Fractal geometry

Fractal Geometry Fractal geometry is rather new mathematical theory which is completely different from the traditional concepts of Euclidean Geometry. Fractal geometry describes elf-similar or scale symmetric objects. It means that if to magnify these objects, their parts will bear an exact resemblance to the whole object. The word " fractal" was created by Benoit Mandelbrot and it means " to break", whereas the form of adjective " fractus" means " fragmentated". (Brandt 24)

It is a matter of fact that the word " fractal" has two definite meanings: the first meaning refer to colloquial use and the second is connected with geometry. In colloquial speech fractal is a shape which is self-similar or recursively constructed. It means that such shape is similar at all levels of magnification and therefore it is sometimes called " infinitely complex". In the sphere of mathematic the word " fractal" means geometric object " that satisfies a specific technical condition, namely having a Hausdoff dimension greater than its topological dimension". (26) The simplest fractal is known to be Cantor Bar Set which was called after German famous mathematician. It is necessary to admit that fractals refer not only to the realm of geometry and mathematics. They can be found everywhere in natural world.

Self-similarity (recursive nature) means that fractals are constructed by iteration and they are made up of the smaller parts (copies) of themselves. The examples of self-similarity are Sierpinski Gasket, the Mandelbrot Set, Self-affine fractals, etc. it must be admitted that fractals are not all self-similar objects. Scientists found out three main types of self-similarity:

Exact self-similarity means that fractals are completely identical at all levels of magnification. It is the strongest type of self-similarity, because fractals bear exact and complete self-similarity.

Quasi-self similarity is a loose form of self-similarity. It means that fractals are approximately identical, but not completely. Such objects " contain small copies of the entire fractal in distorted and degenerate forms". (29) Statistical self-similarity is known to be the weakest type of self-similarity, because fractals are only statistically similar. They are only random fractals. It is necessary to mention that fractals can be used in music, medicine, art forms, image compression, cosmology, seismology, computer design and graphics, fracture mechanisms, fractal antennas, geology, nature and even food industry. But fractals found in nature are different from other fractals, because their self-similarity is statistical, limited and approximate.

Fractals in biology, medicine and nature are new developments. Fractals are found in nature. Such fractals involve snow flacks, clouds, river networks, mountains, blood vessels, lightning, coastlines, because all of them display self-similarity over scale range. Trees and ferns are also considered to be fractal, because they can be virtually modeled with the help of recursive algorithm. Recursive nature of fractals is rather clear, for example a branch of any tree is the miniature copy of the whole tree. The recursive nature ensures that the whole is similar to each detail in statistical way. (55)

Fractals are also found in medicine. It is necessary to mention studying of lung disease with x-rays, human bronchial trees, human electroencephalograms, analysis of neurons, segmentation of cells, and etc. One more example is the healthy rhythm of human's heart. Fractals are very important in biology where surface area is in the first place (the lungs). The surface of human lungs is made up of self-similar branches. The fractal properties are also displayed by blood vessels and nervous cells within human body. (58)

In conclusion it is necessary to note that fractals are of great interest among scientists and they are constantly trying to find new applications of fractals.

Works cited

Brandt, C. Fractal Geometry and Stochastics. Boston, MA: Birkhauser, 1995.