Discussion 4 - Mandelbrot

The next day I went skiing in the mountains all day and relaxed in front of the fireplace all night.

The next day I unfortunately had to go back into town. I had a meeting with an artist named Benoit Mandelbrot (French American 1924-2010) who said he would give me a tour of his art gallery. He is also the man that coined the word "fractal" from the Latin "fractus" which means broken or irregular. He used it to mean all sets of infinite detail. Mandelbrot told me that fractals should have similarity at different scales and infinitely detailed intricacy.

Mandelbrot's gallery contained images of fractals that he and Gaston Julia (France 1893-1978) had studied. Mandelbrot told me that he was inspired by Julia's work, and studied an aspect of the fractals that Julia had studied. Even more impressive is that they both studied these fractals without having pictures of them. They described how they were formed, but it was not until later that computers generated pictures of them - the amazing pictures that are now hanging in Mandelbrot's gallery.

The first part of the tour was about how the fractals are generated. They are made by an iterative process of points in the complex plane, which he explained in detail. (See section 6.4 in your book.)

Consider the iterative function $f(z) = z^2 + a + bi$ for a fixed (unchanging) $a + bi$. Get next value by plugging in the previous: $z_n = z_{n-1}^2 + a + bi$.

Julia set - boundary between those numbers which go off to infinity under many iterations of $z_n = z_{n-1}^2 + a + bi$ and those that never go off to infinity.

There is one Julia set for every complex number. They are fractals.
Julia set video

Mandelbrot set - Those numbers $a + bi$ which generate a 1-piece (connected) Julia set.

There is just one Mandelbrot set, and it is also a fractal.
Mandelbrot video

We then looked at the many pictures around the gallery. The museum even had a room with some videos showing the infinite details of the Mandelbrot Set.

Mandelbrot and Julia

Mandelbrot zoom

Mandelbrot song skip 2:03-08, 3:30-35

Homework:

- What is your reaction to the Julia/Mandelbrot sets?
- Iterative function worksheet