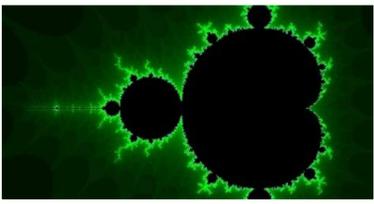


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BENOÎT  
MANDELBROT

Les objets  
fractals

Forme,  
hasard et dimension



Champs sciences



"The deepest and most realistic finance book  
ever published." —Nassim Nicholas Taleb,  
author of *The Black Swan*

# THE (MIS)BEHAVIOR OF MARKETS

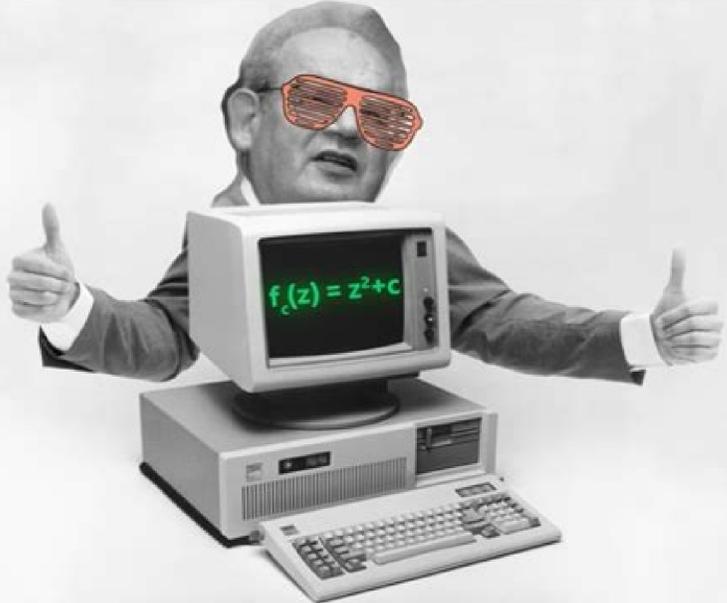
A Fractal View of  
Financial  
Turbulence

WITH A NEW  
PREFACE  
ON THE FINANCIAL  
CRISIS

BENOIT MANDELBROT

Author of *THE FRACTAL GEOMETRY OF NATURE*

& RICHARD L. HUDSON



Benoit mandelbrot quotes. Benoit mandelbrot books. Benoit mandelbrot contribution in mathematics. Benoit mandelbrot net worth. Benoit mandelbrot fractal geometry. Benoit mandelbrot iq. Benoit mandelbrot set. Benoit mandelbrot fractals.

1 Benoit Mandelbrot, fractals pioneer, dies United Press International, October 16, 2010. Weather patterns, stock market price variations and galaxy clusters have all proven to be fractal in nature, but what will we do with this insight? 1 John Casti, Flight over Wall St New Scientist, April 19, 1997. Mandelbrot, A maverick's apprenticeship The Wolf Prizes for Physics (Imperial College Press, 2002). The Fractalist: Memoir of a Scientific Maverick. And fractal statistical analyses of forests can measure and quantify how much carbon dioxide the world can safely process. Regardless of the scale of the graph, whether it represented data over the course of one day or one hour or one second, the pattern of disturbance was surprisingly similar. These images captured the popular imagination: many of them were based on recursion, leading to the popular meaning of the term "fractal." [16] In these images Mandelbrot was able to show how visual complexity can be created from simple rules. Fractal-based antennas that pick up the widest range of known frequencies are now used in many wireless devices. Fractals and Scaling in Finance: Discontinuity, Concentration, Risk. We escaped this fate. K. Benoit Mandelbrot: A Life in Many Dimensions. In so doing, he was able to show how visual complexity can be created from simple rules. 1 3.0 3.1 3.2 3.3 3.4 3.5 3.6 Benoit Mandelbrot. The Fractalist: Memoir of a Scientific Maverick (Random House, 2012, ISBN 978-0307389916). His innovative work with computer graphics stimulated the use of computers in mathematics in a whole new way. 1 18.0 18.1 Arthur C. The result was an awkwardly shaped bug-like formation, and it was perplexing to say the least. Mandelbrot, Benoit B., and Edward Lorenz. Benoit B. Their work intrigued mathematicians around the world and revolved around the simplest of equations:  $z = z^2 + c$ , bringing an element of unity to the worlds of knowing and feeling ... While he will always be known for his discovery of fractal geometry, Mandelbrot should also be recognized for bridging the gap between art and mathematics, and showing that these two worlds are not mutually exclusive. Researchers in Toronto are using ultrasound imaging to identify the fractal characteristics of blood flows in both healthy and diseased kidneys. The hope is to measure the fractal dimensions of these blood flows and use mathematical models to detect cancerous cell formations sooner than ever before. Reacting to news of his death, mathematician Heinz-Otto Peitgen said "if we talk about impact inside mathematics, and applications in the sciences, he is one of the most important figures of the last 50 years." [10] The President of France at the time of Mandelbrot's death, Nicolas Sarkozy, said Mandelbrot had "a powerful, original mind that never shied away from innovating and shattering preconceived notions". The specificity of these details, it turned out, was limited only to the power of the machine computing the equation, and similar shapes could continue on forever—revealing more and more detail, on an infinite scale. Graphic design and image editing programs use fractals to create beautifully complex landscapes and life-like special effects. What's more, every smaller version held more complex detail than the previous version. Surface area and volume. For example, in his research in economics, he found that price changes in financial markets did not follow a Gaussian distribution, but rather Lévy stable distributions having theoretically infinite variance. The most basic example he gave was a tree. He said that things typically considered to be "rough," a "mess," or "chaotic," like clouds or shorelines, actually had a "degree of order." [15] Mandelbrot first published his ideas in his book entitled Fractals: Form, Chance and Dimension. [17] The book was a "breakthrough" for Mandelbrot, who until then would typically "apply fairly straightforward mathematics ... in this book, Mandelbrot highlighted the most occurrences of fractal objects in nature. Bard Center, 2012. What emerged was a geometry of the cosmos—one that broke all Euclidean laws of the man-made world and deferred to the properties of the natural world. A. He postulated that if the stars in the universe were fractally distributed (for example, like Cantor dust), it would not be necessary to rely on the Big Bang theory to explain the paradox. Freeman and Co, 1977, ISBN 978-0716704737). The Pythagorean theorem. Retrieved June 10, 2014. Biology and healthcare are only some of the latest applications of fractal geometry. TED's editors chose to feature it for you. Want to hear more great ideas like this one? Fractal Surfaces. Considered a maverick whose work belonged to no particular academic field, Mandelbrot's work contributed to such diverse fields as geology, medicine, cosmology, engineering, and the social sciences: Fractals have been used to describe diverse behavior in areas including economics, finance, the stock market, and astronomy. If one identified an essential structure in nature, Mandelbrot claimed, the concepts of fractal geometry could be applied to understand its component parts and make postulations about what it will become in the future. Sign up for TED Membership to get exclusive access to captivating conversations, engaging events, and more! This talk was presented at an official TED conference. 1 Décret du 31 décembre 2005 portant promotion et nomination Legifrance.gouv.fr. Fractals and Chaos: The Mandelbrot Set and Beyond. He was helped by Rabbi David Feuerwerker, the Rabbi of Brive-la-Gaillarde, to continue his studies. [5] Much of France was occupied by the Nazis at the time, and Mandelbrot recalls this period: Our constant fear was that a sufficiently determined foe might report us to an authority and we would be sent to our deaths. From 1947 to 1949 he studied at California Institute of Technology, where he earned a master's degree in aeronautics. [6] Returning to France, he obtained his PhD degree in Mathematical Sciences at the University of Paris in 1952. [1] From 1949 to 1958, Mandelbrot was a staff member at the Centre National de la Recherche Scientifique. With these computers, Mandelbrot crunched and manipulated the numbers a thousand times over, a million times over, and graphed the outputs. 1 15.0 15.1 15.2 15.3 15.4 Stephen Wolfram, The Father of Fractals, Wall Street Journal, November 22, 2012. Fractals: An Animated Discussion (63 min video film, interviews with Benoit Mandelbrot and Edward Lorenz, computer animations). W. ISBN 978-0307389916 Notes 1 1.0 1.1 1.2 1.3 Benoit B. Springer, 2004. Alexanderson (eds.), Mathematical People: Profiles and Interviews (A. During this time he spent a year at the Princeton University Institute for Advanced Study, where he was sponsored by John von Neumann. Peters, 2008, ISBN 978-1568813400). They were there, even though nobody had seen them before. Sterling, 2005. True to his academic roots, Mandelbrot went beyond identifying these natural instances and presented the sound mathematical theories and principles upon which his newly coined "fractal geometry" was based. 1 14.0 14.1 Donald J. His methods of research were both old and new: The form of geometry I increasingly favored is the oldest, most concrete, and most inclusive, specifically empowered by the eye and helped by the hand and, today, also by the computer ... ISBN 978-0736505208 Russ, John C. Basic Books, 2004. The task was simple enough: IBM was involved in transmitting computer data over phone lines, but a kind of white noise kept disturbing the flow of information—breaking the signal—and IBM looked to Mandelbrot to provide a new perspective on the problem. World Scientific Publishing Company, 2014. ISBN 978-1568813400 Frame, Michael. Decades after his discovery of the Mandelbrot set, data visualization continues to provide fresh and unexpected insights into some of the world's most difficult problems by altering our perspective, challenging our preconceptions and revealing connections previously invisible to the eye, to areas that had barely seen the light of serious mathematics before. [15] Wolfram adds that as a result of this new research, Mandelbrot was no longer a "wandering scientist," and earned the name "the father of fractals". Mandelbrot ended up doing a great piece of science and identifying a much stronger and more fundamental idea—put simply, that there are some geometric shapes, which he called "fractals", that are equally "rough" at all scales. TED's editors chose to feature it for you. At TED2010, mathematics legend Benoit Mandelbrot develops a theme he first discussed at TED in 1984 – the extreme complexity of roughness, and the way that fractal math can find order within patterns that seem unknowably complicated. This talk was presented at an official TED conference. Fractal patterns have appeared in almost all of the physiological processes within our bodies. Sarkozy also added, "His work, developed entirely outside mainstream research, led to modern information theory." [23] Mandelbrot's obituary in The Economist points out his fame as "celebrity beyond the academy" and lauds him as the "father of fractal geometry." [24] His autobiography, The Fractalist, was published in 2012. Blood is also distributed throughout the body in a fractal manner. Mandelbrot described his feelings in a documentary with science writer Arthur C. Russ, Fractal Surfaces (Plenum Press, 1994, ISBN 978-0306447020). H. In fact, it rose to prominence only over the past 30 or so years—almost entirely through the efforts of one man, the mathematician Benoit Mandelbrot. [15] In 1975 Mandelbrot coined the word "fractal" and illustrated his mathematical definition with striking computer-constructed visualizations. [14] Building on previous work by Gaston Julia and Pierre Fatou, Mandelbrot used the newly developed IBM computers at his disposal to plot images of the Julia sets using computer graphics. 1 7.0 7.1 Anthony Barcellos, Interview of B. Peters, 2008. At the time of the advice, Mandelbrot couldn't find any breakthrough, but the intellectual freedom he found at IBM allowed him to fully engage this new project. Mandelbrot brought these objects together for the first time and turned them into essential tools for the long-stalled effort to extend the scope of science to explaining non-smooth, "rough" objects in the real world. Clouds are not perfect spheres, mountains are not symmetric cones, and lightning does not travel in a straight line. But if one considers the structures that are present in nature, that which are beyond the realm of smooth human construction, many of these rules disappear. This was a definite geometry, there were rules and parameters to this roughness, but it was a form of geometry previously unidentified by the scientific community. 1 Benoit Mandelbrot, IBM: background and policies Web of Stories. I never had the feeling that my imagination was rich enough to invent all those extraordinary things on discovering them. Where will the rabbit hole take us? Stephen Wolfram described fractals as a form of geometric repetition: "in which smaller and smaller copies of a pattern are successively nested inside each other, so that the same intricate shapes appear no matter how much you zoom in to the whole. Freeman and Company, 1982. Plenum Press, 1994, and, unwittingly, as a bonus, for the purpose of creating beauty. [3] Section of a Mandelbrot set Fractals are also found in human pursuits, such as music, painting, architecture, and stock market prices. Hudson. These structures were not exactly alike, but the general shape was strikingly similar, it was only the details that differed. Simply to eliminate the competition, another physician denounced her.... His model would not rule out a Big Bang, but would allow for a dark sky even if the Big Bang had not occurred. [19] Awards and honors Mandelbrot's awards include the Wolf Prize for Physics in 1993, the Lewis Fry Richardson Prize of the European Geophysical Society in 2000, the Japan Prize in 2003, and the Einstein Lectureship of the American Mathematical Society in 2006. In 1955 he married Ailette Kagan and moved to Geneva, Switzerland, and later to the Université Lille Nord de France. [7] In 1958 the couple moved to the United States where Mandelbrot joined the research staff at the IBM Thomas J. The problem was familiar to Mandelbrot, and he recalled the advice his mathematician uncle, Szolem Mandelbrot, had given him years ago in France—attemp to make something of the obscure theories of iteration established by French mathematicians Pierre Fatou and Gaston Julia. Fractals: Form, Chance and Dimension. Albers and Gerald L. Today, we have merely scratched the surface of what fractal geometry can teach us. But as Mandelbrot looked closer, he saw the detailed edges of this formation held smaller, repeating versions of the larger bug-like formation. Nature is rough, and until very recently this roughness was impossible to measure. His most significant work, and that for which he is most famous, was in the study of fractals. Watson Research Center in Yorktown Heights, New York. [7] He remained at IBM for 35 years, becoming an IBM Fellow, the highest honor a scientist, engineer, or programmer at IBM can achieve, and later Fellow Emeritus. [1] Mandelbrot left IBM in 1987 when they decided to end pure research in his division. [8] He then joined the Department of Mathematics at Yale University. Mandelbrot (November 20, 1924 - October 14, 2010) was a Polish-born, French and American mathematician, noted for developing a "theory of roughness" in nature and the field of fractal geometry to help prove it. Clarke: Exploring this set I certainly never had the feeling of invention. Mandelbrot was one of the first to use computer graphics to create and display fractal geometric images, leading to his discovering the Mandelbrot set in 1979. ISBN 978-0716704737 Mandelbrot, Benoit B. Freeman and Company, 1982, ISBN 978-0716711865). 1 Sarkozy rend hommage à Mandelbrot (Sarkozy pays homage to Mandelbrot) Le Figaro, October 16, 2014. Alexanderson (eds.), Fern leaves and Romanesco broccoli are two examples from nature. [15] He points out an unexpected conclusion: One might have thought that such a simple and fundamental form of regularity would have been studied for hundreds, if not thousands, of years. 1 Priya Hemenway, Divine Proportion: Phi in Art, Nature, and Science (Sterling, 2005, ISBN 978-1402735226). Springer, 1997. His personal quest was to create some mathematical formula to measure the overall "roughness" of such objects in nature. [3] He began by asking himself various kinds of questions related to nature: Can geometry deliver what the Greek root of its name [geo-] seemed to promise—truthful measurement, not only of cultivated fields along the Nile River but also of untamed Earth? [3] Mandelbrot emphasized the use of fractals as realistic and useful models for describing many "rough" phenomena in the real world. In 1999 he obtained his first tenured post as Sterling Professor of Mathematical Sciences at the age of 75, the oldest professor in Yale's history to receive tenure. [9] He retired from Yale in 2005. 1 Amanda Geffer, Galaxy Map Hints at Fractal Universe New Scientist, June 25, 2008. 1 Greg Rienzi, Six granted honorary degrees, Society of Scholars inductees recognized The JHU Gazette, June 7, 2010. Who knows why? [3] In 1944, Mandelbrot returned to Paris, studied at the Lycée du Parc in Lyon, and in 1945 to 1947 attended the Ecole Polytechnique, where he studied under Gaston Julia and Paul Lévy. Benoit Mandelbrot was an intellectual jack-of-all-trades. He saw unquestionably organic structures in the details of this shape and quickly published his findings. 1 Legendary mathematician joins national laboratory PNNL News Center, February 16, 2006. In 1974 he offered an explanation of Olbers' paradox (the "dark night sky" riddle), demonstrating the consequences of fractal theory as a sufficient, but not necessary, resolution of the paradox. Since he was a boy, Mandelbrot had always thought visually, so instead of using the established analytical techniques, he instinctually looked at the white noise in terms of the shapes it generated—an early form of IBM's now-renowned data visualization practices. 1 13.0 13.1 13.2 Benoit Mandelbrot, The Fractal Geometry of Nature (W. From him, I learned to read maps before I could read and write." [2] The family emigrated from Poland to

France in 1936 when he was 11. Albers, Donald J., and Gerald L. In November 1919, he was made a Knight in the French Légion d'honneur (Legion of Honor); he was promoted to Officer of the Legion of Honor in January 2006.[20] In December 2005, Mandelbrot was appointed to the position of Battelle Fellow at the Pacific Northwest National Laboratory.[21] An honorary degree from Johns Hopkins University was bestowed on Mandelbrot in the May 2010 commencement exercises.[22] The small asteroid 27500 Mandelbrot, discovered on April 12, 2000, was named in his honor. Random House, 2012. The developments arising from the Mandelbrot set have been as diverse as the alluring shapes it generates. He concluded that "real roughness is often fractal and can be measured."[3] Although Mandelbrot coined the term "fractal", some of the mathematical objects he presented in The Fractal Geometry of Nature had been previously described by other mathematicians. The Islands of Benoit Mandelbrot: Fractals, Chaos, and the Materiality of Thinking. This shape and structure, later known as the Mandelbrot set, was an extraordinarily complex and beautiful example of a "fractal" object, fractal being the name coined by Mandelbrot in 1975 to describe such repeating or self-similar mathematical patterns. An even greater contribution he made to human society, however, may be in showing that geometrical forms found in nature have incredible beauty. There he was introduced to mathematics by another uncle, his father's younger brother Szolem Mandelbrojt, who was a mathematician residing in Paris: "The love of his mind was mathematics,' Mandelbrot wrote in his autobiography.[3] "The fact that my parents, as economic and political refugees, joined Szolem in France saved our lives."[3][4] Mandelbrot attended the Lycée Rolin in Paris until the start of World War II, when his family then moved to Tulle, France. ISBN 978-0387983639 Mandelbrot, Benoit B., and Richard L. In 1980, building on the technology and talent of IBM, Mandelbrot used high-powered computers to iterate the equation, or use the equation's first output as its next input. Retrieved June 11, 2014. "Stable" distributions have the property that the sum of many instances of a random variable follows the same distribution but with a larger scale parameter.[12] "Fractal geometry" and the Mandelbrot set Mandelbrot speaking about the Mandelbrot set, during his acceptance speech for the Légion d'honneur in 2006 Mandelbrot was the first to use the term "fractal," based on the Latin fractus meaning "broken" or "fractured." He used it to extend the concept of theoretical fractional dimensions to geometric patterns in nature.[13][14] The mathematical roots of the idea of fractals have been traced throughout the years as a formal path of published works, starting in the seventeenth century with notions of recursion, then moving through increasingly rigorous mathematical treatment of the concept to the study of continuous but not differentiable functions in the nineteenth century. ISBN 978-0465043552 Mandelbrot, Benoit B. A fractal is a natural phenomena and a mathematical set. While investigating the topology of these Julia sets, he studied the Mandelbrot set fractal that is now named after him. 1 10.0 10.1 Jascha Hoffman, Benoit Mandelbrot, Novel Mathematician, Dies at 85 The New York Times, October 16, 2010. The book sparked widespread popular interest in fractals and contributed to chaos theory and other fields of science and mathematics. † John C. † Edward Tenner, Benoit Mandelbrot the Maverick, 1924–2010 The Atlantic, October 16, 2010. † Nigel Lesmoir-Gordon, Benoit Mandelbrot obituary The Guardian, October 17, 2010. The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin, and Reward. Mandelbrot believed that fractals, far from being unnatural, were in many ways more intuitive and natural than the artificially smooth objects of traditional Euclidean geometry: Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line.[13] Mandelbrot also put this idea to work in cosmology. Watson Research Center in Yorktown Heights, NY. "A Multifractal Walk down Wall Street." Scientific American 280(2) (1999): 70-73. † Benoit Mandelbrot, father of fractal geometry, died on October 14th, aged 85 The Economist, October 21, 2010. Freeman & Company, 1977. The discovery of fractal geometry has made it possible to mathematically explore the kinds of rough irregularities that exist in nature. But it was not. There was a larger structure at work. In the fractal approach, doctors won't need sharper medical images or more powerful machines to see these miniscule pre-cancerous structures. ISBN 978-0300186437 All links retrieved January 20, 2022. † "Fractal" mathematician Benoit Mandelbrot dies aged 85 BBC News, October 17, 2010. Pt. This classical, or Euclidean, geometry is perfectly suited for the world that humans have created. ISBN 978-9814366069 Hemenway, Priya. He is best known for coining the term "fractal," and for discovering the Mandelbrot set of intricate, never-ending fractal shapes, named in his honor. Who could have dreamed that such an incredibly simple equation could have generated images of literally infinite complexity?" Clarke also notes an odd coincidence: The name Mandelbrot, and the word "mandala"—for a religious symbol—which I'm sure is a pure coincidence, but indeed the Mandelbrot set does seem to contain an enormous number of mandalas.[18] In 1982, Mandelbrot expanded and updated his ideas in The Fractal Geometry of Nature.[13] This influential work brought fractals into the mainstream of professional and popular mathematics, as well as silencing critics, who had dismissed fractals as "program artifacts." The "theory of roughness" Mandelbrot created the first-ever "theory of roughness." He saw "roughness" in the shapes of mountains, coastlines and river basins; the structures of plants, blood vessels and lungs; the clustering of galaxies. No matter how close you look, they never get simpler, much as the section of a rocky coastline you can see at your feet looks just as jagged as the stretch you can see from space.[15] Mandelbrot's fractal images have been described as looking like "the delirious exuberance of the 1960s psychedelic art with forms hauntingly reminiscent of nature and the human body."[2] He never felt he was inventing a new idea. His creative approach to complex problem solving has inspired peers, colleagues and students alike, and instilled in IBM a strong belief in the power of perspective. ISBN 978-1402735226 Mandelbrot, Benoit B. Mandelbrot's research took him beyond the field of mathematics. Take biology, for example. Sign up for TED Membership to get exclusive access to captivating conversations, engaging events, and more!TED is supported by ads and partners Geometry. ISBN 978-0387201580 Mandelbrot, Benoit B. A bright young academic who had yet to find his professional niche, Mandelbrot was exactly the kind of intellectual maverick IBM had become known for recruiting. † Benoit Mandelbrot, Fractals: Form, Chance and Dimension (W. Before Mandelbrot, however, they were regarded as isolated curiosities with unnatural and non-intuitive properties. Mathematical People: Profiles and Interviews. Films for the Humanities & Sciences, 1997. For ages, the human heart was believed to beat in a regular, linear fashion, but recent studies have shown that the true rhythm of a healthy heart fluctuates radically in a distinctively fractal pattern. ISBN 978-0306447020 Samuel, Nina (ed.). It's marvelous, a very simple formula explains all these very complicated things. Each split in a tree—from trunk to limb to branch and so forth—was remarkably similar, he noted, yet with subtle differences that provided increasing detail, complexity and insight into the inner-workings of the tree as a whole. In 1961, Benoit Mandelbrot was working as a research scientist at the Thomas J. Mandelbrot died in a hospice in Cambridge, Massachusetts, on October 14, 2010 from pancreatic cancer, at the age of 85.[10][11] Work Having studied Mathematics in France and aeronautics in California, Mandelbrot spent most of his career in both the U.S. and France, having dual French and American citizenship. The possibilities, like the Mandelbrot set, are infinite. This happened to a close friend from Paris, Zina Morhango, a physician in a nearby county seat. Instantly, Mandelbrot knew he was onto something. The Fractal Geometry of Nature. Clarke, Arthur C Clarke – Fractals – The Colors Of Infinity, video interviews, 54 min, YouTube. But it wasn't until his 1982 book, The Fractal Geometry of Nature, that Mandelbrot would receive public attention and widespread legitimacy. Its principles are taught to young students across the world. Divine Proportion: Phi in Art, Nature, and Science. Life Benoit Mandelbrot was born on November 20, 1924 in Warsaw, Poland, to a family from Lithuania. This new way of viewing our surroundings, this new perception of reality, has since led to a number of remarkable discoveries about the worlds of nature and man, and has shown that they are not as disconnected as once thought. Mandelbrot Mathematical People, Birkhäuser, 1984. His family had a strong academic tradition, his mother was a medical professional and he was tutored by his intellectual uncle.[1] He also noted that his "father was a map nut. 1 2.0 2.1 Benjamin Ivry, Benoit Mandelbrot Influenced Art and Mathematics, Forward, November 17, 2012. He worked on problems and published papers in applied fields such as information theory, economics, and fluid dynamics. With a variable of z and parameter of c, this equation maps values on the complex plane—where the x-axis measures the real part of complex number and the y-axis measures the imaginary part (i) of a complex number. Math, rather than microscopes, will provide the earliest detection. So the goal of science is starting with a mess, and explaining it with a simple formula, a kind of dream of science.[18] According to Clarke, "the Mandelbrot set is indeed one of the most astonishing discoveries in the entire history of mathematics. A graph of the turbulence quickly revealed a peculiar characteristic. Skip to main contentSkip to searchAt TED2010, mathematics legend Benoit Mandelbrot develops a theme he first discussed at TED in 1984 – the extreme complexity of roughness, and the way that fractal math can find order within patterns that seem unknowably complicated.Want to hear more great ideas like this one? Mandelbrot used computer graphics to create and display fractal geometric images, leading to his discovering the mathematical set named after him: the Mandelbrot set. ISBN 978-0716711865 Mandelbrot, Benoit B. Legacy Mandelbrot speaking in 2007 Mandelbrot has been called a visionary and often called himself a maverick.[1] His informal and passionate style of writing and his emphasis on visual and geometric intuition (supported by the inclusion of numerous illustrations) made The Fractal Geometry of Nature accessible to non-specialists. B.

Fraktal (łac. fractus – złamany, cząstkowy, ułamkowy) w znaczeniu potocznym oznacza zwykle obiekt samopodobny (tzn. taki, którego części są podobne do całości) albo „nieskończenie złożony” (ukazujący coraz bardziej złożone detale w dowolnie wielkim powiększeniu). Ze względu na olbrzymią różnorodność przykładów matematycy obecnie unikają podawania ścisłej ... Die Mandelbrot-Menge, benannt nach Benoit Mandelbrot, ist die Menge der komplexen Zahlen, für welche die durch die iterative Vorschrift z = z + z mit dem Startwert z = definierte Folge „, ... endlich bleibt, d. h. beschränkt ist. Interpretiert man die Mandelbrot-Menge (eine Teilmenge der Gaußsche Zahlenebenen) als geometrische Figur, so ergibt sie ein Fraktal, das im allgemeinen ... Benoit B. Mandelbrot, imię przy narodzeniu: Benedykt (ur. 20 listopada 1924 w Warszawie, zm. 14 października 2010 w Cambridge (Massachusetts)) - francuski i amerykański matematyk polsko-żydowskiego pochodzenia. Zajmował się szerokim zakresem problemów matematycznych, znany jest przede wszystkim jako ojciec geometrii fraktalnej, opisał zbiór Mandelbrota oraz wymyślił ... Benoit B. Mandelbrot (20 November 1924 – 14 October 2010) was a Polish-born French-American mathematician and polymath with broad interests in the practical sciences, especially regarding what he labeled as "the art of roughness" of physical phenomena and "the uncontrolled element in life". He referred to himself as a "fractalist" and is recognized for his contribution to the field of ...

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