as possible to that which the scene would produce when viewed naturally. In other denotational systems, such as cartoons, a line may represent an edge: many other variations in brightness, for example those produced by shadows or by changes in albedo may be omitted. In some systems, hatching may arbitrarily represent a shadow. As Willats points out, such denotational systems have preprocessed the scene by making explicit the features that produce changes in brightness such as an edge or a shadow. These are novel and interesting ways of categorizing pictures, and they illuminate the motivation underlying different styles of painting.

Three other papers presented ideas and findings that were new — at least at the time of the conference. They were on colour (John Mollon), motion-detecting cells (Tony Movshon), and cells in the monkey's inferotemporal lobe that respond maximally to a person moving in a particular direction — backwards, forwards, left or right (David Perrett). Interestingly, some cells respond to directions of motion relative to the moving person's own position: one cell responded maximally to a person moving forwards to the right, but responded much less if he was facing left and walked backwards. If these results hold up, we are coming perilously close to grandmother cells. The interesting question is not, however, whether such cells exist, but how, if they do exist, they are wired up. The silence elicited by this problem is as profound as the problem itself.

To turn to the trinkets, the one that glitters most is a paper by Jon Darius on the fallibility of scientific observations, particularly in astronomy. It is well known that Martian canals were only disposed of by photographs from space craft, but he gives several other instances in which astronomers have collectively seen patterns that do not exist. One nice story concerns the map of Mercury that one astronomer compiled when it was thought that Mercury took the same period to rotate as to complete one orbit, thus always presenting the same face to the observer. Although it is now known that these periods are quite different, three other astronomers, each looking at a different face, drew maps that were almost identical to the original one.

Of the other papers, two may be singled out for their amusement value. John Krebs recounts the behaviour of the honeyguide, an African bird that is adept at locating bees' nests but rather poor at obtaining access to them in order to eat the honey. It has solved the problem by leading human hunters to the nests it has located: when the hunters open them up, it is able to gorge itself. Mike Land introduces us to the scallop's unusual method of forming a retinal image — by a concave mirror behind the retina — and

the even more bizarre method used by the shrimp — a series of flat mirrors in front of the retina all of which send light from the same point in space to the same point on the retina: he cites several similar curiosities. Entertaining though such discoveries may be, they are hardly likely to change the way scientists think.

In fact, there are few theories, whether grand or small, to be found in this collection. Too many of the authors tell us, often in some detail, what we already know. Colin Blakemore puzzles over the question of why visual and other sensory maps exist, but misses the obvious answer that normally it is necessary to analyse the retinal image locally. The parts of an object are contiguous and must be processed together. In a different world, it might have been necessary to put together the pattern of light falling in the top right-hand corner of the retina with that in the bottom left, which would have needed a form of mapping quite unlike existing cortical maps.

The book has two curious features. The first is what it leaves out. There is nothing

on the difficulty of interpreting medical X rays or the electrocardiogram nor on the merits of attempting to do so by computer. Nor is there anything on the bizarre disruption of images that can occur in brain-damaged patients. Dreams and hallucinations receive no mention, and apart from a philosophical contribution there is little on the nature of mental images. Second, the individual papers have remarkably little relevance to one another. It is just possible that some of the participants will be inspired by the contributions of workers in other disciplines to change their view of their own patch, but it seems unlikely.

Most of the papers are clear and some are elegant: few are deep. They will appeal less to the scientist than to the general reader, whose delight in trinkets is unaffected by their antiquity. I half wish I had remembered to attend the conference. □

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Pretty pictures

P. T. Saunders

Envisioning Information By Edward R. Tufte. *Graphics Press: 1990. Pp. 126. \$48.*

ONE picture, so we are told, is worth a thousand words. Certainly most scientists seem to think so, judging by the large number of figures and tables we put into our papers. With pictures even more than with words, however, it is not always easy to convey information in a way that is both attractive and clear, especially because in both cases the medium is less complex and dynamic than the message it is being asked to carry.

In *Envisioning Information*, Edward Tufte discusses how pictures can be made more effective. But the book is not a text on graphic design. Its aim is to illustrate general principles that help to identify and explain design excellence, not to teach specific techniques. Nor is it aimed specifically at the scientist. There are, to be sure, examples from science, but more from other fields. But they have been chosen with a view to holding the reader's interest, and almost anyone is bound to come across something that he did not know before and is likely to remember.

Tufte provides many beautiful examples of "cognitive art" — and a few horrors as well, to show what can happen when the principles are ignored. The illustrations include such gems as diagrams from an 1847 colour edition of Euclid's *Elements* in which the figures resemble paintings by Mondrian. And even though the focus

of the book is on graphics, the text is especially well written.

All the same, *Envisioning Information* is likely to disappoint any scientist who buys it chiefly in the hope of learning how to write better papers. After reading it, I went through a recent issue of *Nature* looking for figures that I thought would have been better if the authors had followed some of Tufte's suggestions, and I did not find any. That may reveal a lack of imagination on my part, but I think it also indicates that most figures in scientific journals are pretty straightforward. Most of the graphs looked clear enough to me, and I doubt there is very much that even Tufte could do with a photograph of a gel.

A particular shortcoming from the point of view of the scientist is that much of the book is concerned with the effective use of colour. This is an important topic, and it makes the book itself more pleasing to look at, but it is of little practical value for authors who are almost always restricted to black and white on grounds of cost.

Envisioning Information is not as relevant for the scientist as Tufte's earlier *The Visual Display of Quantitative Information*. You would not want to keep it on the laboratory shelf next to handbooks of constants, tables of integrals and style manuals. On the other hand, I enjoyed reading it, it did teach me something about the use of graphics — and if it had been a more practical text I would not have learned anything at all because I would never have picked it up in the first place. □

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