

Richard Taylor

Fractals: hairy, with warts all over them

The Colours of Infinity: The Beauty and Power of Fractals

Ian Stewart et al.

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Eight years ago, I hated fractals. As a result of a documentary being made about my research, fractals had infiltrated every minute of my day for four weeks. One night, in a fractal-exhausted state, I switched on the television.

Expecting to watch the cricket, I was instead confronted with the Mandelbrot set swirling across my TV screen. As the soundtrack of Pink Floyd's guitarist David Gilmour faded into the background, narrator Arthur C Clarke announced that "the Mandelbrot set's got warts all over it and it's quite hairy". What followed was a remarkable documentary about the computer-generated fractal pattern that has become one of the most widely known mathematical images of our time. By the end of the programme, my enthusiasm for fractals had been rekindled.

The Colours of Infinity celebrates this cult documentary's 10th anniversary. The book comes with a DVD of the documentary and contains chapters written by each of the mathematicians interviewed on camera, including Benoît Mandelbrot, Michael Barnsley and Ian Stewart. Whereas previous books by Mandelbrot and Barnsley describe fractals through mathematical detail, *The Colours of Infinity* concentrates more on fractals' visual impact. The book builds on Mandelbrot's view of fractals as a new geometry, where their visual significance goes beyond mathematical origins. In doing so, it successfully bridges the gap between glossy coffee-table books filled with fractal art and textbooks packed with equations and graphs.

In the 10 years since the documentary was produced, the increased computing power available to researchers has triggered a spectacular explosion in the number of articles published on fractals. In response, the book contains chapters that go beyond the original scope of the documentary. They nicely capture the diverse field of fractals.

While the original documentary participants describe examples as exotic as fractal drums (Stewart), fractal scenery in the *Star Trek* movies (Mandelbrot) and Jungian psychology (Clarke), newcomers also make contributions to the fractal scene. Will Rood – the animator of the documentary's striking fractal imagery – discusses the appearance of fractals in art using M C Escher's famous self-similar works. Sociologist Robert Prechter explores the fractal behaviour of the stock market, while *Yahoo!* research

scientists Gary Flake and David Pennock describe one of the fastest growing fractal ecosystems – the World Wide Web.

Now that fractal geometry is entering maturity, it is easy to forget the leaps and bounds involved in its development. *The Colours of Infinity* provides personal perspectives from those close to the action. For example, Mandelbrot reminisces about 1 March 1980 – the day he sat in front of his computer and saw the Mandelbrot set (christened in retrospect by others) emerge for the first time. Did he discover or invent it? "I had never the feeling that my imagination was rich enough to invent all these extraordinary things," he states.

Barnsley also discusses his personal epiphany – when he realized how fractal geometry could be practically applied. His discovery happened after 20 years of a recurring nightmare involving tangled wires of an old telephone switchboard. "The night of the anniversary of my father's death...I saw how all the wires would become untangled," he writes. "When I woke up the next morning, I knew that I'd discovered the total secret of fractal image compression." Barnsley's nightmare turned into a dream. Fractal image compression, which reduces file sizes of images for electronic storage and transmission, went on to become a multimillion-dollar success.

One major research field that the authors forgo is the human response to fractals. This is a surprising omission given the book's subtitle and the inclusion on the DVD of a half-hour "chill-out movie" exposing us to the unique aesthetics of fractal animations. Mandelbrot sets the scene for this subject when he points out that mathematical fractals "were not *intended* to be beautiful. So why is it that they are *perceived* as beautiful?". However, the book leaves the answer in terms of Clarke's vague notions of "triggering resonances in the mind" rather than discussing scientific research of the visual system's ability to process fractal patterns.

The book's final two chapters are devoted to the documentary itself. Producer Nigel Lesmoir-Gordon, whose main drive lies in the educational application of fractals, provides a backstage perspective. "I wrote my treatment [of the Mandelbrot Set] and submitted it to the BBC, Discovery and Channel 4," he writes. "The almost predictable rejections followed." Lesmoir-Gordon goes on to tell his rollercoaster story of how success eventually prevailed with the documentary being aired in over 50 countries.

Taken together, the book and DVD offer an eclectic combination of people

renowned for their skilful communication of science fact and science fiction. Here they are, at the top of their game and in full flow, talking about a phenomenon that has spread like wildfire though virtually all research disciplines. The publication of this book coincides with Mandelbrot's 80th birthday and represents a fitting celebration.

Richard Taylor researches chaos and fractals

[AUTHOR-description ok?] in the Materials Science Institute, Department of Physics, University of Oregon, US, e-mail rpt@darkwing.uoregon.edu