

REVIEWS: BOOKS AND ATLASES

THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION / Edward R. Tufte. Cheshire, Conn.: Graphics Press, c1983. 197 p.: ill., maps. \$34 us. (Available from Graphics Press, Box 430, Cheshire, Conn. USA 06410.)

It is an ancient tradition in the arts and sciences of both East and West that words and pictures belong together. The Chinese have always written on their paintings, and many of their finest poets have been great painters as well. Combining words and pictures in *haiga* and *nanga*, the Japanese Buson and his followers were known as poet-painters. In the West, the parallel traditions of the illuminated manuscript, and emblematic and concrete poetry found their geniuses in the Books of Hours, William Blake and Guillaume Apollinaire, among many others. So integrated are the words and pictures in the treatises of Copernicus and Kepler, Galileo and Newton that the blocks of letters swoop, as around the planetary orbits of Copernicus' *De Revolutionibus Orbium Coelestium*, open and close, as around the diagrams in Newton's notebooks, or interpenetrate the pictures, as in Galileo's brilliantly designed *Sidereus Nuncius*, the 'new' stars blooming on the paper as in the sky. An ancient tradition, it is also all but dead – all but killed, according to Edward Tufte, by the exigencies of printing and labor specialization. Around its deathbed dance the ghouls of ghastly graphics.

You see them everywhere, the flash graphics distorting or obscuring their paltry data in a bewitching brew of svelte design and technological virtuosity, floating ('See Box') somewhere on the page, on the back of the adjacent page, or in another chapter altogether. "Imagine," Tufte asks, "if graphics were replaced by paragraphs of words and those paragraphs scattered over the pages out of sequence with the rest of the text." Such a request raises questions about the content of graphics as well as the relationship to their justifying texts, but it is Tufte's position that the state of the former is a consequence of what has happened with respect to the latter. While there is no formal treatment of this history in *The Visual Display of Quantitative Information*, Tufte does provide the necessary parts of a thoroughly convincing argument, epitomized in this paragraph Tufte quotes from Albert Biderman:

The evolution of graphic methods as an element of the scientific enterprise has been handicapped by their adjunctive, segregated, and marginal position. The exigencies of typography that moved graphics to a segregated position in the printed work have in the past contributed to their intellectual segregation and marginality as well. There was a corresponding organizational segregation, with decisions on graphics often passing out of the hand of the original analyst and communicator into those of graphic specialists – the commercial artists and designers of graphic departments and audio-visual aids shops, for example, whose predilections and skills are usually more those of cosmeticians and merchandisers than of scientific analysts and communicators.

Though Tufte has even less patience for graphic specialists than Biderman, it is the heart of his plaint that, trained in the 'arts' they not only have little experience with the analysis of data, but "believe that statistics are boring and tedious." It then follows that, "decorated graphics must pep up, animate, and all too often exaggerate what evidence there is in the data." For Tufte, the data – if worth publishing at

all – speak best for themselves. He finds himself out of sorts, then, with the assertion of *Time's* first full-time chart specialist – an art-school graduate – who says that “The challenge is to present statistics as a visual idea rather than a tedious parade of numbers”; or the sentence in Jan White’s *Graphic Idea Notebook* which asks, “Why are statistics so boring?” After responding that, “If the statistics are boring, you’ve got the wrong numbers,” Tufte expresses his concern that the doctrine of boring data serves political ends,

... helping to advance certain interests over others in bureaucratic struggles for control of a publication’s resources. For if the numbers are dull dull dull, then an artist, indeed many artists, indeed an Art Department and an Art Director are required to animate the data, lest the eyes of the audience glaze over. Thus the doctrine encourages placing data graphics under control of artists rather than in the hands of those who write the words and know the substance. As art bureaucracy grows, style replaces content.

Inevitably this results in glaring distortion – Tufte’s horrifying examples come from the *New York* and *Los Angeles Times*, *Washington Post*, National Science Foundation and corporate annual reports, as well as *Pravda* – but his ultimate concern is that the existence of such trash has in turn distorted thinking about statistical graphics:

Much of twentieth-century thinking about statistical graphics has been preoccupied with the question of how some amateurish chart might fool a naive viewer ... At the core of the preoccupation with deceptive graphics was the assumption that data graphics were mainly devices for showing the obvious to the ignorant ... The assumption led down two fruitless paths in the graphically barren years from 1930 to 1970: First, that graphics had to be ‘alive,’ ‘communicatively dynamic,’ overdecorated and exaggerated (otherwise all the dullards in the audience would fall asleep in the face of those boring statistics). Second, that the main task of graphical analysis was to detect and denounce deception (the dullards could not protect themselves).

Tufte argues that the doctrines that data graphics are for the unintelligent and that statistics are boring must be rejected once and for all if statistical integrity and graphical sophistication are to be achieved. “These doctrines blame the victims (the audience and the data) rather than the perpetrators.” Graphical competence demands three quite different skills: the substantive, statistical and artistic. “Yet now most graphical work, particularly at news publications, is under the direction of but a single expertise – the artistic. Allowing artist-illustrators to control the design and content of statistical graphics is almost like allowing typographers to control the content, style and editing of prose.”

This analogy is especially apt, for at the heart of Tufte’s program for the redemption of the data graphic is the principle of data/text integration: “Data graphics are paragraphs about data and should be treated as such.” This means they should be run into the text wherever possible, should be printed afresh near each reference (perhaps reduced in size in subsequent showings) should appear in the same typeface as the text, and should not be set off by ruled lines. This advice is scrupulously followed in *The Visual Display of Quantitative Information* and the result is a startling revelation of how friendly a book can be. Though none of its illustra-

tions carries a figure number, because of the gentle but thorough integration of words and pictures, there is quite simply *no* ambiguity of reference. None. Nor, because illustrations are printed afresh at each reference (and not always smaller at second sight), is there any manic flipping through pages with one hand while holding place with the other. Integrated, words and pictures cooperate instead of fight.

Needless to say, graphics accorded such consideration have to be worth looking at. Nor merely decorative, they may not be redundant either. "Modern data graphics can do much more than simply substitute for small statistical tables," Tufte writes.

At their best, graphics are instruments for reasoning about quantitative information. Often the most effective way to describe, explore, and summarize a set of numbers – even a very large set – is to look at pictures of those numbers. Furthermore, of all methods for *analyzing and communicating statistical information*, well-designed data graphics are usually the simplest and at the same time the most powerful.

Illuminating this point are 75 examples of the finest graphical work from 1700 to 1982: time series, thematic maps (one of which earns his praise as perhaps "the best statistical graphic ever drawn"), relational graphics, multivariate designs, small multiples, and very high density displays of an engaging and instructive variety. But what is peculiarly engaging and instructive is the manner in which Tufte has been able to translate his convictions that these graphics represent "complex ideas communicated with clarity, precision, and efficiency," into hard-nosed goals, measures and principles all but sufficient for their production.

Graphical displays should, Tufte insists, show the data; avoid distorting what the data have to say; induce the viewer to think about substance rather than methodology, graphic design or the technology of graphic production; present many numbers in a small space; make large data sets coherent; encourage the eye to compare different pieces of data; reveal the data at several levels of detail; serve a reasonably clear purpose; and be closely integrated with their statistical and verbal descriptions. By and large unexceptionable, Tufte demonstrates – quantitatively – that literally billions of graphical displays fail to meet one or more of these goals each year. Lethal in his analyses are three simple measures: data density (number of entries in a data matrix/area of data graphic), the data-ink ratio (data ink/total ink used to print the graphic), and the lie factor (size of effect shown in graphic/size of effect in data). Taken together these all but quantify assertions which would, without their aid, remain forever in the nebulous domains of taste and personal preference. The principles which promote the maximization of these measures are too numerous to detail, but they largely derive from Tufte's vision of data graphics as paragraphs about data: "maximize the data-ink"; "erase redundant data-ink"; "revise and edit"; "mobilize every graphical element, perhaps several times over, to show the data"; "maximize data density and the size of the data matrix, within reason"; "graphics can be shrunk way down"; and, "above all else show the data." These and others are deftly summarized in Tufte's redrafting of two well-known aphorisms: "For non-data-ink, less is more. For data-ink, less is a bore." Following these principles new graphics are

designed and old ones redesigned – principles of erasure are revealed as particularly powerful – which *speak* with an authority and grace that can only be called elegant. It's a grace striven for by Tufte, who defines good design in these words: "Graphical elegance is often found in simplicity of design and complexity of data." Things like this are easy to say. Tufte demonstrates that they can be easy to achieve as well.

There is throughout this unassuming but brilliant book – which manifests in every way the principles it articulates, from its generous size, first-rate binding, comfortable layout, pleasant typeface, ample leading, clean and quotable prose, and well-chosen illustrations to its bracing no-nonsense thought – a remarkable absence of cant, jargon and cheap talk. It is a book only a statistician could have written (Tufte is Professor of Political Science and Statistics at Yale, fellow of the American Statistical Association, and so on and so on), but only one with also a sharp visual intelligence (Tufte also teaches in Yale's Department of Graphic Design). Abrogating received truth, advocating heresy on almost every page, *The Visual Display of Quantitative Information* is, according to John Tukey, "a *tour de force*," and according to Frederick Mosteller, "a landmark book." It is more: it is a declaration of independence from the dual tyrannies of production exigencies and Boutique Design. "Words, graphics, and tables are different mechanisms with but a single purpose," writes Tufte, "– the presentation of information." With such a thought firmly in mind it might yet be possible to revive the moribund tradition that words and pictures *belong* together.

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GRAPHIC COMMUNICATION AND DESIGN IN CONTEMPORARY CARTOGRAPHY / edited by D.R. Fraser Taylor. Chichester; New York; Brisbane; Toronto; Singapore: John Wiley & Sons, c1983. xviii, 314 p.: ill., maps. (Progress in contemporary cartography; v. 2). ISBN 0 471 10316 0: \$82.95 Cdn.

This work is the second volume in the Wiley series on "Progress in Contemporary Cartography" which aims to present reviews and reports by leading authors on theories, methods and empirical research in the field of cartography. It contains twelve papers contributed by eleven eminent cartographers working in six different countries as widely separated as Canada and the Soviet Union. Their topics are equally divergent, and range from "A Map Maker's Perspective on Map Design Research 1950–1980", through "Visual Information Processing and Cartographic Communication: The Utility of Redundant Stimulus Dimensions" to "The Cartography Lesson in Elementary School". The book is comprehensively illustrated with maps, diagrams and photographs, and detailed bibliographies are appended to each of the papers.

The first of the contributions introduces the volume and consists of the editor's thoughts on "Graphic Communication and Design in Contemporary Cartography". It justifies the publishing exercise in theoretical terms because of the enormous influence of 'communication' on cartography during the last two