A fractal life

Few people would recognise **Benoit Mandelbrot** in the street, but the intricate pattern of blobs, swirls and spikes that bears his name – the Mandelbrot set – is an icon of science. It has come to symbolise the geometry of fractals, patterns whose shape stays the same whatever scale you view them on. His life has followed a path as jagged as any fractal. Next week he turns 80. He tells **Valerie Jamieson** that he still has plenty of work to do

What is it like seeing the Mandelbrot set emblazoned on T-shirts and posters?
I'm delighted. I always felt that science as the preserve of people from Oxbridge or Ivy League universities – and not for the common mortal – was a very bad idea.

Even though most people view it as a beautiful image and ignore the underlying mathematics?
That's right. Yet there is nothing more to this than a simple iterative formula. It is so simple that most children can program their home computers to produce the Mandelbrot set.

How did you feel when you discovered it?
Its astounding complication was completely out of proportion with what I was expecting. Here is the curious thing: the first night I saw the set, it was just wild. The second night, I became used to it. After a few nights, I became familiar with it. It was as if somehow I had seen it before. Of course I hadn't. No one had seen it. No one had described it. The fact that a certain aspect of its mathematical nature remains mysterious, despite hundreds of brilliant people working on it, is the icing on the cake to me.

What's the mystery?
It relates to a rather subtle mathematical property. In simple terms, there are two ways to define the Mandelbrot set. It is rather like proving that 3+1 and 2+2 give the same result. I have always thought that the two definitions were equivalent. But one is easy to study whereas the other is extremely difficult. So far, the proof has defeated many people. The fact that my conjecture is so simple to state, yet baffles everybody, makes it attractive to mathematicians. The conjecture is the mathematical face of the Mandelbrot set, and the T-shirts are the popular face.

Fractals seem to appear all over nature and in economics. Even the internet is fractal. What does that say about the underlying nature of these phenomena?
Well, it depends on the field. Circles and straight lines also appear everywhere. Does this mean that all those phenomena have something in common? Of course not. The roughly circular trajectory of a planet around the sun is due to gravitational interactions. Berries are round because a sphere has a smaller skin. The beauty of geometry is that it is a language of extraordinary subtlety that serves many purposes.

So fractals don't point to a single rule underlying reality?
There is no single rule that governs the use of geometry. I don't think that one exists.

Your uncle Szolem Mandelbrojt was also a mathematician. How has he influenced your life and work?
In every way imaginable. I was 13 when my uncle became professor at Collège de France in Paris. I learned early on that mathematics is an honourable profession from which you can make a living. My uncle was a pure mathematician on weekdays and a painter and fanatic museum visitor on Sundays. He had a gifted eye. But he felt that beauty and mathematics were completely separate. These two gifts probably existed in the family and I put them together,

Benoit Mandelbrot was born in Warsaw in 1924 to a Jewish family. In 1936 he moved to Paris, where his mathematician uncle had a strong influence on his education. He spent much of the war hiding in the French countryside. Later he discovered fractal geometry. He has shown how many complex phenomena such as coastlines, galaxy clusters and share prices can be described as fractals. He is Sterling Professor of Mathematical Sciences at Yale University, and an emeritus fellow at IBM's Watson Research Center in Yorktown Heights, New York