Fractal Geometry

Length of a Coastline

While doing some research on the nature of conflict between nations, the British scientist Lewis F. Richardson (1881–1953) discovered that the common borders between two countries were often given significantly different lengths by each country. After seeing Richardson's work, the French mathematician Benoit Mandelbrot (b. 1924) began to study the geometry of borders and coastlines and other naturally occurring shapes. He named this new branch of geometry **fractal geometry.**

    Mandelbrot showed that the lengths of coastlines are virtually unmeasurable because the smaller the unit of measure becomes, the longer the total length becomes. The following steps, diagram, and table show the compass method of measuring the coastline of Great Britain.

Example   **The Compass Method of Measuring a Coastline**

1. Set the compass points a distance L_1, called the *ruler length*, apart.
2. Fix one point of the compass at P_0, and swing the compass counterclockwise until it meets the coastline at P_1.
3. Use P_1 as the next fixed point, and swing the compass counterclockwise until it meets the coastline at P_2.
4. Repeat this procedure until you reach a point P_k, with a distance from P_0 that is less than the ruler length.
5. Find the perimeter of polygon $P_0 P_1 P_2 \ldots P_k$ to approximate the length of the coastline. (Estimate $P_k P_0$.)
6. Repeat this procedure (steps 1–5) for a sequence of decreasing ruler lengths. The result should be a sequence of increasing approximations for the length of the coastline.