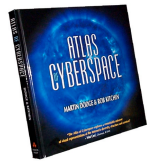
Social Science Research Methodologies

Visualisation, Cartography and (a bit of) GIS

Martin Dodge

Who is Martin Dodge?

- kind of in Geography, but mostly based in Centre for Advanced Spatial Analysis
- contact me via email (m.dodge@ucl.ac.uk)
- slides online at
- www.casa.ucl.ac.uk/martin/ss_methods/



www.cybergeography.org

Course outline

- 23rd February
  - Visualisation for academic research
- 2nd march
  - Cartographic design and exploratory mapping
- 9th March
  - What is GIS and what is it good for?
- 16th March
  - No lecture. Time to work on the course assessment!

Course assignment

- critically evaluate how visualisation (images, statistical charts, maps, diagrams) has been used in your chosen research topic
- discuss how you think mapping might usefully be applied in your future research
- 2000 word essay
- due date: 29th April 2005. Submit directly to Martin Dodge
- (practical exercises have been dropped)

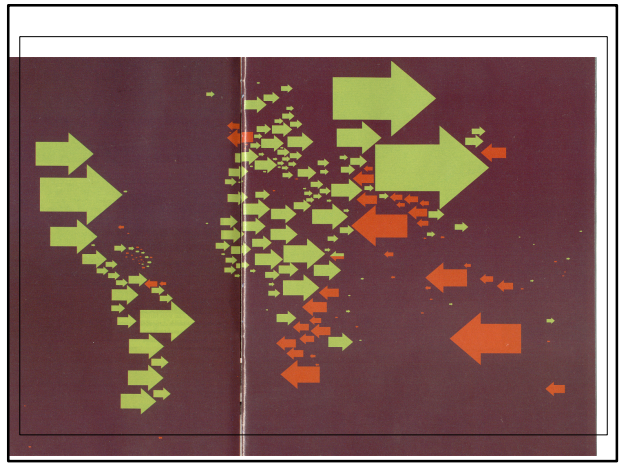
Social Science Research Methodologies

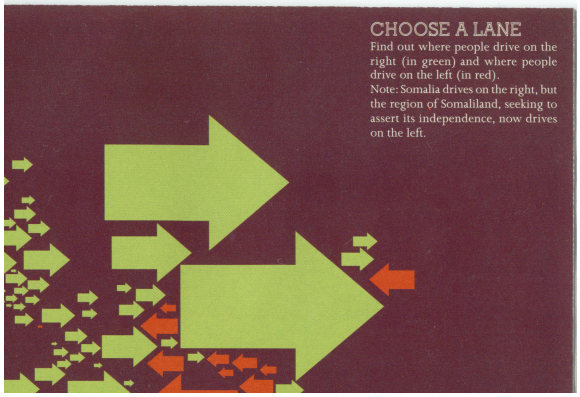
Visualisation for Academic Research

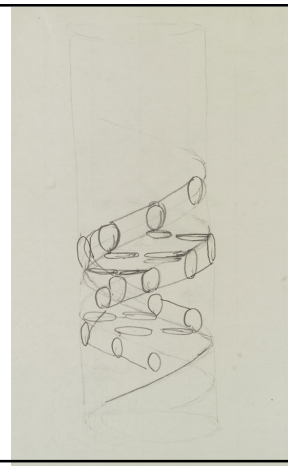
Martin Dodge

Lecture 1, 23rd February 2005, 2-3pm

http://www.casa.ucl.ac.uk/martin/ss_methods/







Goals

- descriptive overview of importance of visualisation and cartography
- focus on the art and science
- excuse to show lots of examples
- most examples are from social geography and cyberspace mapping
- little theory, and non-technical
- references to find out more

Not covered

- data collection, data structures and types of digital representations of spatial data
- technical information on projections, datums, reference systems. no equations
- specifics on map reading & interpretation
- map production, distribution, legal/copyright issues
- nothing on software to use

Visualisation - seeing the unseen

- visualise - make visible, esp. to one's mind
- an interactive process of learning through the creation and observation of abstract images, providing humans with a method for seeing the unseen
- visualisation differs from illustration in that its purpose is to *discover* the unknown rather than to *show* what is already known
- premised on the simple notion that humans can reason and learn more effectively in a visual environment than when using textual or numerical data

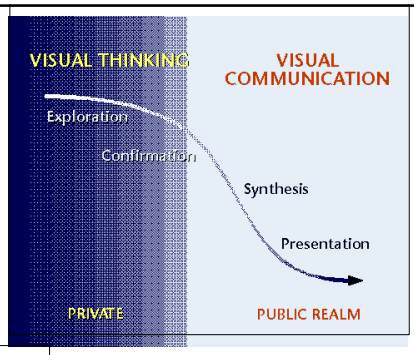
Why visualise?

"Scientific disciplines with good pictures are rich in resources that keep them well funded and moving forward."

- Eric Heller, (2003), "The power of the image to promote science" in Silver M, Balmori D (eds), *Mapping in the Age of Digital Media* (Wiley-Academy)

Why visualise?

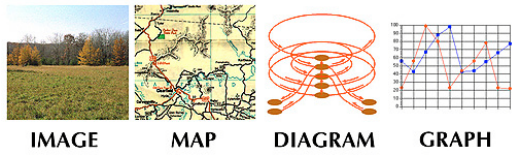
- research and analysis (in the academic or commercial arena) depends on all kinds of tools and methods of work
- use the most appropriate tools for data collection, analysis/interpretation and presenting your findings to others
- in all these stages of working visualisation may be appropriate
- handling large, complex datasets without huge simplification or unfathomable statistical techniques
- data rich, but theory poor research
- but watch out for 'chartjunk' and 'eye candy'
- maps have proven themselves to be particularly adept forms of visualisation, especially for geographical analysis



David DiBiase

http://www.geog.psu.edu/people/dibiase/

Forms of visualisation



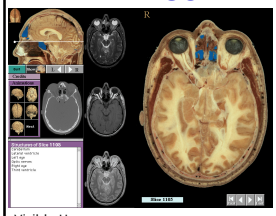
Overlaps

- computer graphics, animation, ray-tracing
- statistical charts
- virtual reality
- computer games, special effects
- graphic design, scientific illustration
- CAD, architectural design
- interface design, HCI, info-visualisation
- cartography

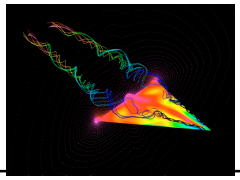
Scientific visualisation

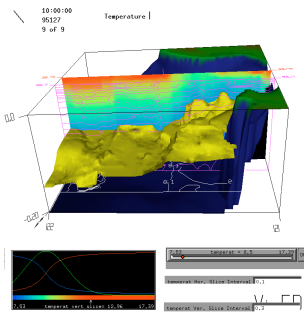
- Scientific data visualization 'big thing' in late 80s
- McCormick et al. (1987)
- "to leverage existing scientific methods by providing … insight through visual methods"
- high-end viz super-computing stuff - fluid flows, multidimensional data, atmospheric modelling, genetic structures, atom-smashing, medical imaging, etc
- visualisation of spatial data in many disciplines (see Stephen Hall's book)
- by mid 1990s visualisation become readily ~~available to all through powerful desktop PCs~~

Sci viz examples



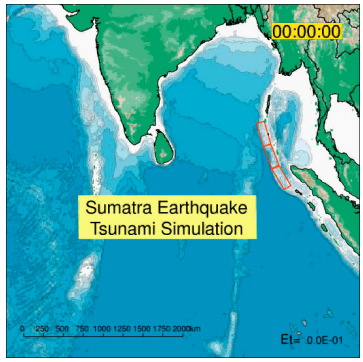
Visible Human
www.nlm.nih.gov/research/visible/visible_human.html

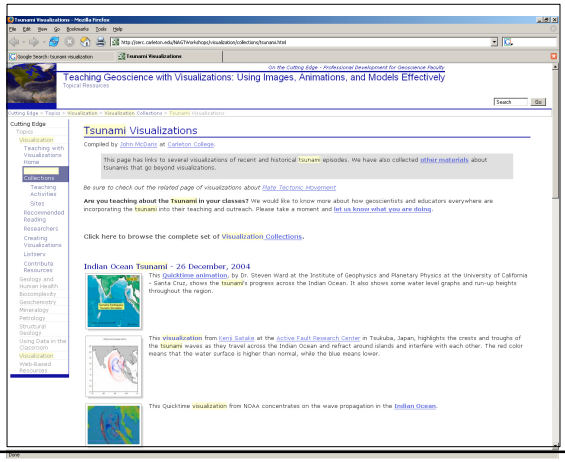




Geophysics
www.ats.ucla.edu/people/yafang_su/visualization.html

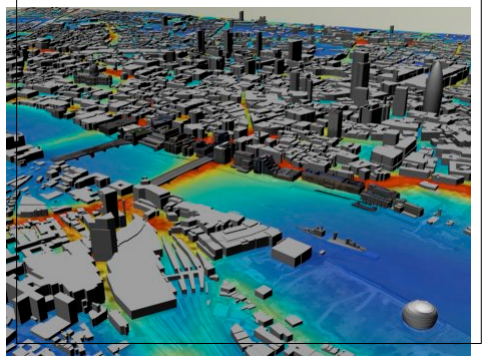
Steven Ward, Institute of Geophysics and Planetary Physics
University of California, http://es.ucsc.edu/~ward/

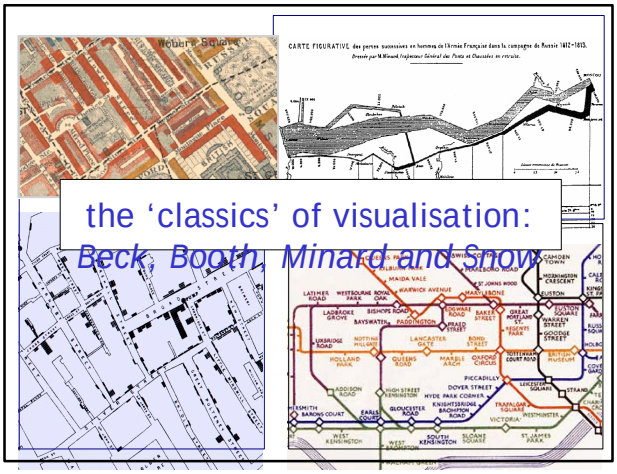




Virtual London

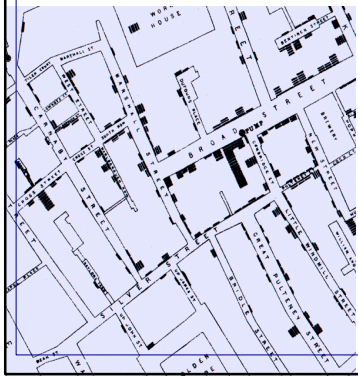
www.casa.ucl.ac.uk/olp/

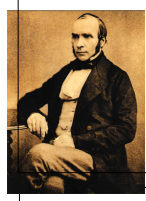




the 'classics' of visualisation:
Beck, Booth, Minard and Snow

Dr John Snow's 'Cholera' Map, 1854



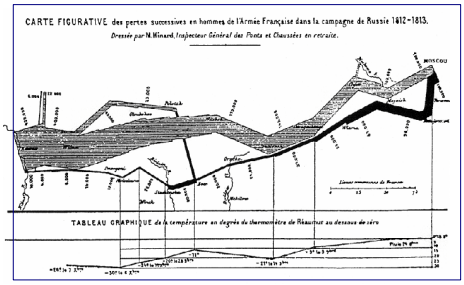


- classic 'eureka' example for spatial analysis and power of visualisation
- clear and powerful visual demonstration of the waterborne nature of cholera spread
- widely cited in geography and epidemiology
- but a bit of an urban myth

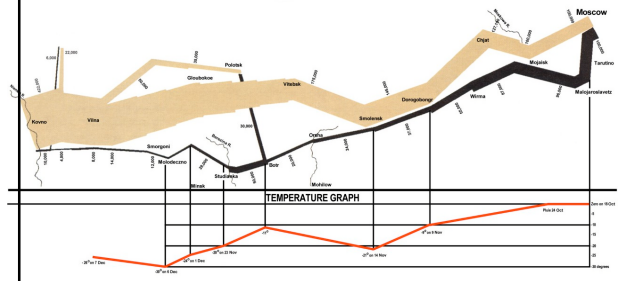
- further reading
  - Ralph Frerichs website, www.ph.ucla.edu/epi/snow.html
  - Brody H, *et al.*, (2000) "Map-making and myth-making in Broad Street: The London cholera epidemic, 1854" *The Lancet*, 356, pp. 64-68.

Charles Joseph Minard's 'Napoleon' map, 1869

• visualises the failure of Napoleon's invasion of Russia in 1812-13

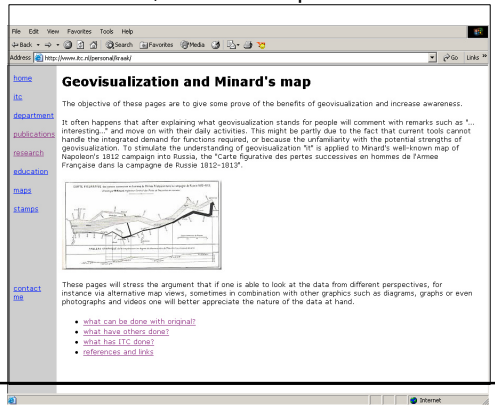


- cited by Edward Tufte as best info graphic ever
- flow mapping, try to show a dynamic process is a tough challenge
- just 2d, black and white, but shows 6 variables clearly
  - time, size of army, temperature at key points
  - location (x,y) and direction (advance and retreat)
- width of band is proportional to number of troops (starts at 442,000)
- retreat tied to temperature chart
- visualisations dramatises the devastating loss of life and understanding for reason (temp.)



Tufte (1983), "a narrative graphic of time and space which illustrates how multivariate complexity can be subtly integrated …. so gentle and unobtrusively that viewers are hardly aware that they are looking into a world of four or five dimensions."

Menno-Jan Kraak, www.itc.nl/personal/kraak/1812



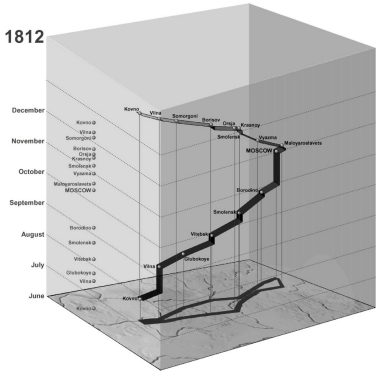
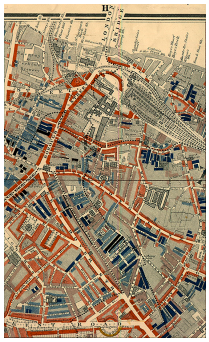


Fig. 6. A space–time cube of Napoleon's march in Russia (source: ITC-cartography).

(Source: Kraak M-J., (2003) "Geovisualization illustrated", *ISPRS Journal of Photogrammetry & Remote Sensing*, 57, pp. 390-399)

Charles Booth's Inquiry into the Life and Labour of the People in London



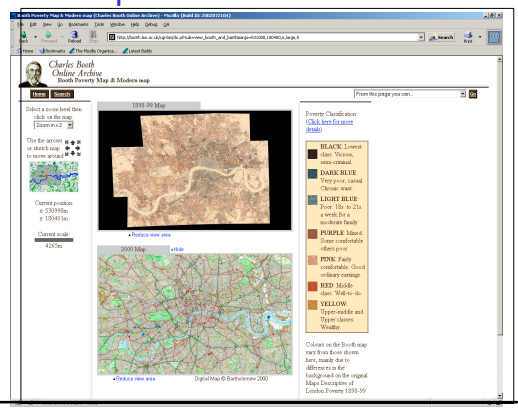
The Streets are coloured according to the general condition of the inhabitants, as under:–

- Lowest class. Vicious, semi-criminal.
- Very poor, casual. Chronic want.
- Poor. 18s. to 21s. a week for a moderate family.
- Mixed. Some comfortable, others poor.
- Fairly comfortable. Good ordinary earnings.
- Middle-class. Well-to-do.
- Upper-middle and Upper classes. Wealthy.

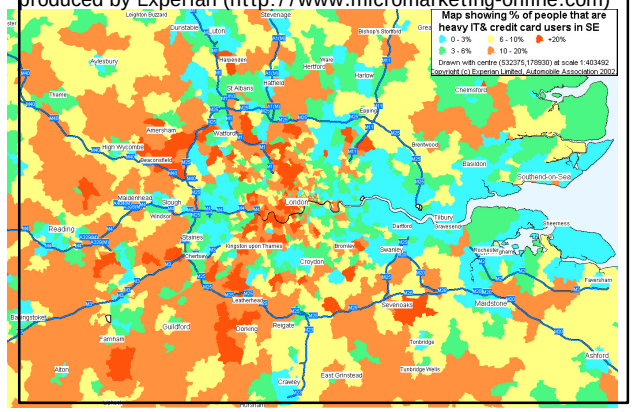
A combination of colours – as dark blue and black, or pink and red – indicates that the street contains a fair proportion of each of the classes represented by the respective colours.

(Source: www.umich.edu/~risotto/)

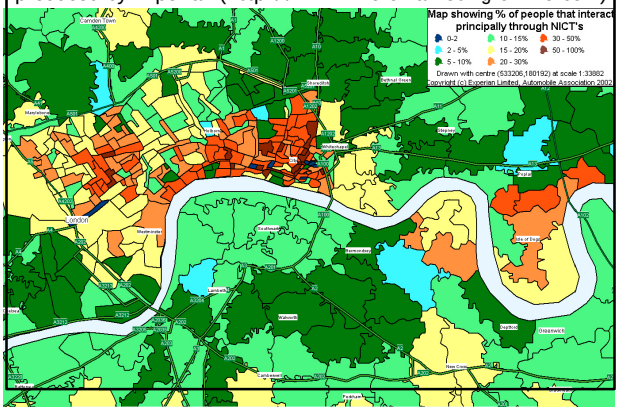
http://booth.lse.ac.uk/



Touchpoint Segment, a consumer 'lifestyle' classification produced by Experian (http://www.micromarketing-online.com)



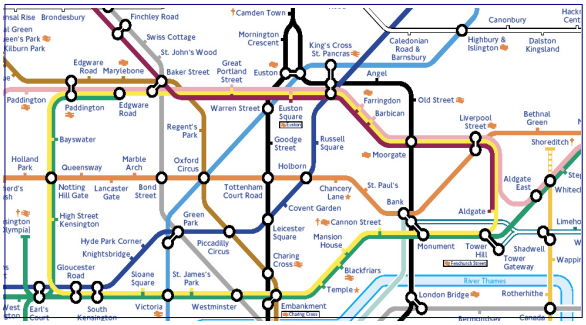
Touchpoint Segment, a consumer 'lifestyle' classification produced by Experian (http://www.micromarketing-online.com)

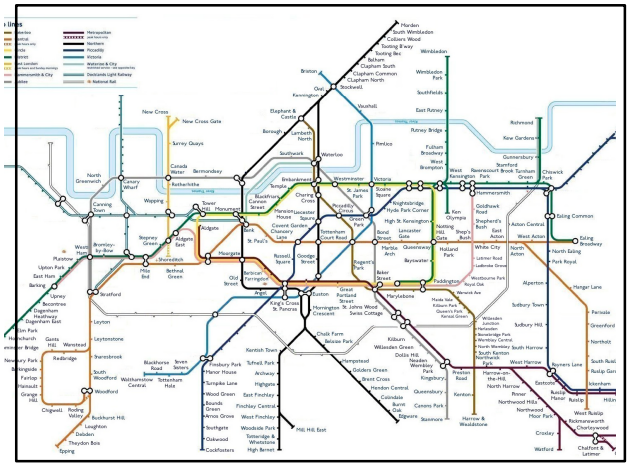


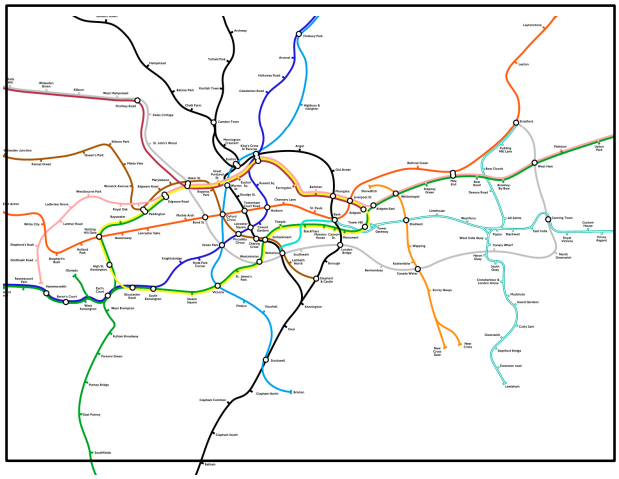
Network maps

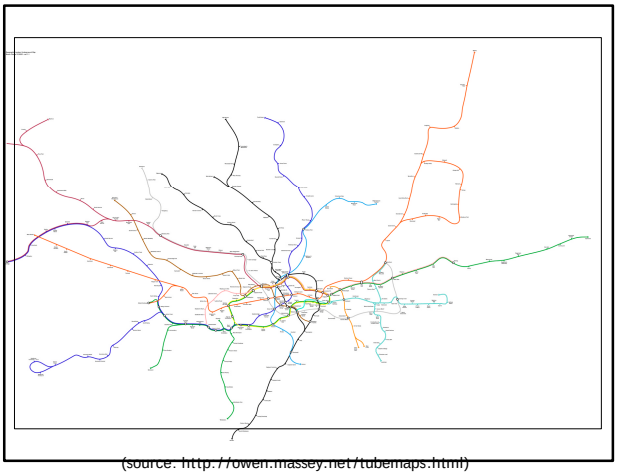
- topology not geography
- "If you're going underground, why do you need bother about geography? It's not so important. Connections are the thing." (Harry Beck)
- connections not location
- e.g. subway maps, internet backbone maps

Is this the layout of London in your head?

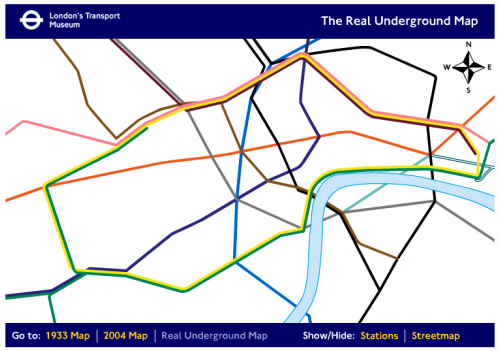








(source: http://owen.massey.net/tubemaps.html)

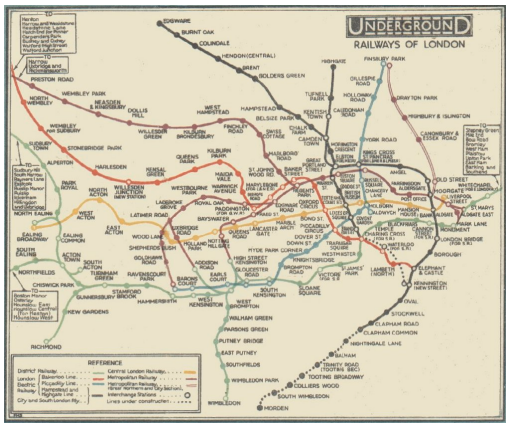


Harry Beck's Tube 'map'

- Beck was an electrical draughtsman
- key innovations in terms of visualisation
  - variable scale
  - distorting locations
  - straightening lines
  - 45' diagonals
  - interchange symbols
  - schematic river Thames

further reading:

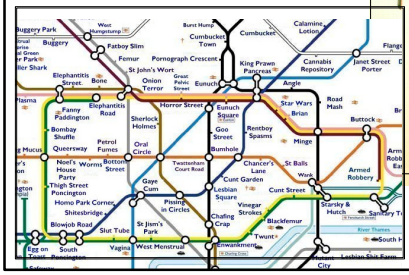
- Ken Garland, (1994) *Mr Beck's Underground Map*
- http://clives.members.easyspace.com/tube/tube.html

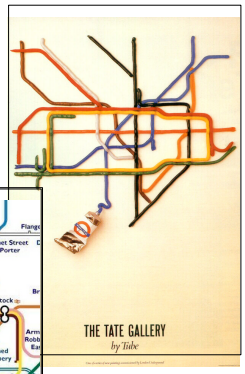


1926 (note, lack of surface geography)

1933

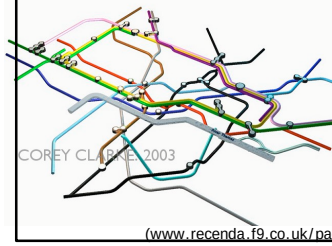
Visualisation as cultural icon





(source: Rude Tube Map http://owen.massey.net/tubemaps.html)

3d Tube map

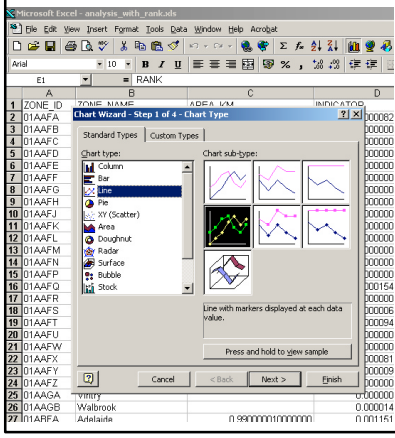


BUT, what are the benefits of going into 3d?

(www.recenda.f9.co.uk/pages/tubemap.htm)

Don't forget the 'basic' stuff

- remember to KISS your work
- tell your story in the simplest fashion
- less is more
- if you need to write a paragraph to explain the chart/diagram/map, maybe the visualisation is too complex
- 2d or 3d. don't assume because 3d looks sexy it will be more effective



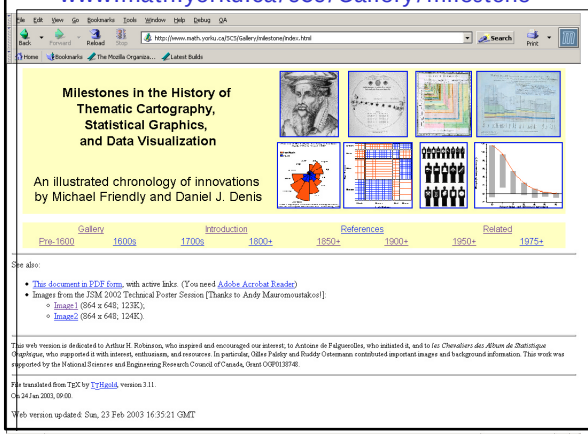
- statistical charts. appropriate use of bar charts, pie charts, scatter charts can be very effective
- I would avoid the pseudo-3D chart options

Further reading

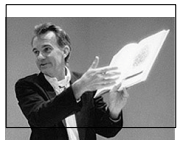
- Stephen S. Hall, (1992) *Mapping the Next Millennium: How Computer-Driven Cartography is Revolutionizing the Face of Science*

- Scott Orford, Danny Dorling and Richard Harris, (1998) *Review of Visualization in the Social Sciences: A State of the Art Survey and Report*. Report for the UK Advisory Group on Computer Graphics, No 41. <http://www.agocg.ac.uk/train/review/cover.htm>

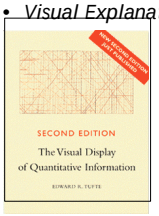
www.math.yorku.ca/SCS/Gallery/milestone

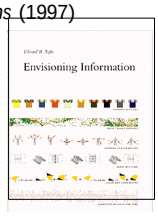


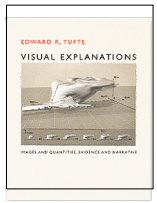
- Edward Tufte,



- *The Visual Display of Quantitative Information* (1983)
- *Envisioning Information* (1990)
- *Visual Explanations* (1997)



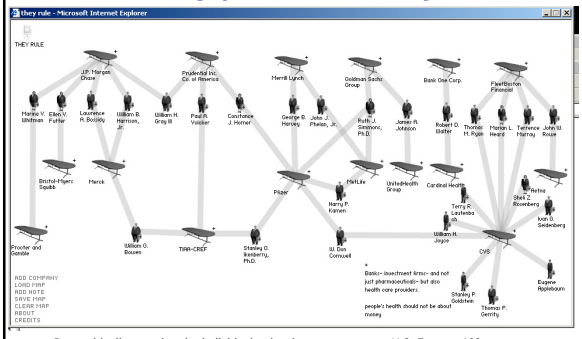




Visualising social worlds

- not only 'material things' you can map
- visualisation techniques can potentially make any type of data (objects and their relationships) visual, in the form of a spatial representation
- visualisation of
  - power
  - money
  - ideas
  - social ties

Visualising power - They Rule



By graphically mapping the individuals who sit on one or more U.S. Fortune 100 executive boards, **www.theyrule.net** gives a view of the close connections between board members and seemingly unrelated companies.