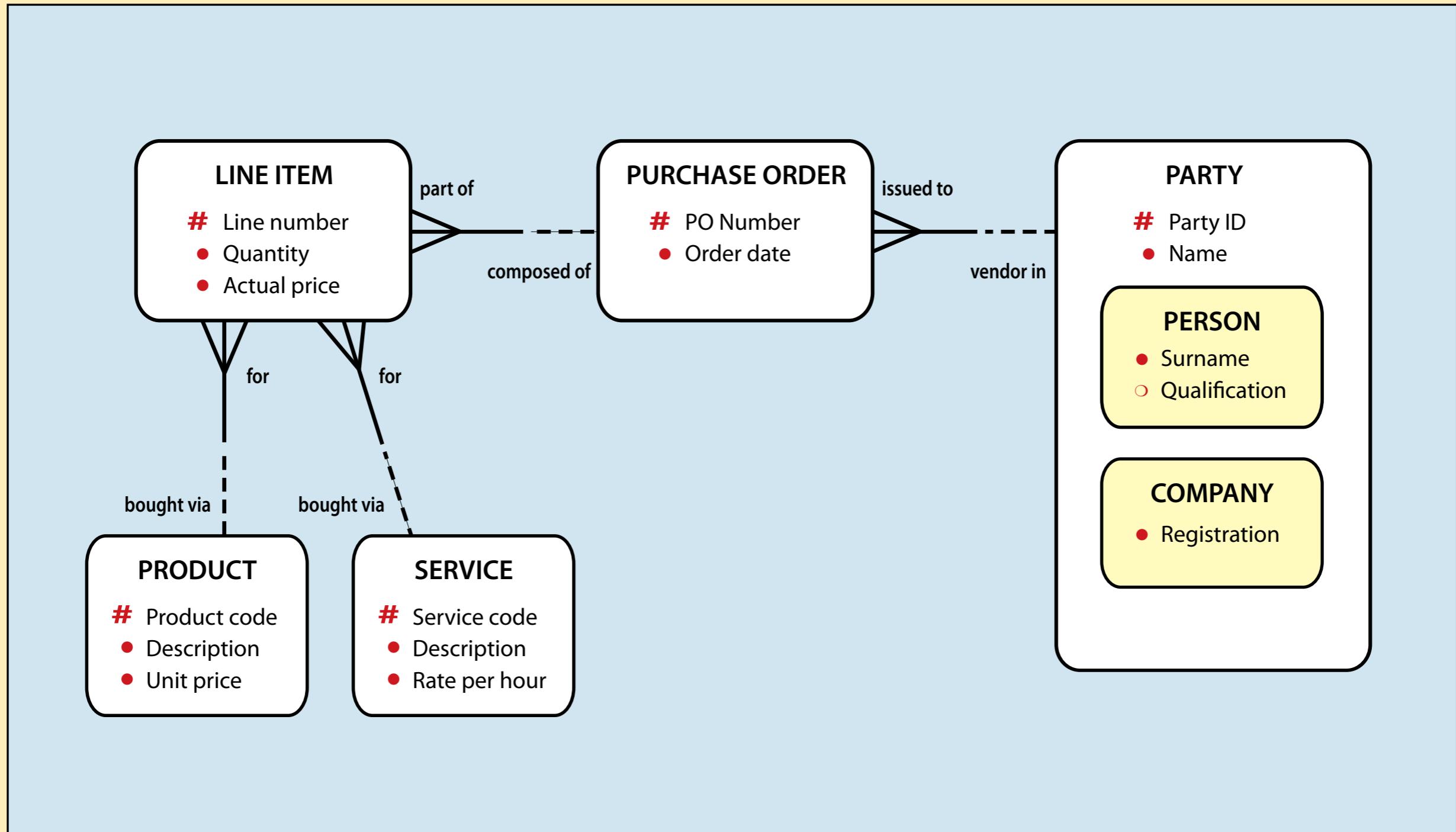
CASE*Method data model, using Ellis-Barker notation



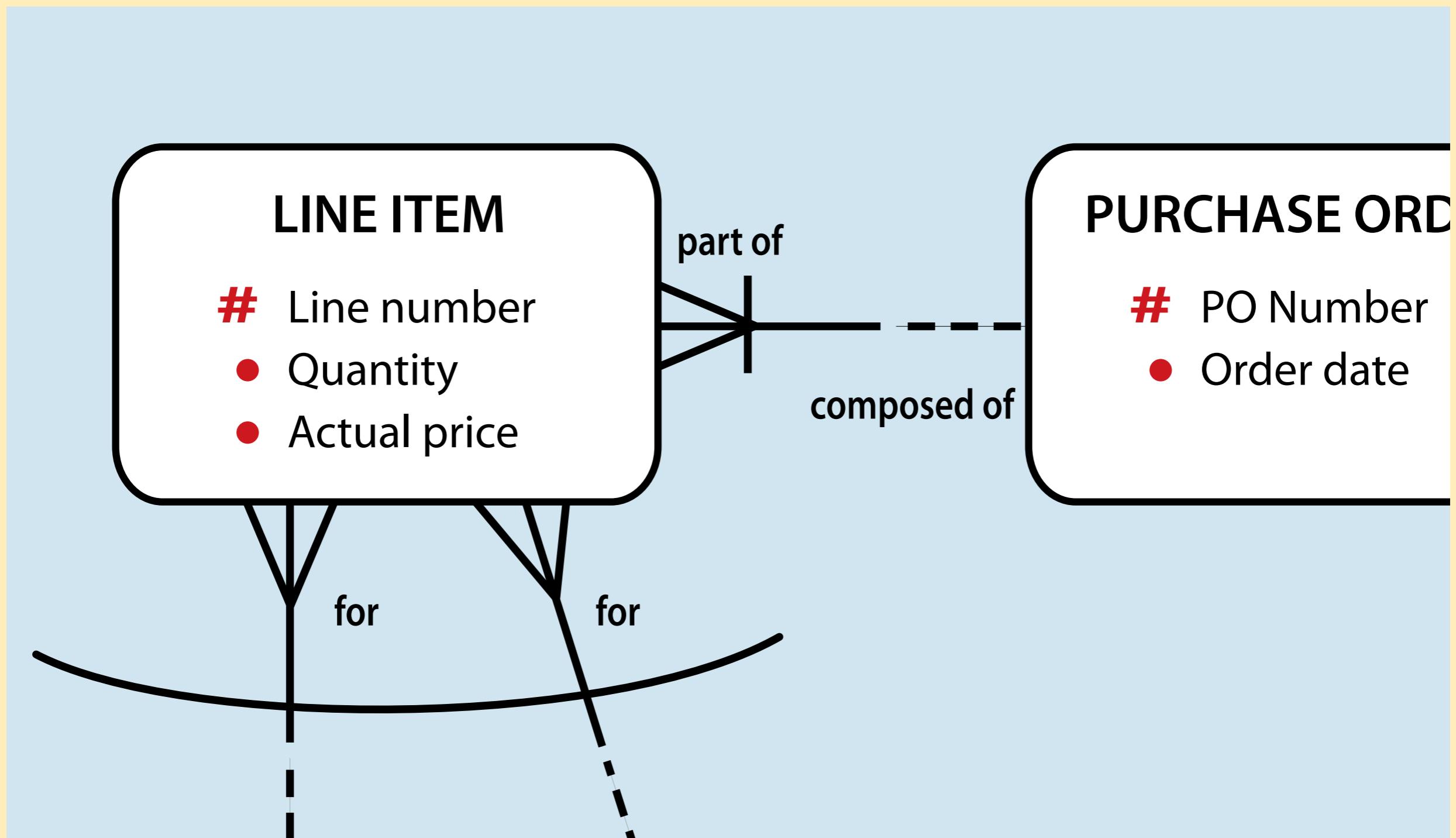
CASE*Method data model, using Ellis-Barker notation

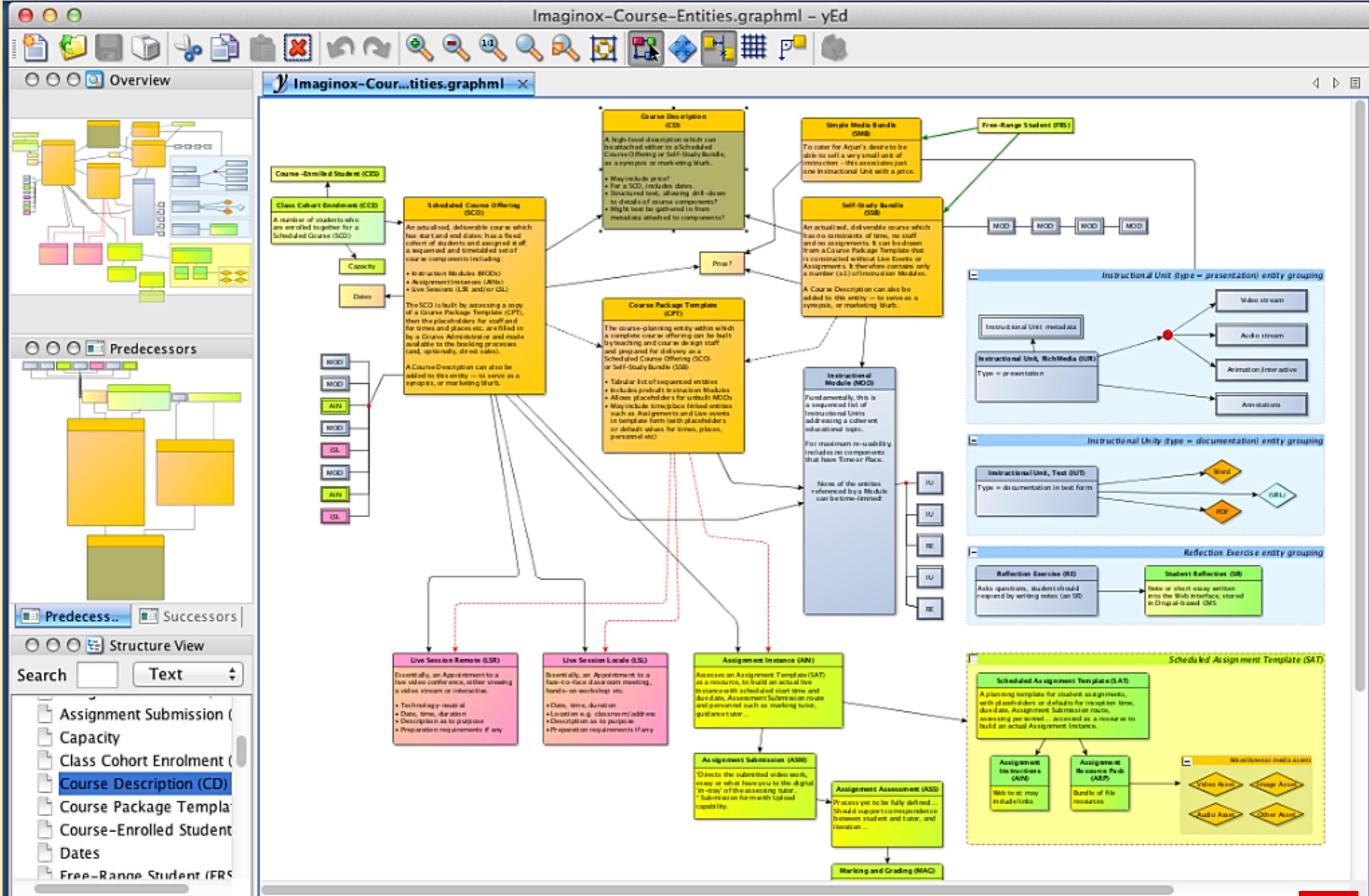


CASE*Method data model, using Ellis-Barker notation



CASE*Method data model, using Ellis-Barker notation





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Peace in the Middle East

debategraph.org/Stream.aspx?nid=11474&iv=05

Login Register Reset + View: Hub Details Outline Stream Search Community Help

Peace in the Middle East Map Home

```

graph TD
    A[Pragmatic first steps?] --> C((Peace in the Middle East))
    B[US role in the Middle East peace process?] --> C
    D[Peace Proposals?] --> C
    E[Contentious issues and options?] --> C
    F[Historical background?] --> C
    G[Related maps]
    C --> G
  
```

Edit Delete Bookmark Share

+ Hub view: Focus

Add idea Discuss Move Cross-link Cite New map

Debategraph » Quick guide » Change language » Posters »

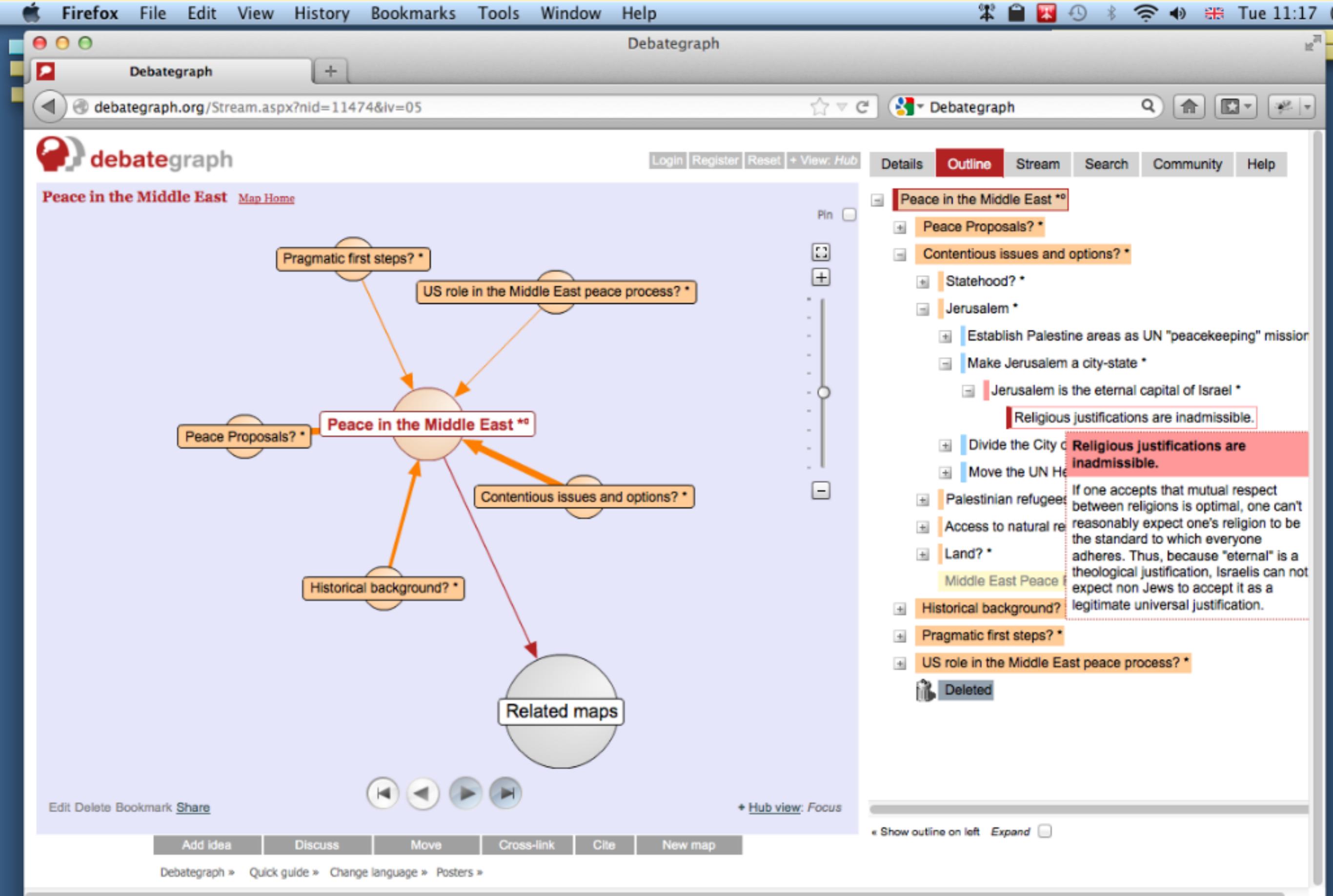
Peace in the Middle East Map Home #11474

Help The Independent and the Debategraph community map and evaluate the contentious issues and potential paths to long-term, sustainable peace in the Middle East.

Building on [The Independent's map of the Crisis in Gaza](#), which generated widespread interest and support, Independent readers and the [Debategraph](#) community have begun to focus on the options for achieving a long-term sustainable peace in the Middle East.

Source: [Yale University Geographic Information Systems](#)

In this case, we want to push the mapping process one stage further. As before the first objective will be to develop a comprehensive map of the issues and options facing the main regional actors and the



**animation,
interaction,
computation**

Animated presentation...



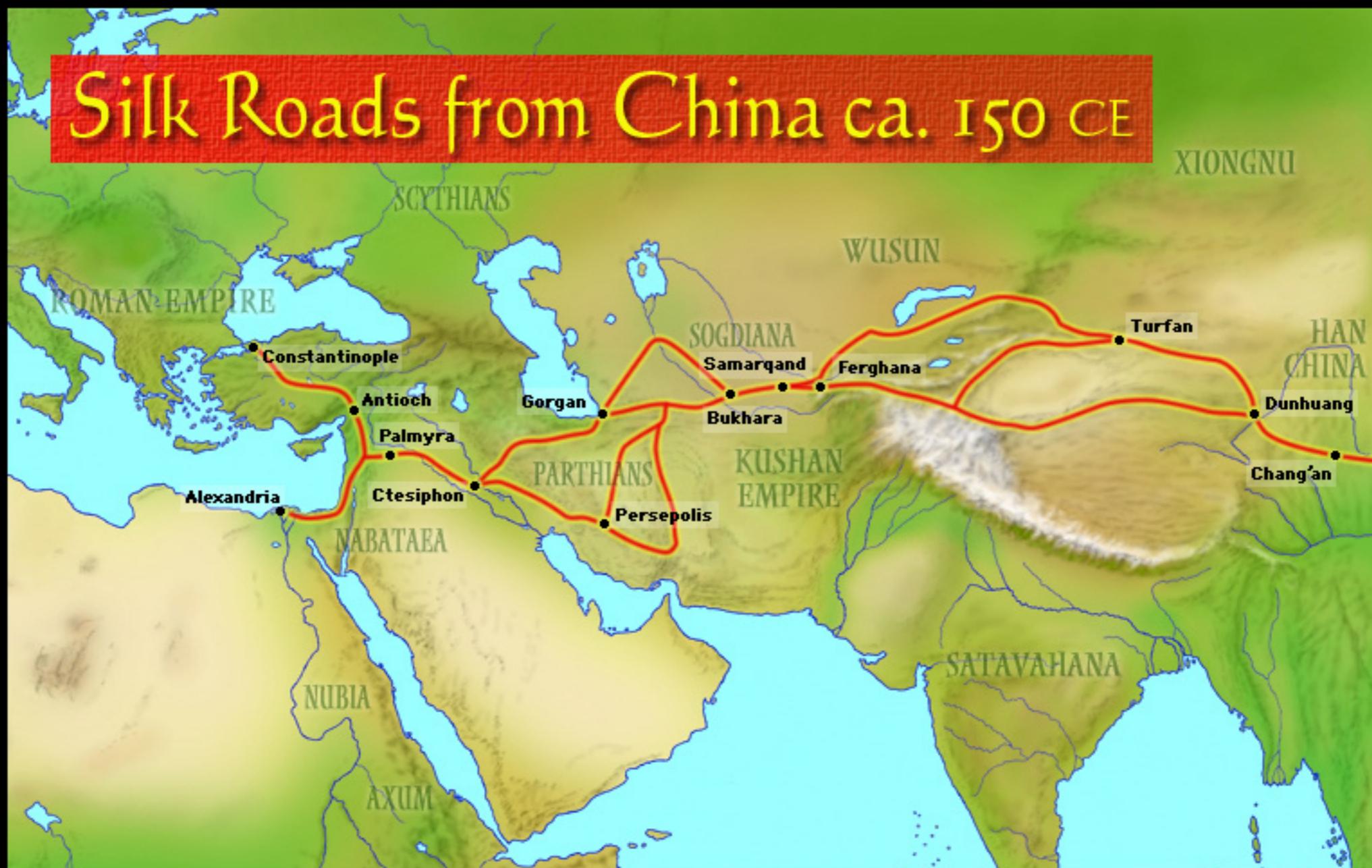
...to change the viewer's focus

Animated presentation...



...to change the viewer's focus

Animated presentation...



...to build up layers of knowledge about a graphic

World Health Organisation – interactive map, incidence by country of death rate from Non Communicable Disease (males)



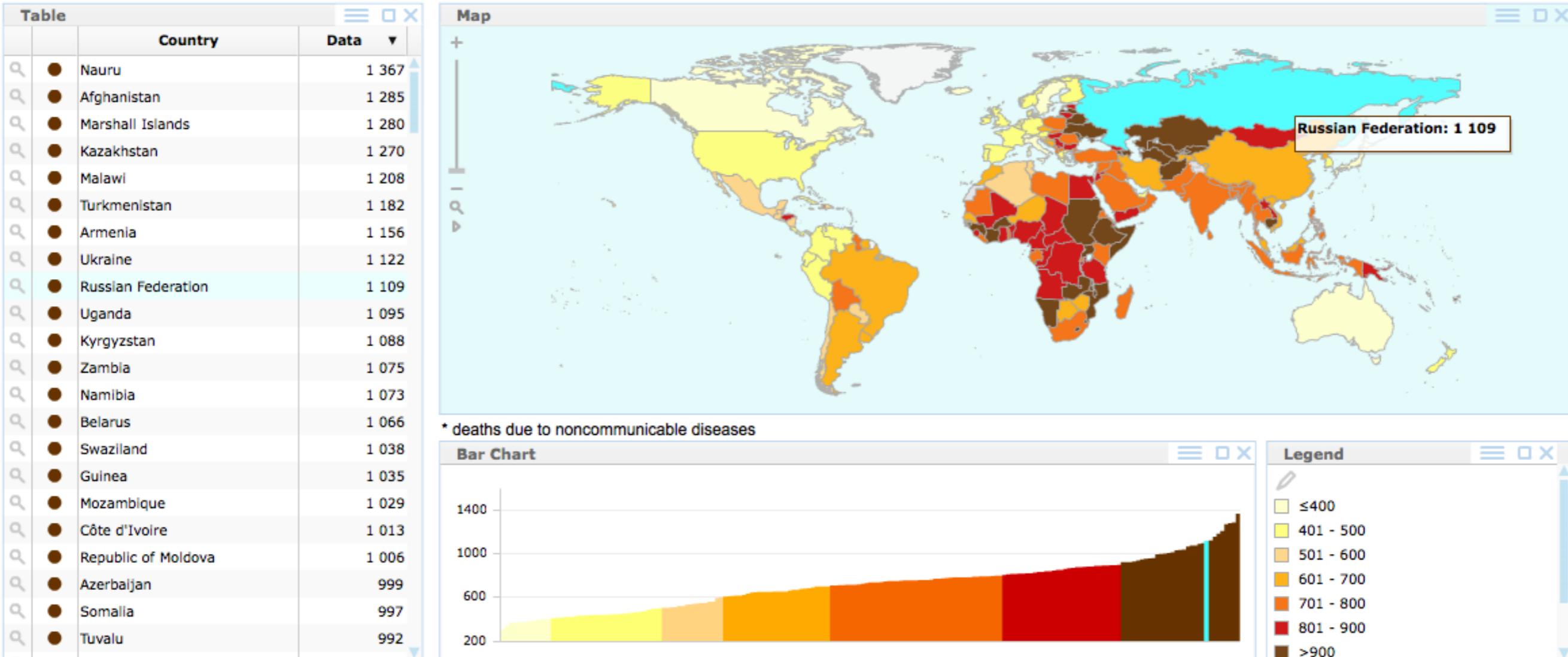
NCD mortality, 2008
Total NCD* death rates, age standardized (per 100 000 population): Male

[View more indicators](#)

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Use your mouse to select data. Use Ctrl-key to make multiple selections. Click on the right mouse button to clear selections.

© WHO 2011. All Rights Reserved. Map Disclaimer.

See http://www.who.int/gho/map_gallery/en/index.html for this and other Global Health Observatory maps

World Health Organisation – interactive map, incidence by country of death rate from Non Communicable Disease (males)



NCD mortality, 2008
Total NCD* death rates, age standardized (per 100 000 population): Male

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Table

	Country	Data
1	Nauru	1 367
2	Afghanistan	1 285
3	Marshall Islands	1 280
4	Kazakhstan	1 270
5	Malawi	1 208
6	Turkmenistan	1 182
7	Armenia	1 156
8	Ukraine	1 122
9	Russian Federation	1 109
10	Uganda	1 095
11	Kyrgyzstan	1 088
12	Zambia	1 075
13	Namibia	1 073
14	Belarus	1 066
15	Swaziland	1 038
16	Guinea	1 035
17	Mozambique	1 029
18	Côte d'Ivoire	1 013
19	Republic of Moldova	1 006
20	Azerbaijan	999
21	Somalia	997
22	Tuvalu	992

Map



* deaths due to noncommunicable diseases

Bar Chart



Legend

≤400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 900
>900

Use your mouse to select data. Use Ctrl-key to make multiple selections. Click on the right mouse button to clear selections.

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See http://www.who.int/gho/map_gallery/en/index.html for this and other Global Health Observatory maps

[Chart](#)[Map](#)

Gapminder World (April 7, 2011)



Gapminder.org

Hans Rosling



Life expectancy (years)



Income per person (GDP/capita, PPP\$ inflation-adjusted)

Various sources

Play ►

1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000

lin
Trails[Terms of use](#)

© Google 2008

Color

Gapminder Geogra... □

Geographic regions ▾



Select

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all

Size

Various sources □

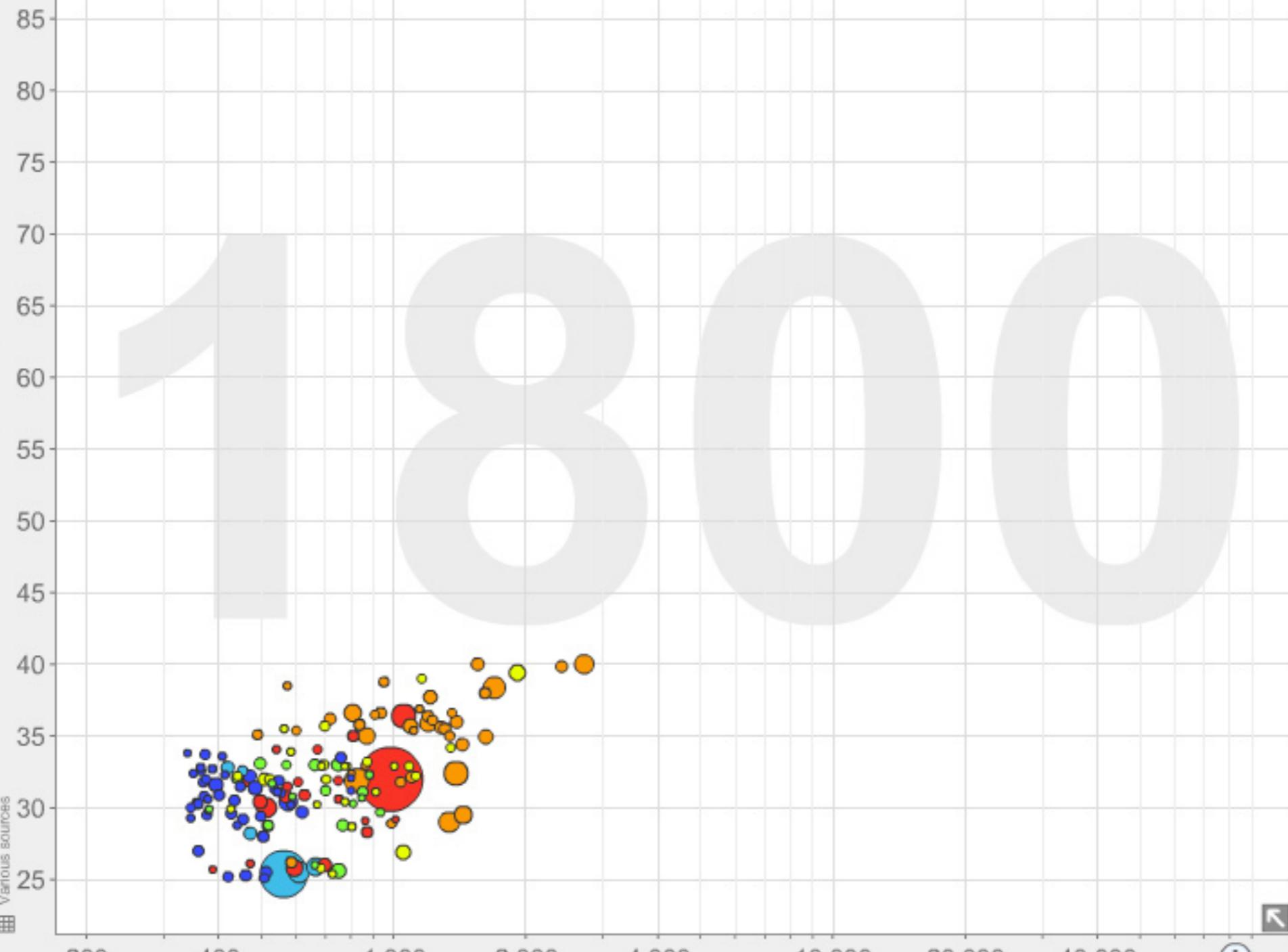
Population, total ▾



Chart**Map****Gapminder World (April 7, 2011)**

▶ Lin

▼

Life expectancy (years)**Color**

Gapminder Geogra... ■

Geographic regions ▾**Select**

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all

Size

Various sources ■

Population, total ▾

© Google 2008

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[Chart](#)[Map](#)

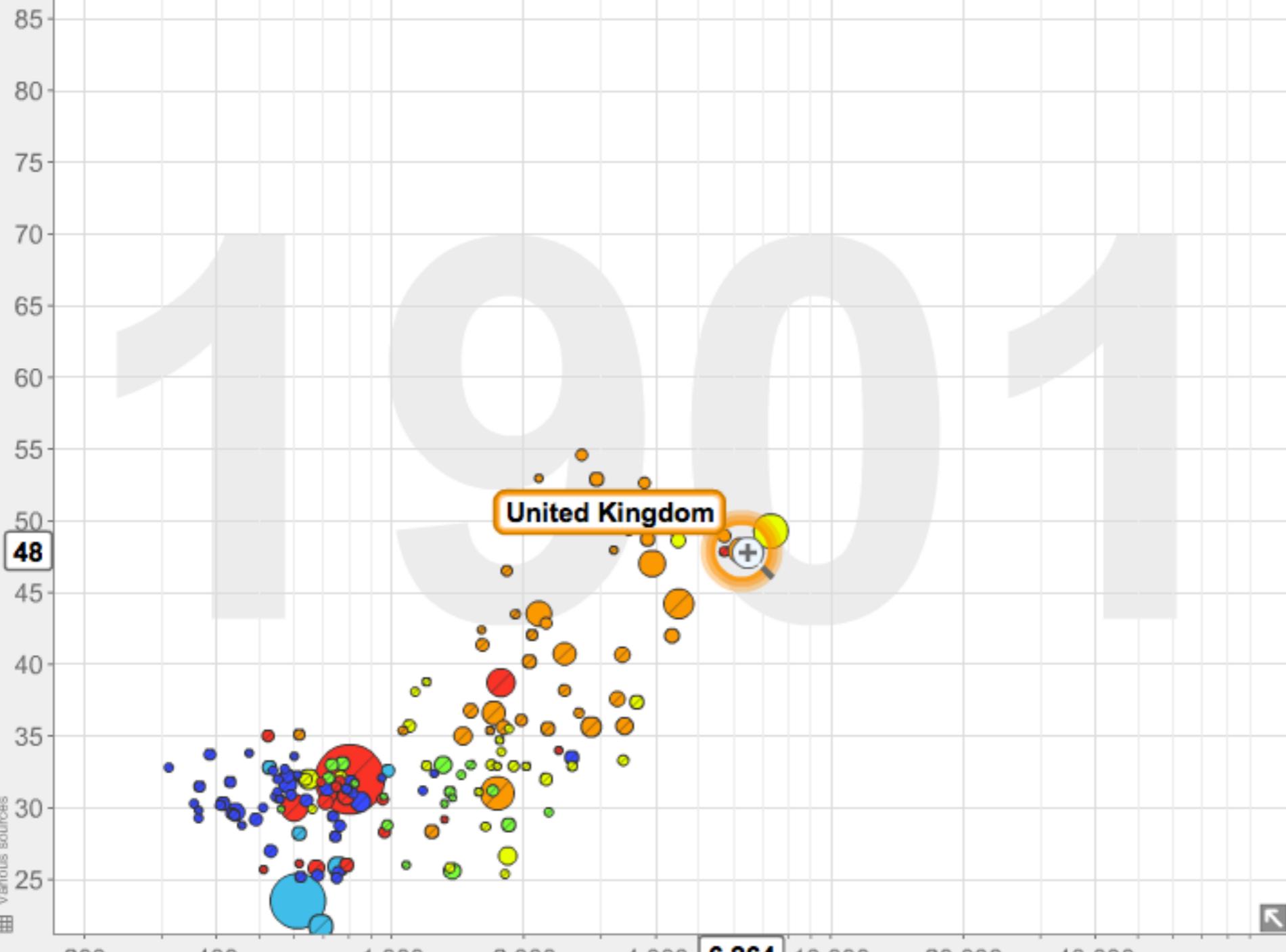
Gapminder World (April 7, 2011)



Line

Map

Life expectancy (years)



Color

Gapminder Geogra...

Geographic regions



Select

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all

Size

Various sources

Population, total

38 M

[Terms of use](#)

© Google 2008

[Chart](#)[Map](#)

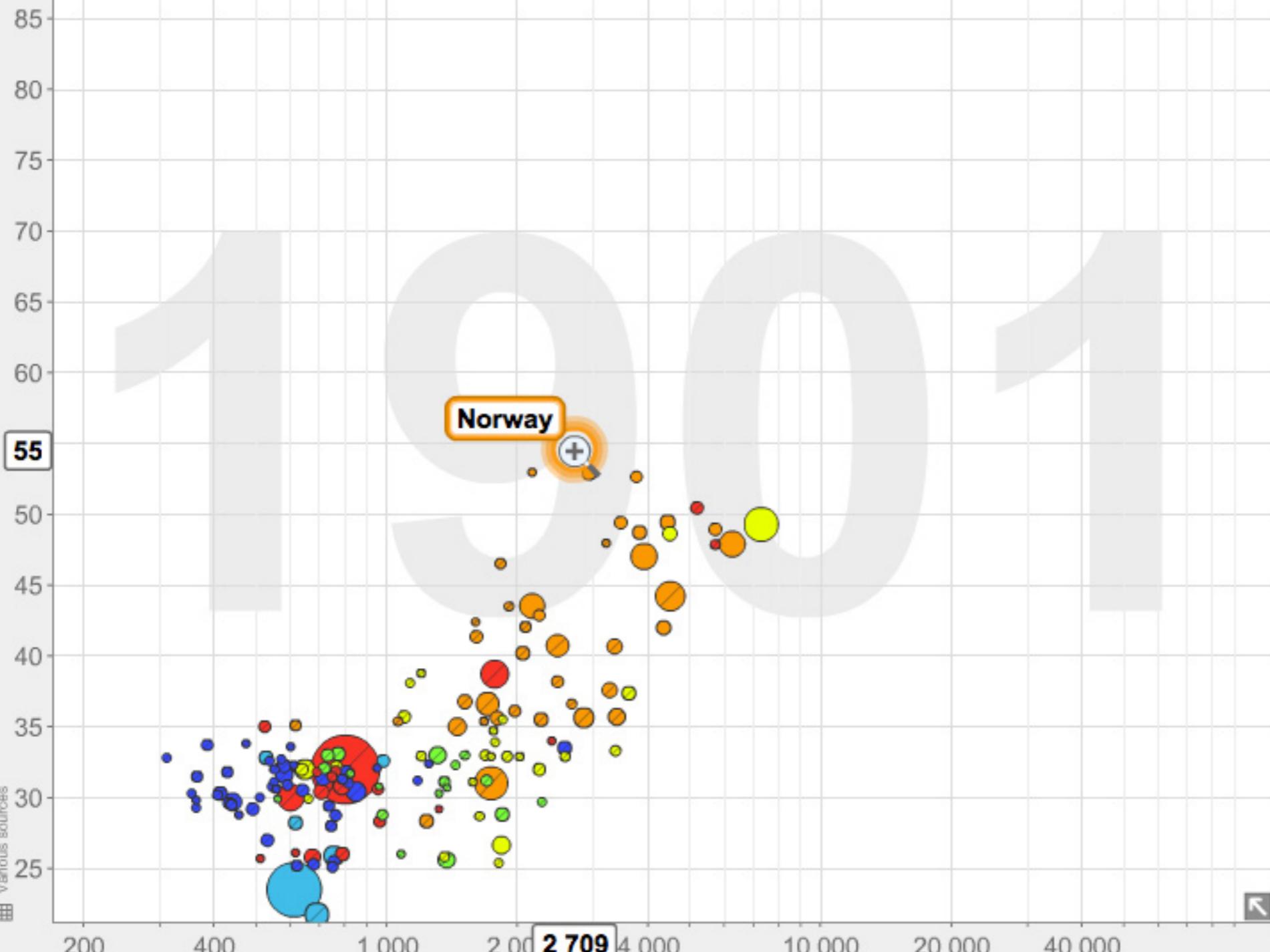
Gapminder World (April 7, 2011)



▶ Lin

▼

Life expectancy (years)



Various sources

200 400 800 1,000 2,000 4,000 20,000 40,000

Income per person (GDP/capita, PPP\$ inflation-adjusted)

log

Various sources

Play ►

1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000

 Trails

Various sources

Population, total

2.26 M

© Google 2008

Color

Gapminder Geogra... □

Geo

Europe & Central Asia



Select

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all

[Terms of use](#)

Chart**Map****Gapminder World (April 7, 2011)**▶
Line

▼

Life expectancy (years)

Various sources

200 400 800 1 000 2 000 4 000 8 000 10 000 20 000 40 000

Income per person (GDP/capita, PPP\$ inflation-adjusted)

Various sources

Play ▶

1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000

log**Size**

Various sources

Population, total

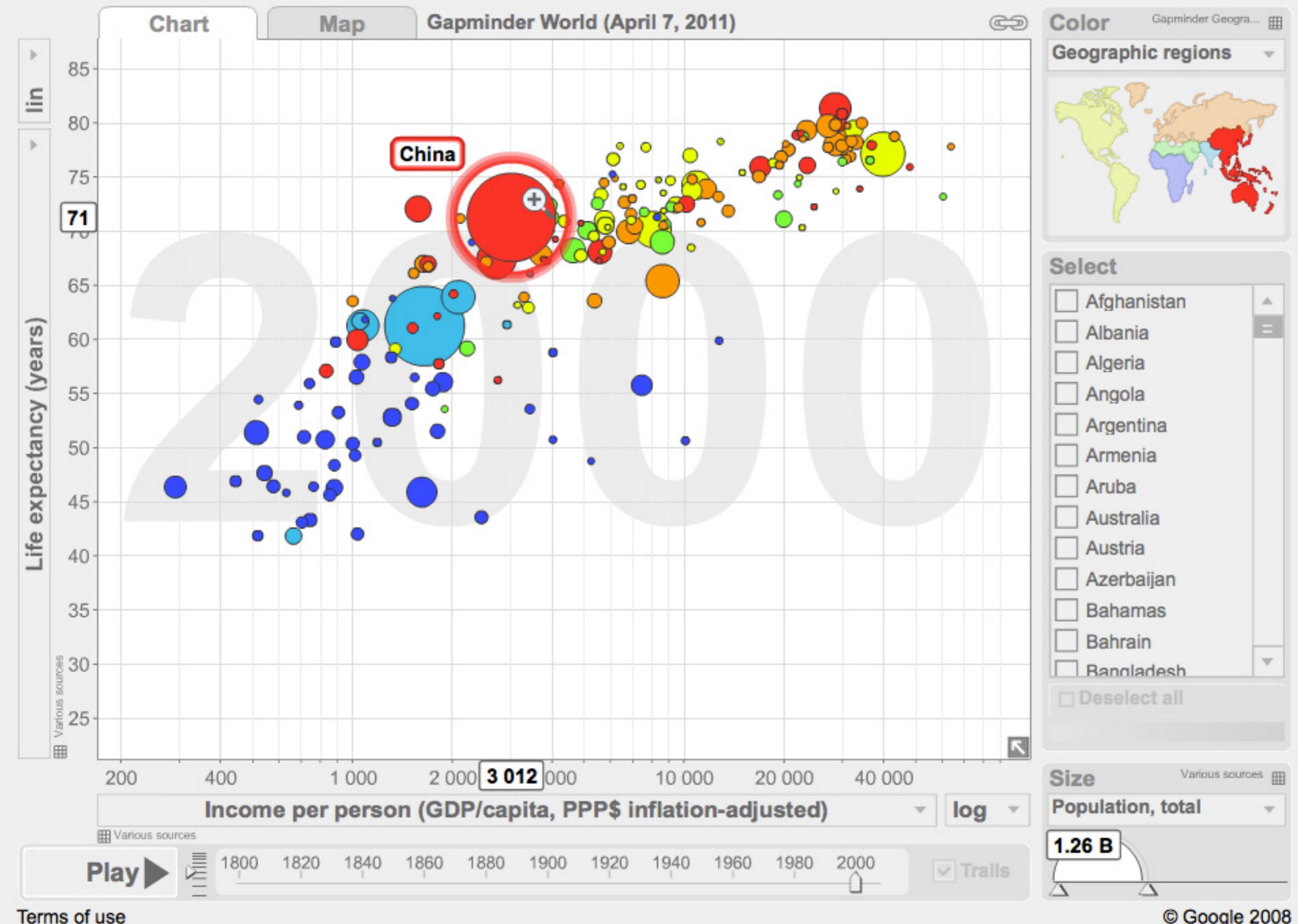
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 TrailsTerms of use**Color**

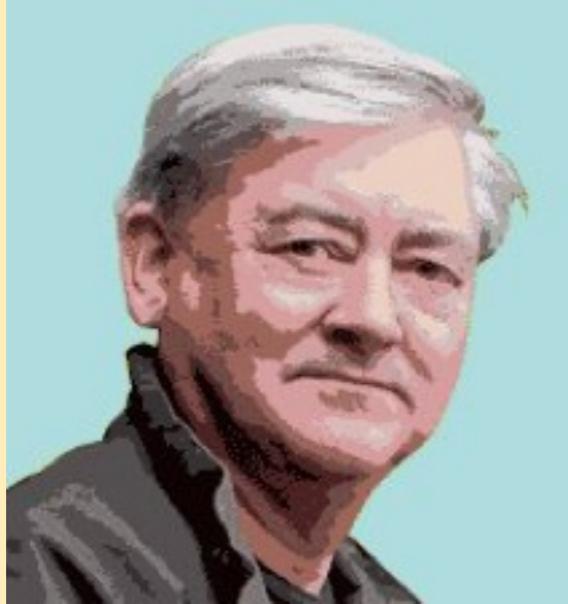
Gapminder Geogra...

Geographic regions ▾**Select**

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all



Gapminder — see <http://www.gapminder.org> — download and install the desktop edition



Conrad Taylor

www.conradiator.com

conradtaylorbcs@gmail.com

the end

other talks from the ISKO UK events
at <http://www.iskouk.org>