A VERY BRIEF INTRODUCTION TO FRACTALS

The beautiful image that you see on the cover is a fractal, a recent entrant into the world of mathematics, dating from the 1980s in the work of the mathematician Benoit Mandelbrot, who himself coined the term 'fractal'. Mandelbrot recognised that most objects found in nature cannot be modelled very well by the regular objects we encounter in Euclidean geometry (triangles, rectangles, circles, spheres…). Here are some famous quotes of his about fractals:

- "Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line."
- "I conceived, developed and applied in many areas a new geometry of nature, which finds order in chaotic shapes and processes. It grew without a name until 1975, when I coined a new word to denote it, *fractal* geometry, from the Latin word for irregular and broken up, *fractus*."
- "A fractal is a mathematical set or concrete object that is irregular or fragmented at all scales…"

Essentially, the term denotes a set of points whose dimension can be regarded, in a definite and precise sense, as non-integral. One of the very surprising facts about fractals is that using procedures that are extremely simple to describe, sets of extraordinary geometrical complexity can be generated, having a fractal nature. These arise when the procedures are iterated indefinitely; so recursion is a key component of the algorithm. Two such examples are described in the article by Jonaki Ghosh in this issue of AtRiA (the article deals with the use of GeoGebra in generating fractal shapes).

Many fractals have the property of *self-similarity:* they are made up of scaled-down replicas of themselves. A particularly beautiful example of this is the Sierpinski triangle described in the article referred to above. It will be seen that the set consists of three copies of itself, each at half the scale of the original; and each of those copies consists of three copies of itself, each at half its scale; and so on indefinitely. It is precisely this property which makes it possible to describe such shapes in a very compact manner; yet, their complexity is bewildering.

The topic offers a wealth of opportunities for exploration on one's own.