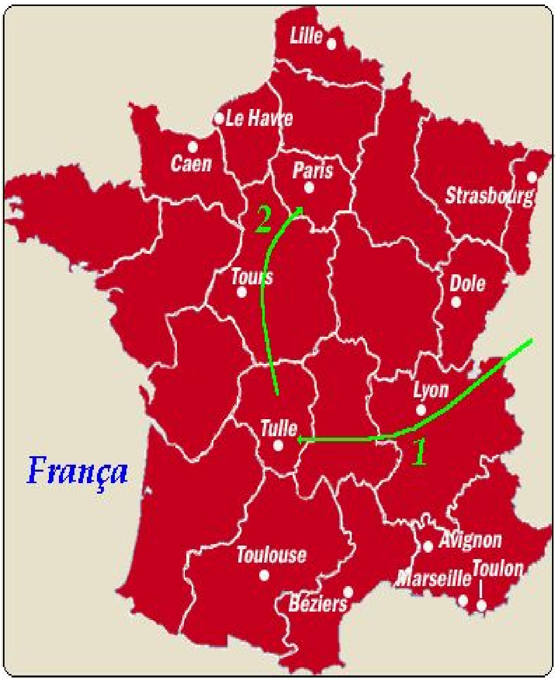
Benoit B. Mandelbrot

Varsóvia, Polônia

Benoit B. Mandelbrot, um dos mais importantes matemáticos da nossa era, nasceu Varsóvia, na Polônia em 20 de Novembro de 1924. Uma cidade histórica de grande tradição. Varsóvia pertenceu à Prússia, foi sitiada por Napoleão em 1806 e, em 1813, foi incorporada ao Império Russo. Após a II Guerra Mundial a cidade teve que ser reconstruída a partir das suas ruínas devido a brutalidade dos conflitos.

Em Varsóvia Mandelbrot terminou os seus estudos de nível fundamental, porém devido aos problemas causados pela segunda guerra mundial Mandelbrot teve que se mudar para a França, onde terminou os estudos de nível médio na cidade de Tulle (1), uma cidade no interior da França. Concluindo mais tarde a sua formação superior na Ecole Polytechnique de Paris (2) em 1947. Mandelbrot obteve o seu grau de mestre no Caltech (California Institute of Technology – EUA) em 1949, e o seu doutorado em Ciências Matemáticas na Université de Paris, em 1952.



Mapa da França

Mas afinal, o que Mandelbrot fez? Na verdade até hoje se estuda a criação de Mandelbrot, e se estudará cada vez mais nos próximos anos, logo não seria possível explicar em uma página de revista o que ele fez, porém de forma bastante resumida e simplista, é possível dizer que ele tornou a Matemática mais bonita.

A Geometria de Fractais, criação de Mandelbrot, é especialmente útil para explicar a formação do objetos que possuem uma dimensão fracionária, por exemplo 1,35, algo que não segue a geometria Euclidiana. Parece estranho? Complicado? É isto mesmo, estranho e complicado. É algo tão complicado que só foi possível chegar ao seu estágio de desenvolvimento atual com o auxilio de (na época) supercomputadores. No início dos anos de 1980, Mandelbrot já trabalhava na International Business Machines Corporation IBM, onde utilizou os computadores da empresa para aprofundar a revolução.

E além de coisas aparentemente incompreensíveis as pessoas mais comuns para que servem os fractais?

Os fractais não são meramente artifícios da Matemática Pura ou obras de arte sem sentido, são na verdade algo que se descobre aplicações novas a cada dia nos mais diversos ramos da ciência a das artes. Muitas pesquisas são desenvolvidas baseadas nas características dos fractais, por exemplo a forma como a quantidade de informações é armazenada dentro do DNA talvez utilize uma estrutura fractal, órgãos como os pulmões, rins e veias talvez sejam estruturas com características fractais, a variação de preços no mercado, a forma com que grãos de areia se distribuem em uma praia, e uma infinidade de outros exemplos, que utilizam os fractais para encontrar uma certa ordem em sistemas que aparentam ser totalmente aleatórios.

Procurando por mais respostas, nós (Grupo Tchê Química) fomos entrevistar Benoit B. Mandelbrot, o ser humano que percebeu os fractais. Veja o que ele respondeu as nossas questões:

Benoit B. Mandelbrot

1. *What city were you born? In what year?*

I was born in Warsaw (Poland), 1924.

2. *Where did you finish elementary school? And high school?*

I finished elementary school in Warsaw. And finished high school in Tulle (a small city in Central France)

3. *What university did you concluded your graduation? What course? Did you do any post graduation course?*

Ecole Polytechnique (Paris): 1947; Caltech: MS 1949; Université de Paris: Ph.D. in Mathematical Sciences 1952.

4. *In what area, specifically, were your post graduation studies concentrated? Why did you choose this area?*

The topic of my Ph.D. thesis was conceived and written completely on my own, I chose a very unusual combination of linguistics, statistics (power-law distributions) and statistical physics. This was viewed as strange but I thought was far more interesting than the conventional topics that my teachers mentioned as possibilities. The thesis was very badly written, but much of its content has survived and is now viewed as "classical."

5. *What was your first job?*

Junior Professor Université de Genève.

6. *How did you decided to work on IBM?*

While I was a post-doc with John von Newmann, in Princeton, I met one of his programmers. He later joined IBM and wanted me to join also. I accepted, but only for the duration of a summer. However, once at Yorktown, I found I liked IBM better than my professorship in France, so I stayed. This was a colossal gamble but an excellent decision.

7. *Professor Benoît, what is, after all, the Fractal theory?*

Fractal geometry is the proper geometry of roughness, while Euclidean geometry is the geometry of smoothness.

8. *Which fractal is the most commonly known? Why?*

The Mandelbrot set. It combines extraordinary beauty with extraordinary mathematical difficulty.

9. Then, what is exactly the "fractal dimension" (originally, the Hausdorf-Besicovitch dimension)?

Fractal dimension is a quantitative measure of roughness. It comes in several variants, of which the Hausdorff-Besicovich dimension is the earliest but most difficult, and also impossible to measure experimentally.

10. *Professor Mandelbrot, people say that Newton got struck in the head by an apple and realized all the gravity around us, what struck you to realize about the fractals?*

Nothing that I recall. Amusingly, the legend of Newton's apple makes concrete the fact that one tends to expect a theory to proceed from top down, from a principle to its consequences. To the contrary, fractal geometry grew from bottom to top, very slowly, over very many years.

11. *Due to your European origin and the beautiful shapes that fractals can be shown, several people deduce that you are a painter. When you finished your fractal studies did you expect this kind of reaction from the public?*

I do not paint myself, but am a skilled amateur critic. I did not expect any strong reaction from the public but the very wide interest that my work has attracted is a delight.

12. *Is there any object that is a clear example of a fractal, that we can look and say: "That was what Mandelbrot was talking about"? Or do we have to study a great deal of mathematics to, through the interpretation of equations, finally be able to say that?*

The cauliflower's surface is fractal. It subdivides into small pieces, called florets; each of which is a small version of the whole and itself subdivides into even smaller pieces. This very important property is called self-similarity and all fractals satisfy some strict or generalized form of self-similarity.

13. *Which mathematics equations represent the shape that the fractals can take place in order that any person that has studied some mathematic will be able to understand?*

The equations that represent fractals are very simple. For example, the main part of the equation of the Mandelbrot set is z.z+c. This formula only requires five symbols! But even the most skilled mathematician could not conceivably have expected the complexity of the set it defines.

14. *We are used to realize only objects that represent entire dimensions, like 1, 2, and 3. What is an object that does not represent a complete dimension (1, 2 or 3), or so, that represent a fractal dimension, 1,85 for example?*

Take coastlines; rather smooth ones have dimensions like 1.1, more wiggly ones have dimensions like 1.3 or 4/3. The dimension 1.85 is found for curves more wiggly than any coastlines on Earth.

15. *When we integrate the fractals to the Minkowski space-time concept, is it reasonable to suppose that fractionary dimensions are not part of Euclidian geometry and can be excluded as a future possibility?*

Yes. To give them a precise meaning, you must go beyond Euclidean geometry.

16. *Can fractionary dimensions be described as transition stages between integer dimensions?*

In general, yes, but not always.

17. Hendrik Houtahkker utilized Gaussian distribution to attempt to find the behavior patterns for the price of cotton, however, the curve did not adjusted to the expected Gaussian behavior. In which way did the fractal geometry adjusted this problem?

Models that use fractal functions provide a mathematical model for many properties of pricesthat simple inspection suffices to reveal. They change discontinuously and their changes today depend on their changes in the distant past. Also, markets "slumber" for some periods and for other periods are subjected to storms and hurricanes.

18. *What is the relation of the fractal geometry with the work of Edward Lorenz? Do they complement each other? Did you, in any time, exchanged information with Edward Lorenz as you did with Hendrik Houtahkker?*

I know Edward Lorenz very well. His work has introduced many beautiful shapes that are fractal.

19. Is it possible to study fractals for some practical application (in viable time) without the use of computers?

Now it has become easier but computers are becoming unavoidable in almost every field.

20. *The computers evolved a lot since you started the fractal research. Nowadays, is it possible for an ordinary person to use a domestic computer to make, with the proper mathematic treatment e utilizing an equally proper data base, predictions about the financial market or about which horse has a better chance of winning the race?*

Not really. Formulas that are able to predict are an old, very nice, and indestructable dream of humanity. But so far no one has achieved this dream.

21. *Have you ever considered the possibility of using the fractal geometry to place bets in casinos? Have you ever heard of someone who has done that?*

No.

22. *Professor Mandelbrot, a lot of people see applications of fractal geometry in practically everything. Do you believe that this can lead other areas of mathematics to regress or do you think that mathematics, as a whole will gain benefit from the fractals?*

Some degree of roughness is found everywhere, therefore fractals have innumerable practical applications. They also help in other branches of mathematics. But roughness is only one of many structures and fractals leave much work for other parts of mathematics.

23. *When you started your fractals studies did you imagine that they would have so many applications? And also that just a few people would be able to interpret the possibilities offered by the fractals?*

Nobody could have expected fractals to develop that far and more and more persons are using the new possibilities. The main difficulty is often not strictly speaking technical but psychological. To convince people they should try fractals has been and continues to be a struggle.

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