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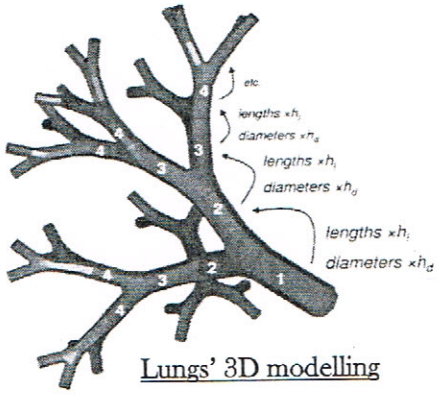
FRACTALS : A POWERFUL SYSTEM OF OUR BODY

The term "fractal" is a neologism created in 1974 by the French and American mathematician Benoit Mandelbrot, whose fractals discovery is attributed. This notion refers to objects where the structure is invariant by scale changes, it means that it's not the figure that changes, but only the scale. What is particularly striking is the number of fractal applications, whether it's in nature, geometry, meteorology, or even in biology.

Indeed, human body shelters plenty of fractals. However, we can't talk about perfect fractals, as the auto-similarly phenomenon is not infinite. In spite of it, we find many structures considered as fractals in our body airways, small intestine, blood vessels, neurones... We regularly find new proves showing that our organism is fractal. The first organ identified as it is the pulmonary system.

Lung's goal is to transmit the dioxygen of inhaled air to blood. In order to have a maximum of dioxygen exchanges, lungs need to have the largest exchanges area, while having a limited volume (otherwise, it wouldn't enter the rib cage). To do so, lungs resort to fractal structure.

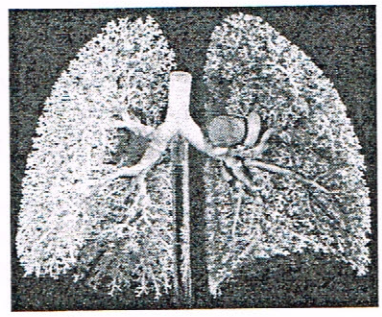


Lungs' 3D modelling

Thanks to this modelling, it is possible to have a forecast of the exchanges area which is almost... 200 m², the equivalent of a tennis court. It is such a huge surface, possible thanks to the lungs' fractal geometry. Indeed, the geometry of this tree is very close to a fractal structure, that is to say, a zoom on a subset of the tree shows a very similar structure of the complete structure. Such a tree is characterized by its scale factor which is the ratio of sizes of consecutive generations of bronchi.

Besides the importance of the area, the air volume's transmitted from the lungs to the blood vessels is about four to four and a half litres which is quite enormous.

This impressive space-saving is a proof of the fractal organisation's adopted by nature. Fractals intervene in the lungs' structure and also in their functioning. Indeed, the junctions between the capillaries' cells create an overall of heterogeneous sized passages which leads to good exchanges between blood and the tissues.



This structure is coded by the genetic code. The DNA codes for specific proteins essential for the lungs' fabrication. Moreover, it is a well-known fact that smokers risk to damage their pulmonary system. A few studies revealed that even if we amputate pulmonary alveoli too much affected, smokers would still be able to breath. This phenomenon could as well be explained by the lungs' fractals. We may understand that this fractal structure lets the human body to be robust because, although a part of the system would be amputated, it will have very small results.

To put it in a nutshell, fractals are a structure which enables to increase lungs performances. This increase of performances justifies the omnipresence of fractals in nature and in biology. Moreover, it explains why humankind resorts to fractals, whether it is in science, geology, medicine, astronomy, or in music, art and cinema.

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New Scientist, n°1605 : *Fractals : a powerful system of our body*