

Benoit Mandelbrot, Mathematician, Dies at 85

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Benoit B. Mandelbrot, a maverick mathematician who developed an innovative theory of roughness and applied it to physics, biology, finance and many other fields, died on Thursday in Cambridge, Mass. He was 85.



Shizuo Kambayashi/Associated Press

Benoit B. Mandelbrot at a conference in Tokyo in 2003.

His death, at a hospice, was caused by pancreatic cancer, his wife, Alette, said. He had lived in Cambridge.

Dr. Mandelbrot coined the term “fractal” to refer to a new class of mathematical shapes whose uneven contours could mimic the irregularities found in nature.

“Applied mathematics had been concentrating for a century on phenomena which were smooth, but many things were not like that: [the more you blew them up with a microscope the more complexity you found](#),” said David Mumford, a professor of mathematics at [Brown University](#). “He was one of the primary people who realized these were legitimate objects of study.”

In a seminal book, [“The Fractal Geometry of Nature,”](#) published in 1982, Dr. Mandelbrot defended mathematical objects that his colleagues had dismissed as “monstrous” and “pathological.” Using fractal geometry, he argued, the complex outlines of clouds and coastlines, once considered unmeasurable, could now “be approached in rigorous and vigorous quantitative fashion.”

For most of his career, he had a reputation as an outsider to the mathematical establishment. From his perch as a researcher for I.B.M. in New York, he noticed patterns that other researchers had overlooked in their own data, then often swooped in to collaborate.

“He knew everybody, with interests going off in every possible direction,” Professor Mumford said. “Every time he gave a talk, it was about something different.”

Dr. Mandelbrot traced his work on fractals to a question he first encountered as a young researcher: How long is the coast of Britain? The answer, he was surprised to discover, depends on how closely one looks. On a map an island may appear smooth, but zooming in will reveal jagged edges that add up to a longer coast. Zooming in further will reveal even more coastline.

“Here is a question, a staple of grade-school geometry that, if you think about it, is impossible,” Dr. Mandelbrot told The New York Times earlier this year in an interview. “The length of the coastline, in a sense, is infinite.”

In the 1950s, he proposed a simple but radical way to quantify the crookedness of such an object by assigning it a “fractal dimension,” an insight that has proved useful well beyond the field of cartography.

Over nearly seven decades, working with dozens of scientists, Dr. Mandelbrot contributed to the fields of geology, medicine, cosmology and engineering. He used the geometry of fractals to explain how galaxies cluster, how wheat prices change over time and how mammalian brains fold as they grow, among other phenomena.

“I decided to go into fields where mathematicians would never go because the problems were badly stated,” Dr. Mandelbrot said. “I have played a strange role that none of my students dare to take.”

Benoit B. Mandelbrot (he added the middle initial himself, though it does not stand for a middle name) was born on Nov. 20, 1924, to a Lithuanian Jewish family in Warsaw. In 1936 his family fled the Nazis, first to Paris and then to the south of France, where he tended horses and fixed tools.

After the war he enrolled in the École Polytechnique in Paris, where his sharp eye compensated for a lack of conventional education. His career soon spanned the Atlantic. He earned a master’s degree in aeronautics at CalTech, returned to Paris for his doctorate in mathematics in 1952, then went on to the Institute for Advanced Study in Princeton, N.J., for a postdoctoral degree under the mathematician John von Neumann.

After several years spent largely at the Centre National de la Recherche Scientifique in Paris, Dr. Mandelbrot was hired by I.B.M. in 1958 to work at the Thomas J. Watson Research Center in Yorktown Heights, N.Y. Although he worked frequently with academic researchers, it was not until 1987 that he began to teach at Yale, where he earned tenure in 1999.

Dr. Mandelbrot received more than 15 honorary doctorates and served on the board of many scientific journals, as well as the Mandelbrot Foundation for Fractals. Instead of rigorously proving his insights in each field, he said that he preferred to “stimulate the field by making bold and crazy conjectures” — and then move on before his claims had been verified. This habit earned him some skepticism in mathematical circles.

“He doesn’t spend months or years proving what he has observed,” said Heinz Otto Peitgen, a professor of mathematics and biomedical sciences at the University of Bremen. And for that, he said, Dr. Mandelbrot “has received quite a bit of criticism.”

“But if we talk about impact inside mathematics, and applications in the sciences,” Professor Peitgen said, “he is one of the most important figures of the last 50 years.”

Besides his wife, Dr. Mandelbrot is survived by two sons, Laurent, of Paris, and Didier, of Newton, Mass., and three grandchildren.

When asked to look back on his career, Dr. Mandelbrot compared his own trajectory to the rough outlines of clouds and coastlines that drew him into the study of fractals in the 1950s. “If you take the beginning and the end, I have had a conventional career,” he said, referring to his prestigious appointments in Paris and at Yale. “But it was not a straight line between the beginning and the end. It was a very crooked line.”