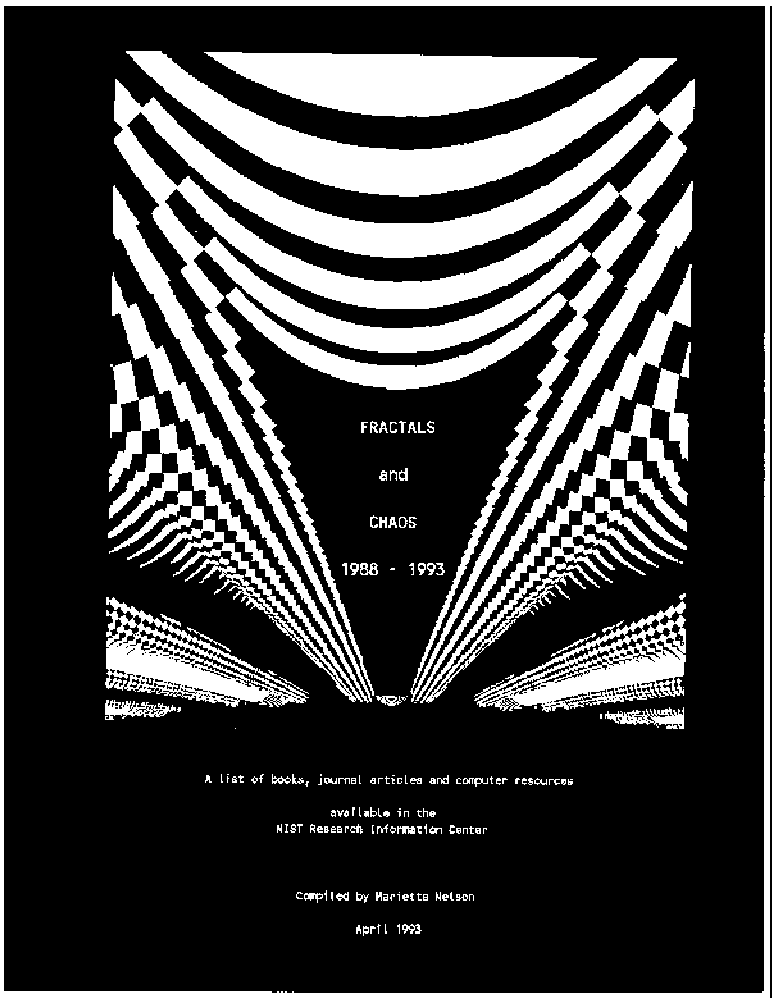

Fractals and Chaos, 1988-1993

A list of books, journal articles, and computer resources available in the NIST Research Information Center (RIC)

available in the
NIST Research Information Center

Compiled by Marietta Nelson

April 1993

Fractals and Chaos, 1988-1993

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[Paper Publication Cover design: STRIPES, by Richard Hughes; a saved command set from FracTint (see p. 33)]

The "McGraw-Hill Dictionary of Scientific and Technical Terms," 4th ed., 1989, which is possibly the most useful one-volume work in the RIC, defines these two terms as follows:

FRACTAL: "A geometric shape whose structure is such that magnification by a given factor reproduces the original object." Naturally occurring shapes such as ferns, trees, snowflakes and river systems are often cited as examples of fractals.

CHAOS: "The behavior of a system whose final state depends so sensitively on the system's precise initial state that the behavior is in effect unpredictable and cannot be distinguished from a random process, even though it is strictly determinate in a mathematical sense." The key word in this definition is "sensitively"--a chaotic system can be described as one in which the flutter of a butterfly's wing over Boulder might determine whether a developing thunderstorm will dissipate over Lake Michigan or descend heavily upon Gaithersburg.

The term "fractal" (from the Latin word for "fragmented") was introduced by the Polish-born mathematician Benoit Mandelbroit in a book originally published in French in 1975. The first English version, "Fractals: Form, Chance, and Dimension," appeared in 1977, but it was the updated and augmented 1982 version entitled "The Fractal Geometry of Nature" which became the fractal bible.

The term "chaos" is as old as "fractal" is new; it was the ancient Greeks' word for the void (or according to some, the shapeless mass) that preceded the creation of an ordered universe. Recently, however, the word has been used in a wide variety of applications in a way that almost totally reverses the Greek concept; chaos is now seen as growing out of an ordered state, rather than preceding it. The "bible" of chaos is the 1987 "Chaos: Making a New Science," by James Gleick, which won a National Book Award nomination for nonfiction.

The early studies of fractals and chaos were mostly theoretical, but suggestions for practical applications of both are now filling the pages of scientific books and journals. Fractals have been applied to the study of properties of materials, growth phenomena of all kinds, computer graphics, data compression, medical imaging-- the list continues to grow. Chaos is being used in a similarly long list of applications, and the two concepts are being increasingly combined, especially in the field of fluid mechanics in general and turbulent flow in particular.

Following is a list of books and journal articles on the subject of fractals and chaos published in the past five years which are available in the Research Information Center.

Among the books, Michael Barnsley's "Fractals Everywhere" (QA614.86 .B37) became an instant classic when it appeared in 1988. The 1992 title "Chaos: From Theory to Application" by A. S. Tsonis (Q172.5 .C45 U25) is one of many which emphasizes the potential usefulness of chaotic processes.

A journal article of particular interest on the subject of fractals is "Fractal fracas: question of whether fractals are just pretty pictures or more substantial tools" (Science, 1990, v254, p363: Q1 .S35), which describes a "squabble" in the mathematical community over the actual problem-solving potential of fractals.

In the field of chaos, "Mathematicians learn how to tame chaos" (New Scientist, 1992, v134, 30 May, p16: Q1 .N52) describes work at the University of Maryland which ranges from ideas for controlling the weather via the above-mentioned "butterfly" effect to saving millions of dollars for manufacturers by introducing a chaotic process to mix paint more efficiently.

The recreational value of chaos to anyone but the most dedicated theorist is probably limited; but fractals are fun! Computer users have a wide choice of software which can be used to construct an unending succession of astoundingly beautiful abstract images. This is usually at a nominal cost, because the creators of fractal programs appear to be eager to freely distribute their wares. In the introduction to their popular program FracTint, the Stone Soup Group says: "Don't want money. Got money. Want admiration."

* * * * * * *

This list is arranged in Library of Congress (LC) call number order. If you are trying to locate a journal, however, note that the most recent issues may still be in the Unbound area, where journals are shelved alphabetically by title.

If a book or journal is not on the shelf, NIST employees may reserve it (if it is checked out) or may order it on Inter-Library Loan. For help in locating an item, ask at the RIC Circulation Desk. For information about retrieving additional books and journal articles about fractals and chaos, ask at the Reference/Information Desk or call x3052.

NIST: National Institute of Standards and Technology; formerly (1901-1988): National Bureau of Standards.

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ONLINE SEARCHES: To arrange a computerized literature search, ask at the RIC Reference/Information Desk or call x3052.

FRACTINT: This software package created by the Stone Soup Group is available on a 5 1/4" high-density disk at the Reference/Information Desk. It may be freely copied, and contains many fractal programs that can be constructed, manipulated, and printed in color or monochrome. The program requires 512K bytes of RAM.

COMPUTER SELECT: Information on many other fractal software packages, as well as references to fractals and chaos (and in some cases full texts) in current computer journals, is available on COMPUTER SELECT, at the CD-ROM station at the rear of the RIC main floor.

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