put the emphasis on behavioural and social aspects of the past, and especially the very remote past, is — as the author is well aware — that one is often reduced to pure speculation: one need only refer to the endless, infinitely ingenious theories of why hominids became bipedal. This does not mean that it is not worth trying to take a fresh look at the evidence — indeed Gamble is to be admired for having a go at such an intractable problem — but alas it does not seem to lead to any new insights. The book's blurb claims that it "throws a striking new light into the background of human history", but in fact the concluding chapter merely decides that people colonized the world purposefully rather than through aimless drifting or random diffusion. Their only direction or goal was to survive and reproduce their existing social life, and the motor of prehistory was behaviour ungoverned by natural laws but constrained by the practicalities of existence.

In other words, people rather than penguins ended up all over the globe because they were people with rational minds who could construct and change their worlds. But this is pretty similar to the traditional view that people went to the ends of the Earth 'because they were there' or because there was nowhere else to go. It seems to come down to 'people colonized the Earth precisely because they were people'. Nevertheless, in presenting the theories of how they became people in the first place, and in attempting to chart how and when and even why the various stages of global colonization occurred, Gamble has produced a readable and novel (I use the word advisedly) account of prehistory.

I am not sure whom the book is aimed at, however. It is certainly not a textbook, and although it presents a (highly selective and skewed) establishment view of human evolution, readers will find several more user-friendly and richly illustrated volumes on the market. Gamble's text is often dense, and his love of buzz-words such as 'exaptation' or 'teleology', and his use of obscure terms such as 'vicariance biogeography', are likely to alienate students and public alike. □

Paul Bahn is a freelance writer on archaeology at 428 Anlaby Road, Hull HU3 6QP, UK.

Picturing mathematical information

Nick Beard

The Visual Mind: Art and Mathematics. Edited by Michele Emmer. *MIT Press: 1993. Pp. 274. $39.95, £35.95.*

THE *Visual Mind* is about the overlap between art and mathematics, and it is replete with examples, many from the days before computer graphics. It is written by mathematicians and artists, some of whom claim to be both. Although the blend of art and mathematics will not seem odd to mathematicians (and not just topologists, nonlinear-systems analysts and computer scientists), the book's thesis is that the interplay is mutually beneficial. Evidence of mathematics' continuing contribution to art is not in dispute. But evidence of a reciprocal contribution is sparse indeed.

There are choices to be made in building representations, especially visual ones. The mapping of abstract mathematical data to real images is arbitrary, yet important decisions, many of them aesthetic, must be made in selecting one map over another. Perhaps artists can play a valuable part? But graphics are at once easier and harder to understand than raw data. Their appeal is in the swiftness with which one can grasp the intended message. The difficulty is the ease with which graphically represented data can be missed, masked or misinterpreted. Unfortunately, for all their insight and intuition, many artists fail to appreciate these subtleties: recall the flurry of innumerate prose penned on chaos and fractals.

There is more to this book than fractals, however. There are many examples of weird and wonderful mathematical forms, most of which, before computer graphics, were effectively invisible except in the imaginations of mathematicians. Tiling, tessellation, topology, trigonometry and technology all loom large. There is much here to interest a wide range of readers. *The Visual Mind* is an attractive and enjoyable work, despite its uneven demands on readers' mathematical abilities.

The opening essay is Max Bill's "The Mathematical Way of Thinking in the Visual Art of Our Time", first published in 1949. It is intriguing that the first line should now appear so dated: "By a mathematical approach to art it is hardly necessary to say I do not mean any fanciful ideas for turning out art by some ingenious system . . . with the aid of mathematical formulas." Art *can* be algorithmic: William Lathan and Harold Cohen, for example, have written software to produce art. However, digitally produced images have no 'original'. The art critic Peter Fuller writes of the "bogus religiosity" attached to "original works", even when most observers cannot tell an original from a copy. Yet for some people, the lack of an original and the apparently formulaic roots of computer art still seem to undermine its artistry.

The book includes some strange excursions. Charles Perry, the sculptor responsible for the beautiful aluminium "Eclipse" in a San Francisco hotel and the bronze "Continuum" in the National Air and Space Museum, Washington, DC, writes an honest and self-effacing essay, inappropriately entitled "The Role of the Artist's Intuition in Science". He describes himself as one of the many dreamers gathered at the frayed edges of science, fraught with wishful intuitions about the Universe, and gives a cheerful tour of the background to his geometrically complex sculptures. Harriet Brisson, in "Visualisation in Art and Science", is less modest: "Visual imagery may serve as a bridge between the human spirit and the complicated technical language of the twentieth century".

The overall impression of the book is of mathematicians enjoying exploring and creating beautiful objects and spaces (without the help of artists, thank you) and a few artists joining in (with varying degrees of humility). The essentially commercial work of developing tools for a wide range of computer users continues alongside these recreations. "The 1990s will be the decade of visual processing", announces Silicon Graphics, manufacturers of visualization tools and workstations. Whether people value artists' contribution will be tested in the time-honoured way: by asking them to pay for it. □

Nick Beard is director of information services at Health Care International, Beardmore Street, Clydebank G81 4DY, UK.

New in paperback

The Structure and Confirmation of Evolutionary Theory by Elisabeth A. Lloyd. Philosophy of Darwinism, first published in 1988. Princeton University Press, $14.95, $11.95.

The Uses of Life by Robert Bud. A well-received history of biotechnology. Cambridge University Press, £12.95, $19.95.

Exploding the Gene Myth by Ruth Hubbard and Elijah Wald. "A broad overview of the science of genetics and its social implications" (Dorothy Nelkin, *Nature* **363**, 27; 1993). Beacon Press, $12.

Land Degradation by C. J. Barrow. An introduction to this "key issue in world conservation". Cambridge University Press, £19.95, $29.95.

The Royal Society and Its Fellows, 1660–1700: The Morphology of an Early Scientific Institution by Michael Hunter. Revised edition of this standard source, first issued in 1982. British Society for the History of Science, £10 (£8 for members).