

Book review article

Tufte, E.R. 1997: *Visual explanations: images and quantities, evidence and narrative*. Zurich: Graphics Press. 156 pp. US\$45.00 paper. ISBN: 0 961 39212 6.

Visual explanations: images and quantities, evidence and narrative completes Tufte's trilogy of best-selling and influential books on graphical design. Tufte's ambitions for his books have grown as the series expanded. The first, *The visual display of quantitative information* (1983) was, in his own words 'about pictures of numbers, how to depict data and enforce statistical honesty' (p. 10). This book was well timed, being published just before the start of the 'visualization revolution' (Orford *et al.*, in press) when there was a dearth of up-to-date and original thinking. That book inspired much of the early work in the then rapidly expanding interdisciplinary field of visualization. His second book *Envisioning information* (1990) was, again in his words, 'about pictures of nouns (maps and aerial photographs, for example, consist of a great many nouns lying on the ground)' (p. 10). For the human geographers and cartographers for whom I am writing this review, this book may have promised more than it could deliver. There are more to maps than collections of nouns. In fact it is in this book that Tufte first showed a lack of appreciation for the uses of maps and it is this aspect of his work which should most concern us and on which I wish to concentrate here.

In *Envisioning information* Tufte reproduced Chinese maps of the birthplaces of poets 'shifting through centuries toward southeast China . . .' (p. 75). Hardly surprising, you may think, as that is where the population came to be concentrated. But Tufte is more interested in the visual clarity and beauty of the map than in what it really tells us. He reserved his venom for the most informative, if garish, map he reproduced, a multivariate multitemporal choropleth map of 'primary home heating fuel by counties of the United States: 1950, 1960, 1970' which he labelled as an 'exuberantly bad example' (p. 82). He also neglected to include the map's key, thereby conscripting the reader to his point of view through their ignorance. At the same time he extols the virtues of the most simple of maps. For instance, he contrasts the above example with (what he calls) the 'first-rate United States flashlight' map of population at night, and earlier in the book marvels at the 'extraordinary statistical maps report[ing] data for thousands of tiny grid squares' (p. 40). Apparently the only maps Tufte admires are the most simple maps of population density that cartographers can produce. It is within this limited cartographic context that *Visual explanations* (1997) was subsequently published.

Tufte's third book in the trilogy is, he says, 'about pictures of verbs, the representation of mechanism and motion, of process and dynamics, of causes and effects, of explanation and narrative' (p. 10). Given that, what message is there in this book for human geography and cartography? The biggest surprise, and the one that the remainder of this review will consider, is the dedication of the majority of Chapter 2 to

singing the praises of a single map of human geography. Perhaps Tufte's view of mapping has changed? A map which is about pictures of verbs, which represents mechanism and motion, process and dynamics, causes and effects, a map of explanation and narrative? Well, perhaps, but the reader may be a little disheartened to hear that, yet again, John Snow's population density map of 1854 cholera deaths in Soho in London has been wheeled out as an exemplar of best practice. One would have thought that a better map had been produced in the last century and a half. For those who do not know the story, and now the stories of the story, I will explain why the perpetuation of the Snow mapping myth is so disappointing. Particularly as, given subsequent sales of Tufte's books, it is likely that more people will read his version of the myth than all the others combined.

Following the south London cholera epidemic of 1848 Dr John Snow published *On the mode of communication of cholera* in 1849. It was Snow's work on south London which provided the most valuable data which led to the conclusion that cholera was caused by polluted drinking water. However, the first edition included no maps (Rip *et al.*, 1998). In the second edition the now famous map of the 1854 outbreak in Soho was included showing the apparent clustering of cholera deaths around the Broad Street pump. It is this version of Snow's work which Tufte claims to have rediscovered, despite it being the most cited map in medical geography and thus hardly a revelation (Cliff and Haggett, 1988). For those who know the full story this inaccurate recital (that the drawing of the map led to the identification of the cluster) lends weight to the collective belief of epidemiologists that mapping diseases tells them little. People who like maps on the other hand delude themselves that this was the means by which John Snow identified the cause of cholera. Conversely, for those who are new to the story, its recital perpetuates the idea that dot density mapping is the way to find clusters of disease. In reality the map was not used to identify the cluster or cause in 1854 and if you were trying to identify such a cause or cluster today this is not the kind of map you would draw.

That Snow did not use his map to identify the Broad Street pump as the conduit for the Soho cholera outbreak is obvious from the map itself, let alone from a reading of Snow's work. The map is centred on the pump, and hence the pump was seen as the cause before the map was even drawn. The pump was not identified from the map.

To me the far more interesting question a century and a half later is was it specifically and only the water in the Broad Street pump which was contaminated and why were the environmental causes of disease of paramount interest to Snow given the huge range of social inequalities which were being identified at that time (Chadwick, 1842; Engels, 1844)? It is well known, and even Tufte reports, that the numbers of deaths from cholera were falling a week before the pump handle was removed.

Removing a pump handle is the simple act of the 'pure scientist' but it is the complex unfolding of events around the world which determines history, not the lone decisions of great men. It was the 1848 world-wide cholera epidemic and the uprisings of that year, in Berlin, Paris, Vienna, Sicily, Milan, Naples, Parma, Rome, Warsaw, Prague, and Budapest which were the historical companions of the first Public Health Act in Britain. The creation, by the Act, of the General Board of Health, empowered to establish local boards to deal with water supply and sewerage (Krieger *et al.*, 1997) led, along with other factors, to improved living conditions in Britain. The removal of a pump handle five years later was a consequence of these and other events, not their precursor as

Tufte's telling of the story would have us believe.

This debate has resonance today, when a report of a cluster of half a dozen deaths in a dozen years around a power station will result in far more publications, public interest and research funding than does the knowledge that tens of thousands of people die prematurely every year even in Britain due to poverty. Indeed poverty, and the commensurate overcrowding, exhaustion and infirmity that it caused, led both to the crowding of people most susceptible to die into this part of Soho (Dorling, 1998) and to their remaining there after the most affluent had fled. As Snow reported and Tufte reiterated but neither remarked upon: 'Persons in furnished lodgings left first, then other lodgers went away, leaving their furniture to be sent for' (Snow, 1855 in Tufte 1997, p. 27). Those in furnished lodgings left first because they had the resources to do so, not because they were not worried about the furniture.

On overcrowding, Tufte admits that 'the big problem is that dot maps fail to take into account the number of people living in an area' (p. 35). He then goes on to illustrate the problems of choropleth mapping, having apparently never heard of kernel density estimation or the innumerable alternative techniques which have been invented to overcome these problems since 1854. A decade ago Cliff and Haggett showed how Snow's data could be remapped on an isodemographic map base (Cliff and Haggett, 1988, Figure 1.18D) – never mind what we have learnt about society and the interplay of social inequalities and disease since 1848.

Tufte omits to mention, or perhaps didn't realize, that he was dealing with the second edition of John Snow's work, which may partly explain some of the errors in his version of the story (and why he could not find copies of the maps in some editions of the work):

Some facsimile editions of *On the mode of communication of cholera* have given up, reprinting only Snow's text and not the crucial visual evidence of the map. Redrawings of the map for text books in medicine and in geography fail to reproduce key elements of Snow's original . . . Standards of quality may slip when it comes to visual displays; imprecise and undocumented work that could be unacceptable for words or tables of data often shows up in graphics (p.35).

The first map I know of, drawn by a doctor for studying the geography of disease (rather than for illustrating it) was produced in Iowa State (Wallace, 1926) to study vaccination rates. But in the context of this review perhaps the most interesting alternative to Snow's map is one published for London exactly one hundred years after Snow's second edition, plotting the distribution of polio by borough (Taylor, 1955). Both these maps were far cruder than Snow's and neither produced conclusive results nor the dramatic tale of a pump handle being removed in the midst of piles of cholera-racked corpses, but both are examples of working general practitioners using maps in novel ways in an attempt to understand the geography, causes and consequences of the diseases of their day. Taylor was studying the distribution of poliomyelitis in 1947 and his map identified the highest rates to be in Shoreditch and the lowest rates in Islington and areas around Hampstead. Most of today's epidemics are similarly geographically patterned from poor to rich areas, although infectious and viral diseases spread through sewage are no longer epidemic.

In 1991 Shoreditch was home to the highest proportion of people in low paid work in the country: 39% of its economically active residents being in unskilled or semiskilled manual labour compared to 11% in Hampstead (almost the lowest rate of any borough

or district in the country). Shoreditch also has the highest premature mortality rate of adults in Britain (Dorling, 1997: 48). If we consider those most at risk of ill health, then exactly a century and a half after the cholera epidemic that began this story, the corpses found on the streets of London today, and identified at coroner's courts as people of no fixed abode, are dying (albeit in much lower numbers) with much the same geographies as in 1848 and at an average age, not much different, of 42 (Shaw and Dorling, 1998). Had Tufte compared maps of cholera deaths in 1848 with deaths from homelessness in 1998 he may have learnt how mappings can fuel the understanding of historical social processes which create such slowly changing human geographies of ill health. Read with hindsight, the story of the 'Hampstead widow' who had water delivered from the Broad Street pump tells us as much about the social geography of London in the past as it does about cholera:

A niece, who was on a visit to this lady, also drank the water; she returned to her residence, in a high and healthy part of Islington, was attacked with cholera, and died also. There was no cholera at this time, either at West End [Hampstead] or in the neighbourhood where the niece died (Snow on Fraser's report in Tufte, 1997: 32).

The geographical extremes and contours of inequalities in health in London have changed little over time.

Edward Tufte's chapter on John Snow's mapping ends with the modern day tale of the Challenger space shuttle disaster of which he concludes that if only NASA and their contractor's engineers had had the graphical dexterity of Snow, then they could have convinced the powers on high not to have launched on that cold January day in 1986. Again this is a good story, if also already told elsewhere, but again the simple message that all can be solved if only we were more technically adept is overplayed. At least here Tufte alludes to the other social, economic and political forces at play at the end of this second tale:

For the Challenger, there were substantial pressures to get it off the ground as quickly as possible [among them] a possibility of a televised conversation between the orbiting astronaut – teacher Christa McAuliffe and President Reagan during his State of the Union address that night (10 hours after the launch). But these pressures would not have prevailed over credible evidence against the launch, for many other flights had been delayed in the past for good reasons. Had the correct scatterplot or data table been constructed, no one would have dared to risk the Challenger in such cold weather (p. 52).

That Tufte, despite all his searching over many years in many libraries could not find an example of 'the scatterplot which changed the world' is, I think, evidence enough that such things do not exist. In the case of Challenger 'The scatterplot that could have been' benefits too much from hindsight, just as John Snow's map, in his second edition, was a good afterthought.

Maps and charts, if drawn with understanding, can make us think more carefully about 'mechanism and motion, of process and dynamics, of causes and effects, of explanation and narrative', but they cannot do this in isolation. The isolation of the pictures in *Visual explanations* from their social contexts and the scant reinterpretation which is provided produces a series of potted histories of 'good science' and 'bad science' with little space for social science or historical understanding.

This has been an incomplete review of *Visual explanations*. Even given the criticisms above the scope of the book is far too wide for one reviewer to cover and so I have tried to concentrate on those subjects (and that chapter) closest to the interests of *Progress in*

Human Geography. The main reason for my criticism has been the wide range of the book which, while making it very enjoyable to read, means that the author cannot hope to understand each particular subject to the depth that his confidence suggests. Tufte's style of constantly criticizing what he sees as bad practice undoubtedly makes him a fair target for a more critical examination of his work. That said, this book, like his previous two, is lavishly illustrated, albeit mainly with other people's illustrations. The number of typographic errors is very low. All I could find in Chapter 2, for example, was a spurious reference to data being reproduced with red ink on p.44. The time-space cyclograms of the Salyut 6 orbit are especially interesting to would-be time-space cartographers. My one remaining worry though, is knowing what else is known of the other side to one of Tufte's tales, how much else in the book is fiction and how much fact?

University of Bristol

Daniel Dorling

- Brody, H., Vinten-Johansen, P., Paneth, N. and Rip, M.R.** 'John Snow revisited: Getting a handle on the Broad Street pump'. *Pharos* (in press).
- Cliff, A. and Haggett, P.** 1988: *Atlas of disease distributions, analytical approaches to epidemiological data*. Oxford: Blackwell.
- Chadwick, E.** 1842: *Report from the poor law commissioners on an inquiry on the sanitary conditions of the labouring population of Great Britain*, reproduced 1965. London: HMSO.
- Dorling, D.** 1997: *Death in Britain: how local mortality rates have changed: 1950-1990s*. York: Joseph Rowntree Foundation.
- Dorling, D.** 1998: *Mapping disease patterns, The Encyclopedia of biostatistics*. Chichester: Wiley.
- Engels, F.** 1844: *The condition of the Working Class in England*. London: Penguin.
- Krieger, N., Zapata, C., Murrain, M., Barnett, E., Parsons, P.E. and Birn, A.** 1997: Spirit of 1848: a network linking polities, passion, and public health. *Radical Statistics* 66, 22-32.
- Orford, S., Harris, R. and Dorling, D.** 1999: Information visualization in the social sciences: A state of the art review. *Social Science Computer Review* Vol. 17, no. 2.
- Paneth, N., Vinten-Johansen, P., Brody, H. and Rip, M.R.** 'A rivalry of foulness: official and unofficial investigations of the London cholera epidemic of 1854. *American Journal of Public Health*, November 1998 (in press).
- Rip, M.R., Paneth, N., Vinten-Johansen, P., Brody, H., Rachman, S.** 1998: Cartopathology: John Snow and the London cholera epidemics 1848 and 1854 re-examined. *Proceedings of the Eighth International Symposium in Medical Geography*. Baltimore, MD, 13-17 July.
- Shaw, M. and Dorling, D.** 1998: Mortality among street youth in the UK. *Lancet* 29 August, 743.
- Taylor, I.** 1955: An epidemiological map. *Ministry of Health Monthly Bulletin* 14, 200-201.
- Tufte, E.R.** 1983: *The visual display of quantitative information*. Cheshire, CT: Graphics Press.
- Tufte, E.R.** 1990: *Envisioning information*. Cheshire, CT: Graphics Press.
- Wallace, J.M.** 1926: Population map for health offices. *American Journal of Public Health* 16, 1023.