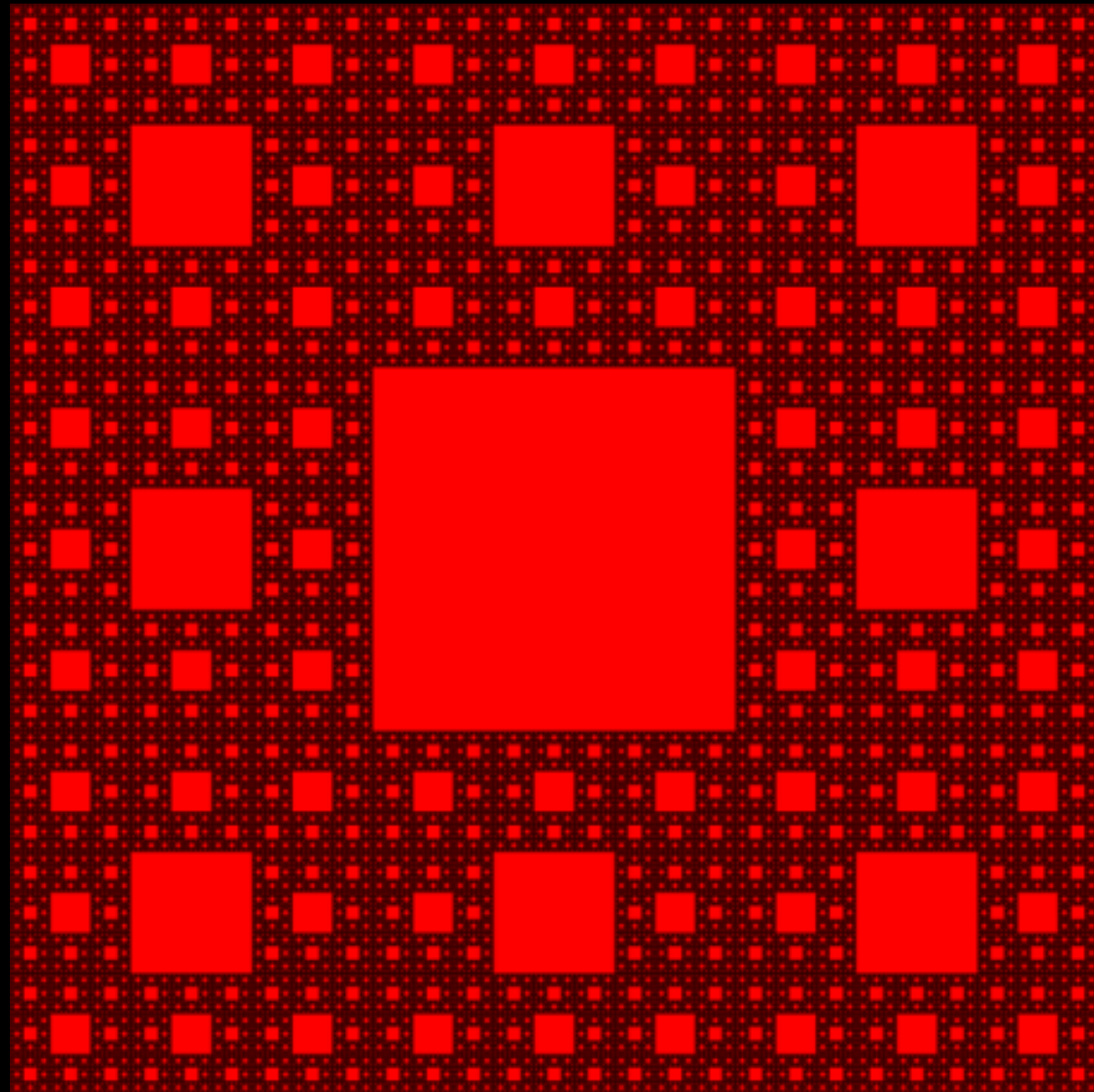


Fractals are SmART: Science, Math & Art



www.FractalFoundation.org

What is a Fractal?



A pattern that repeats itself on different scales

“Self-similarity”

Very complex patterns made by repeating a simple process over and over

Fractals in Nature

The creation of a thousand forests is in one acorn.

-Ralph Waldo Emerson







A photograph showing a network of thin, brown, woody branches against a clear blue sky. The branches are covered with numerous small, bright yellow-green flowers, illustrating a branching pattern.

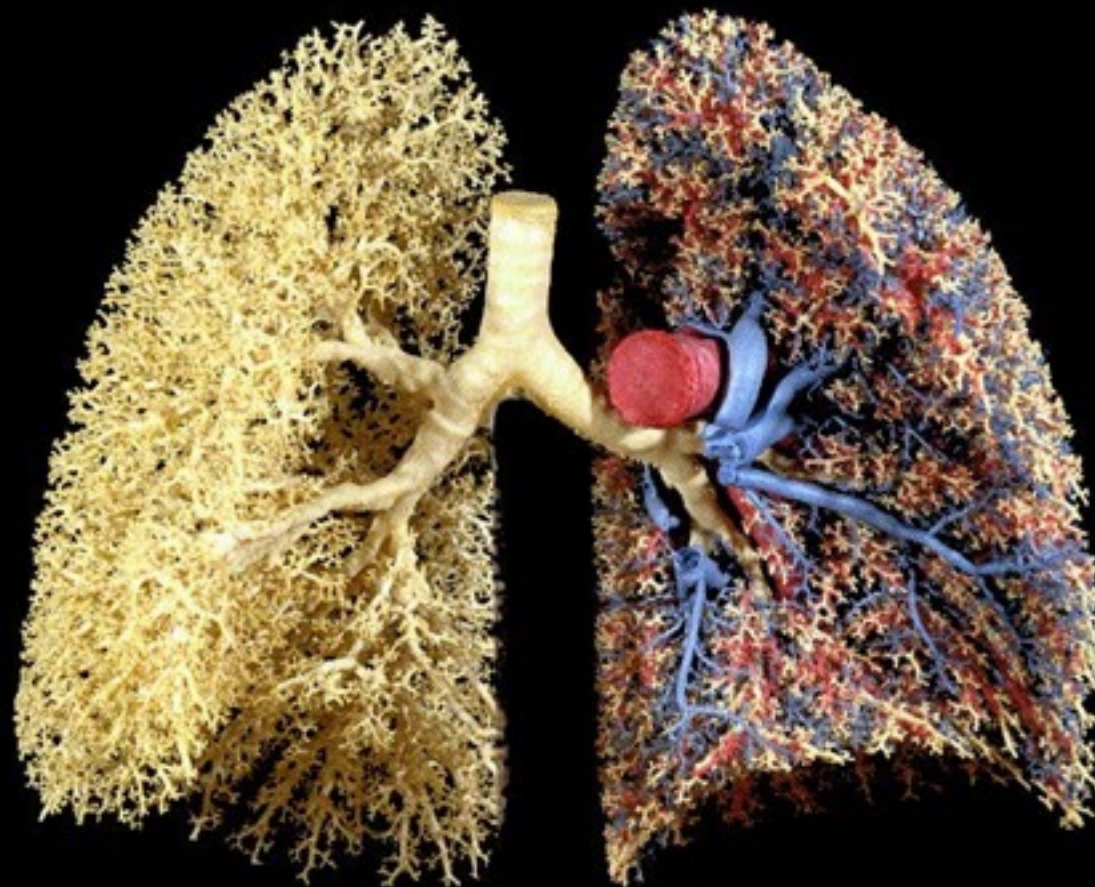
BRANCHING

A close-up photograph of a snail's shell resting on a bed of green moss and small, smooth, greyish-brown stones. The shell is a light greyish-brown color with a prominent spiral pattern, showing the concentric growth lines of the shell.

SPIRAL



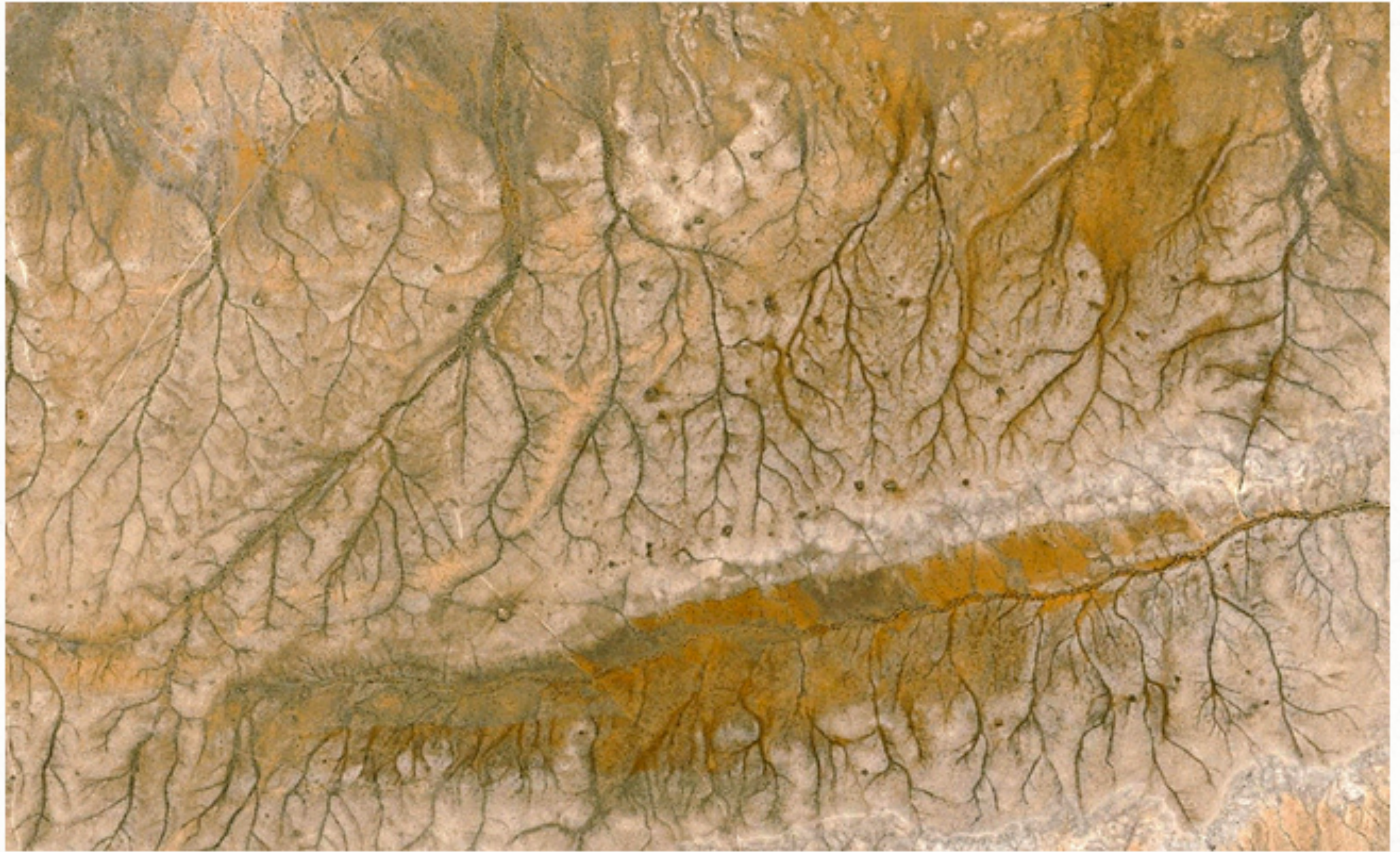




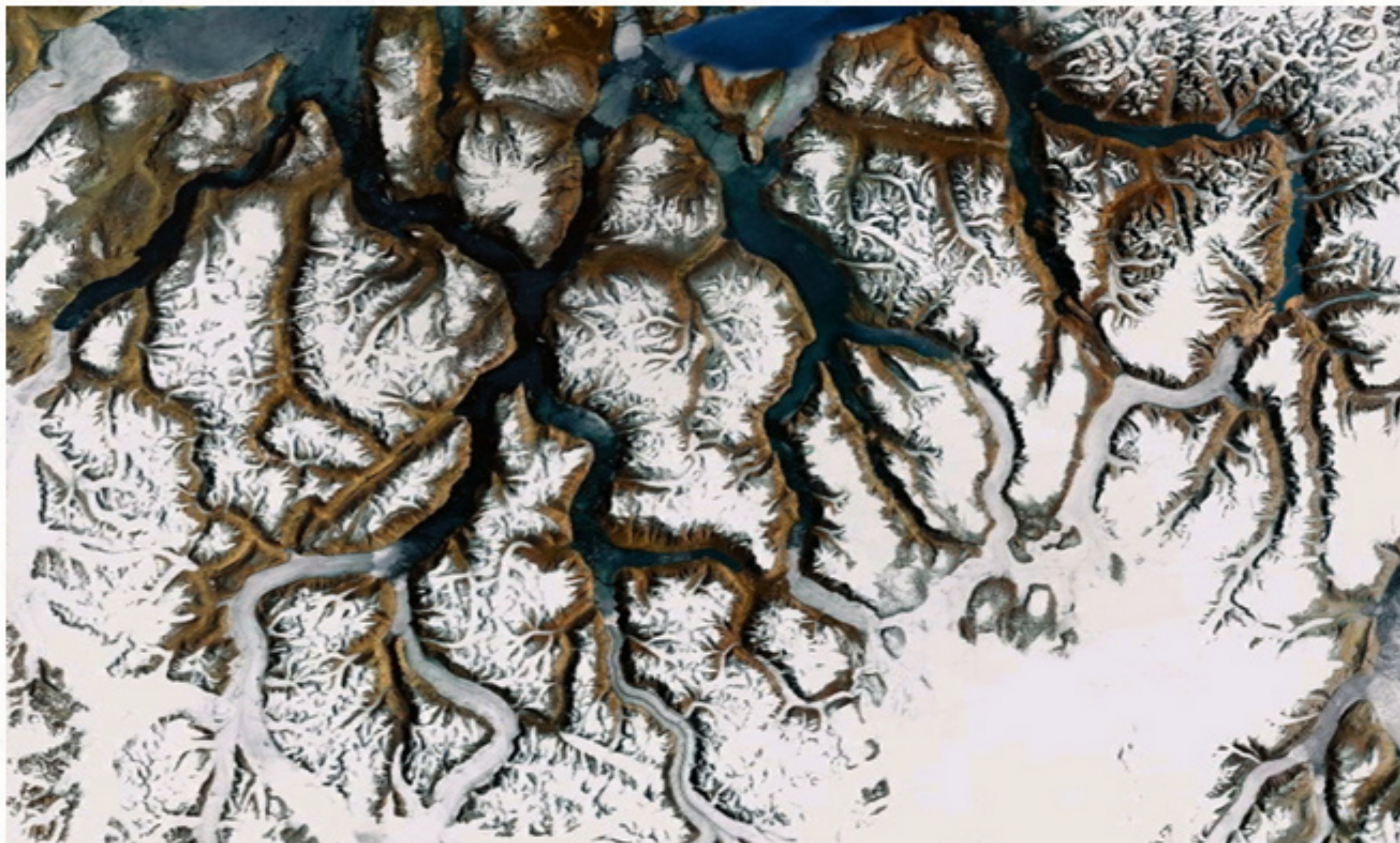




Myanmar. (Photo: Paul Bourke/Google Earth fractals)



Namibia. (Photo: Paul Bourke/Google Earth fractals)



Greenland. (Photo: Paul Bourke/Google Earth fractals)

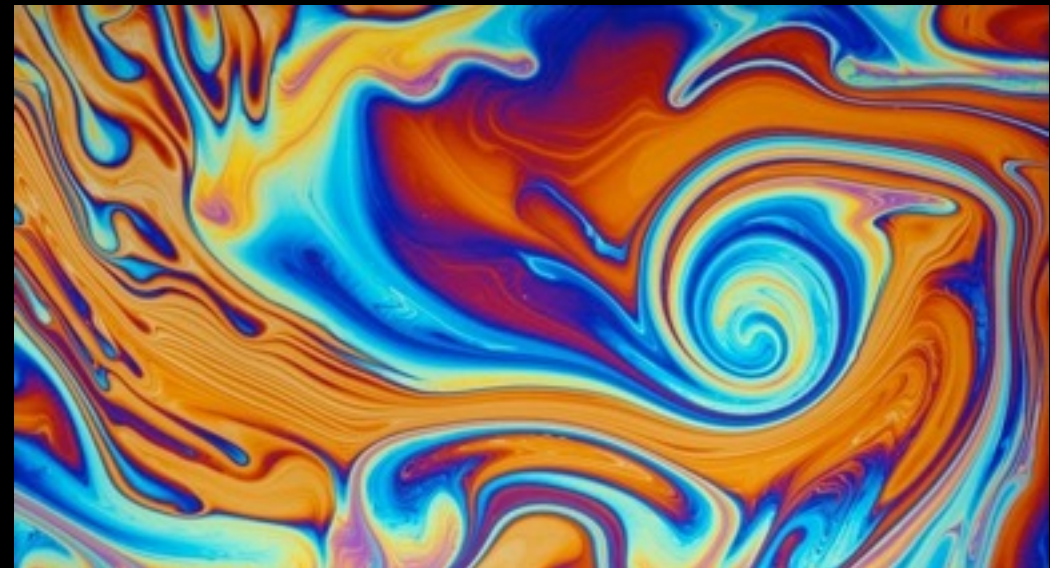
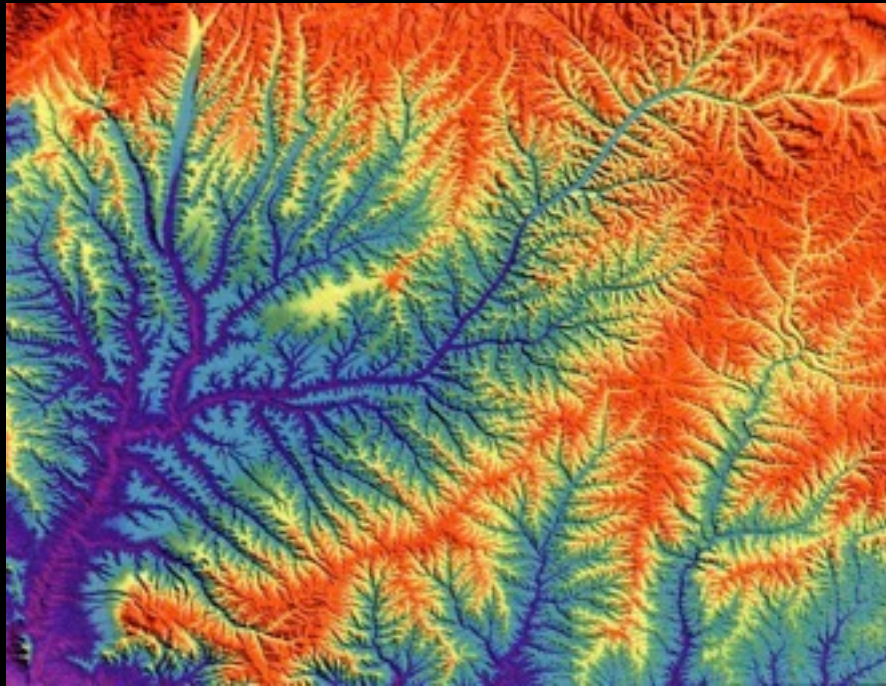


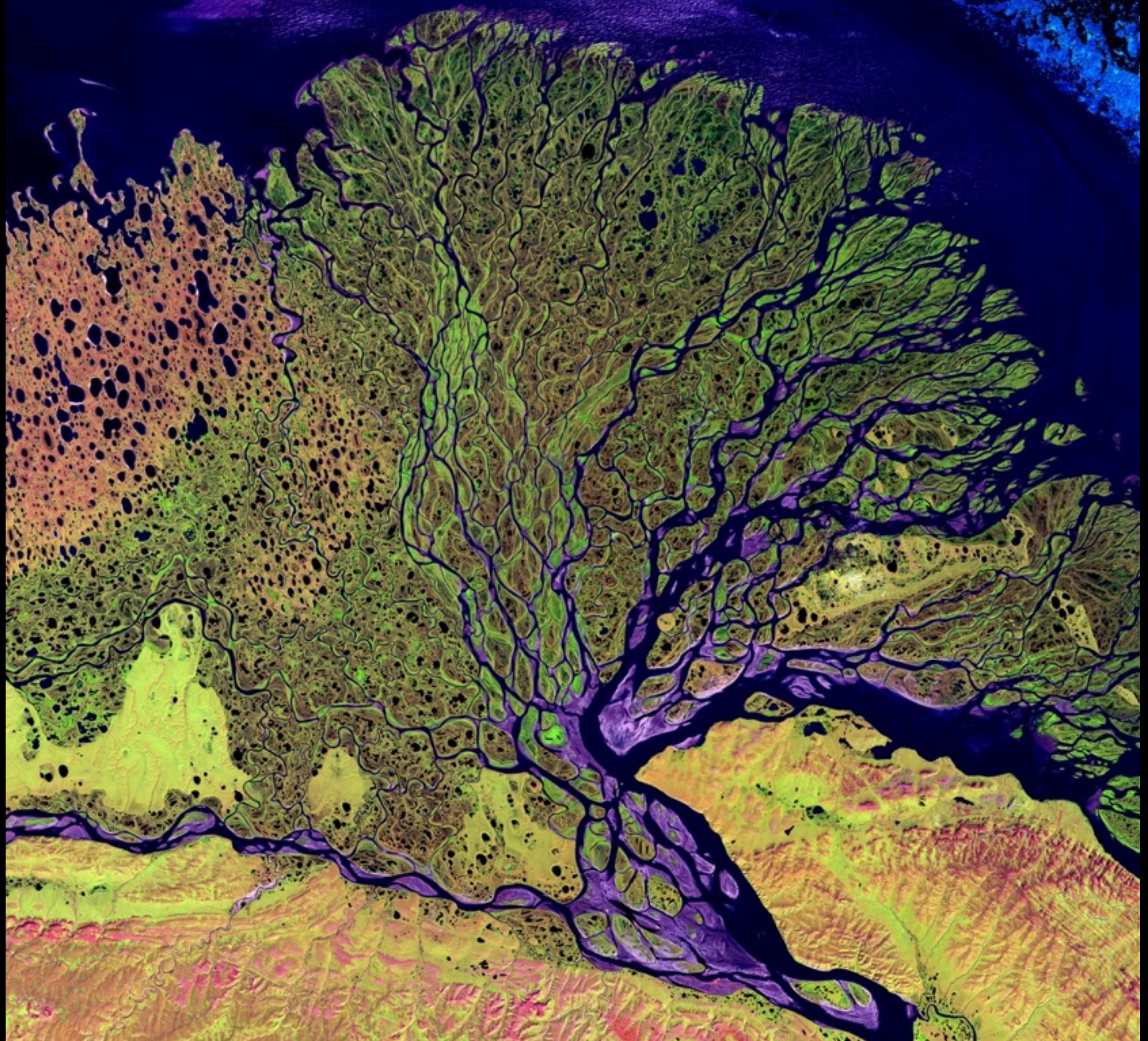
THE COMPLEXITY OF

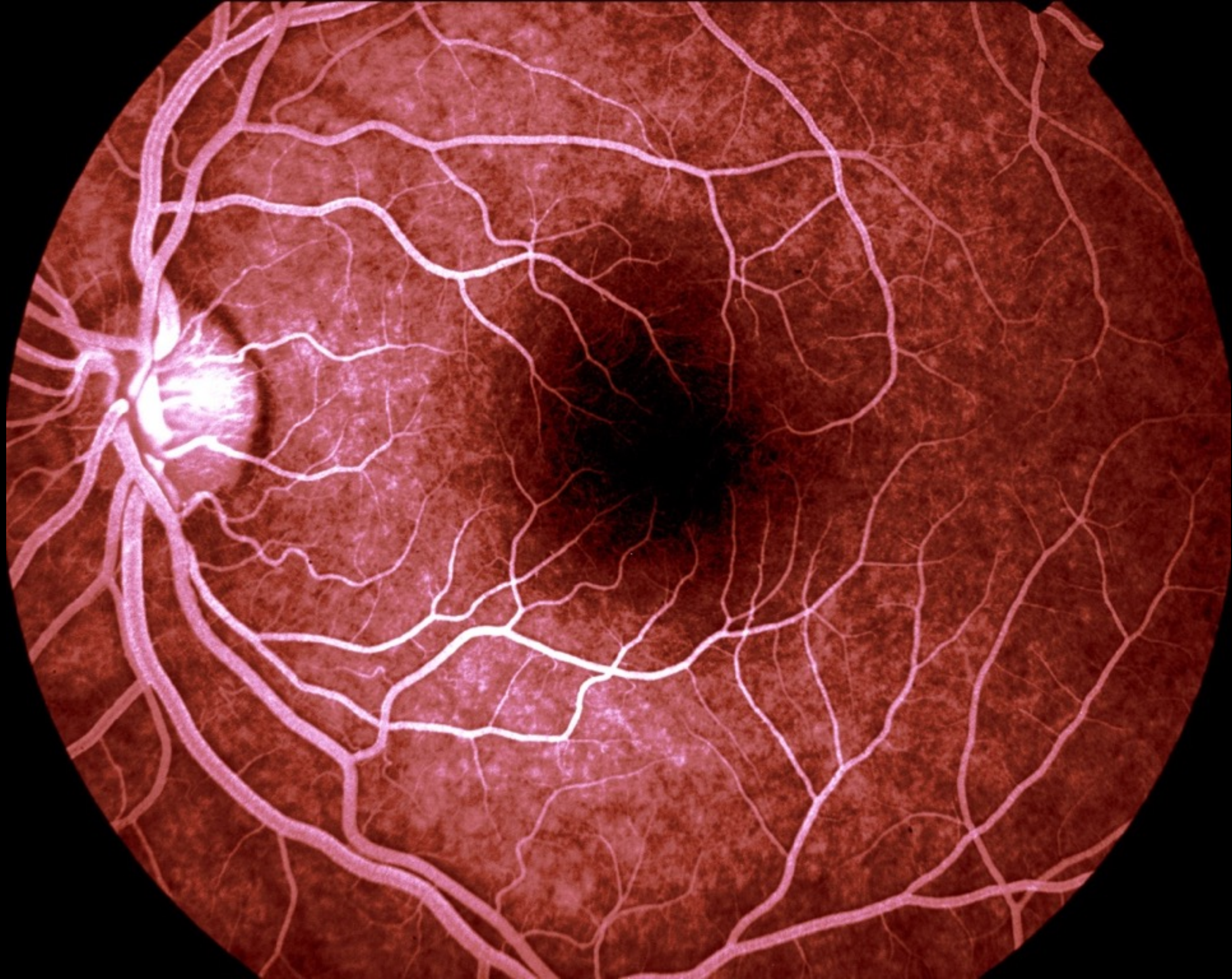


A TREE

Fractals are Scalable!

















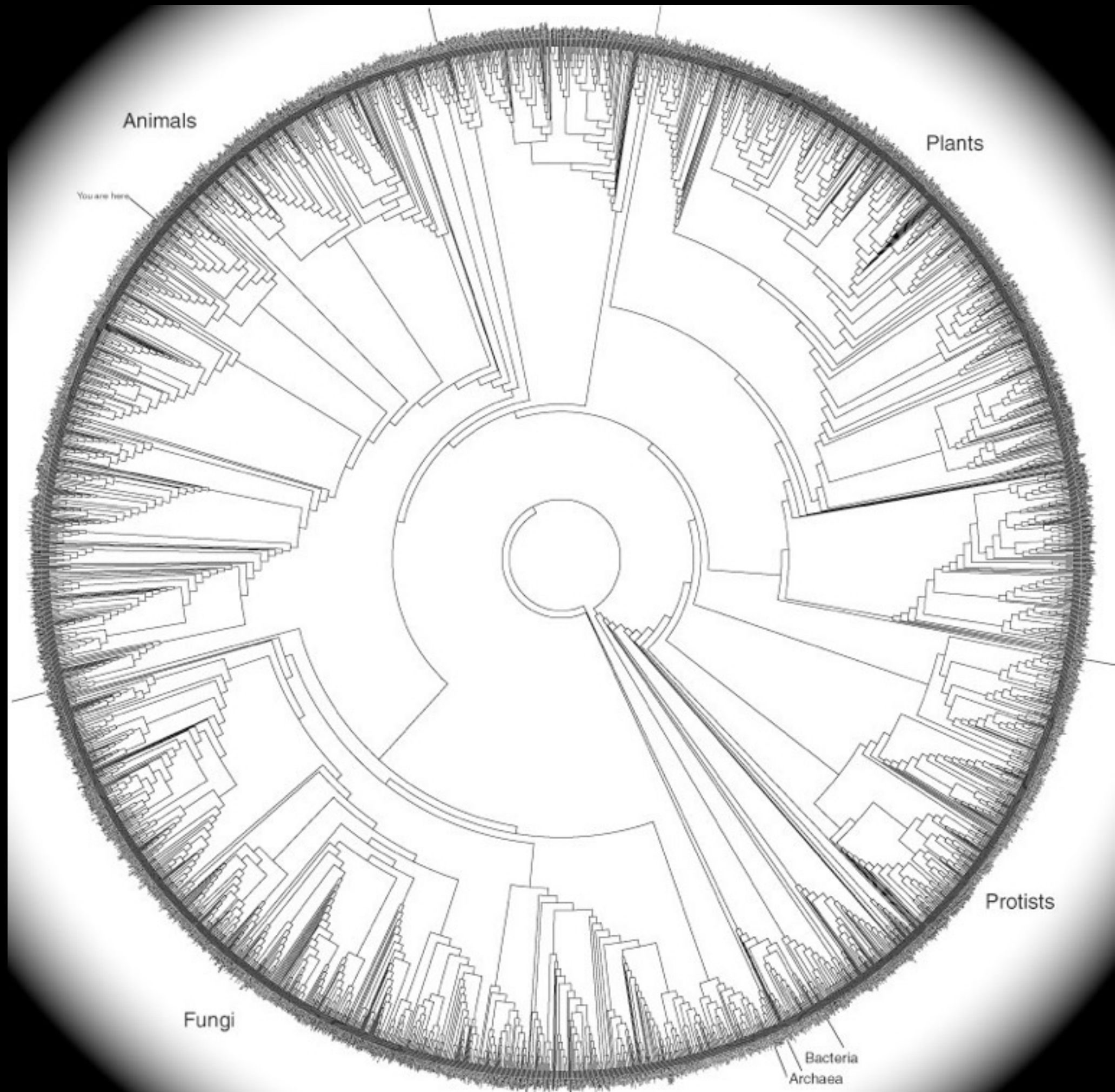


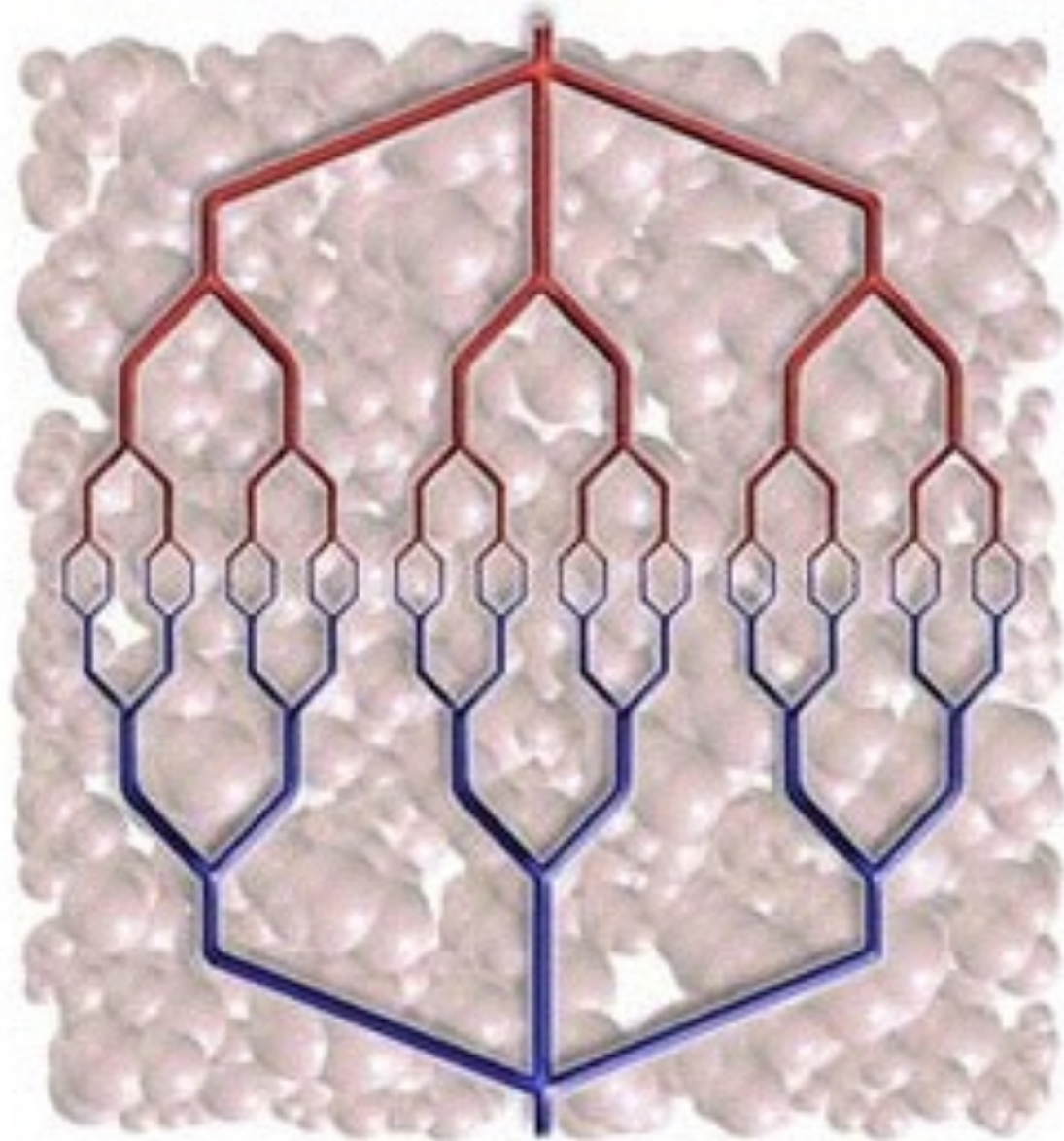




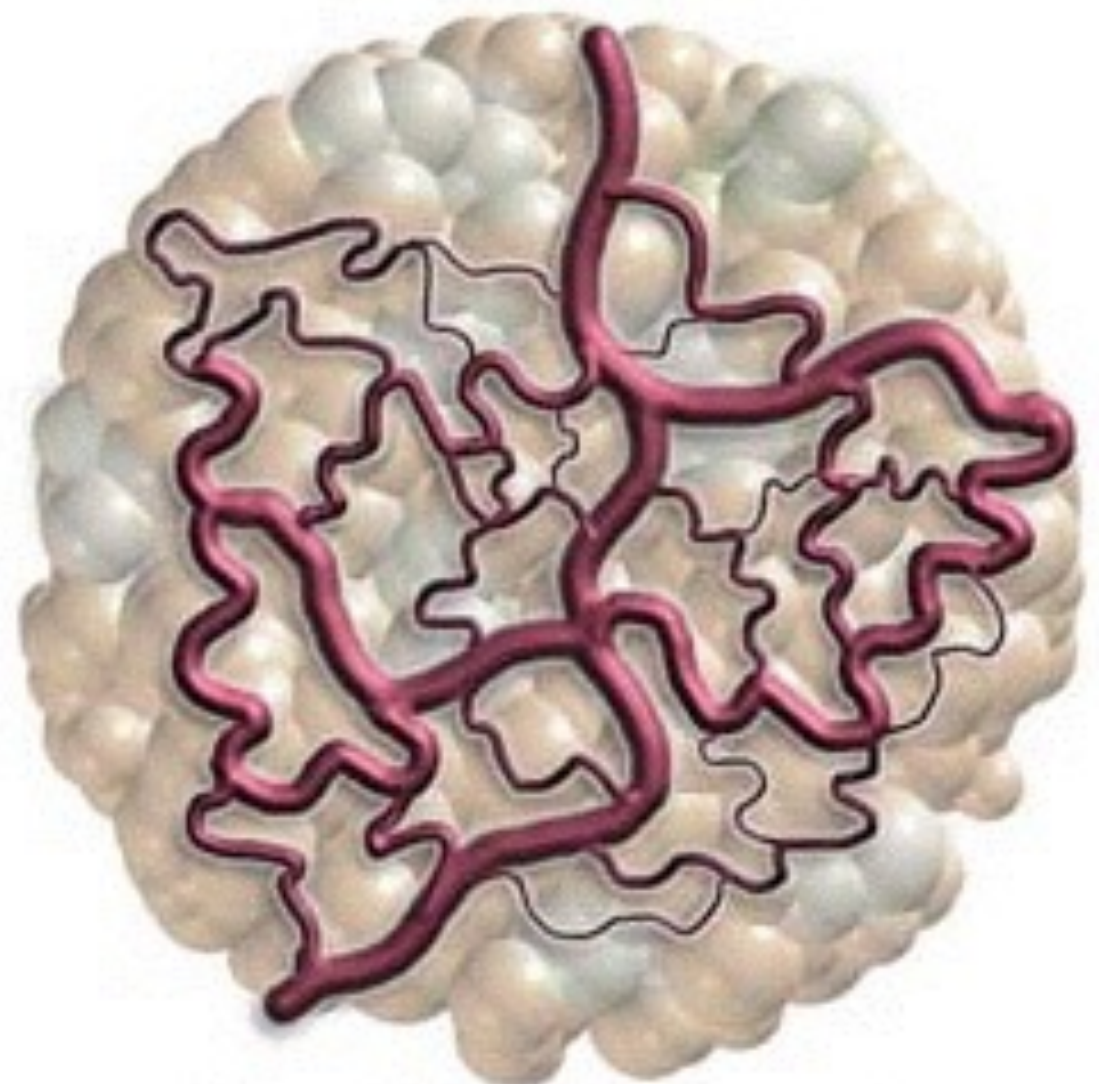




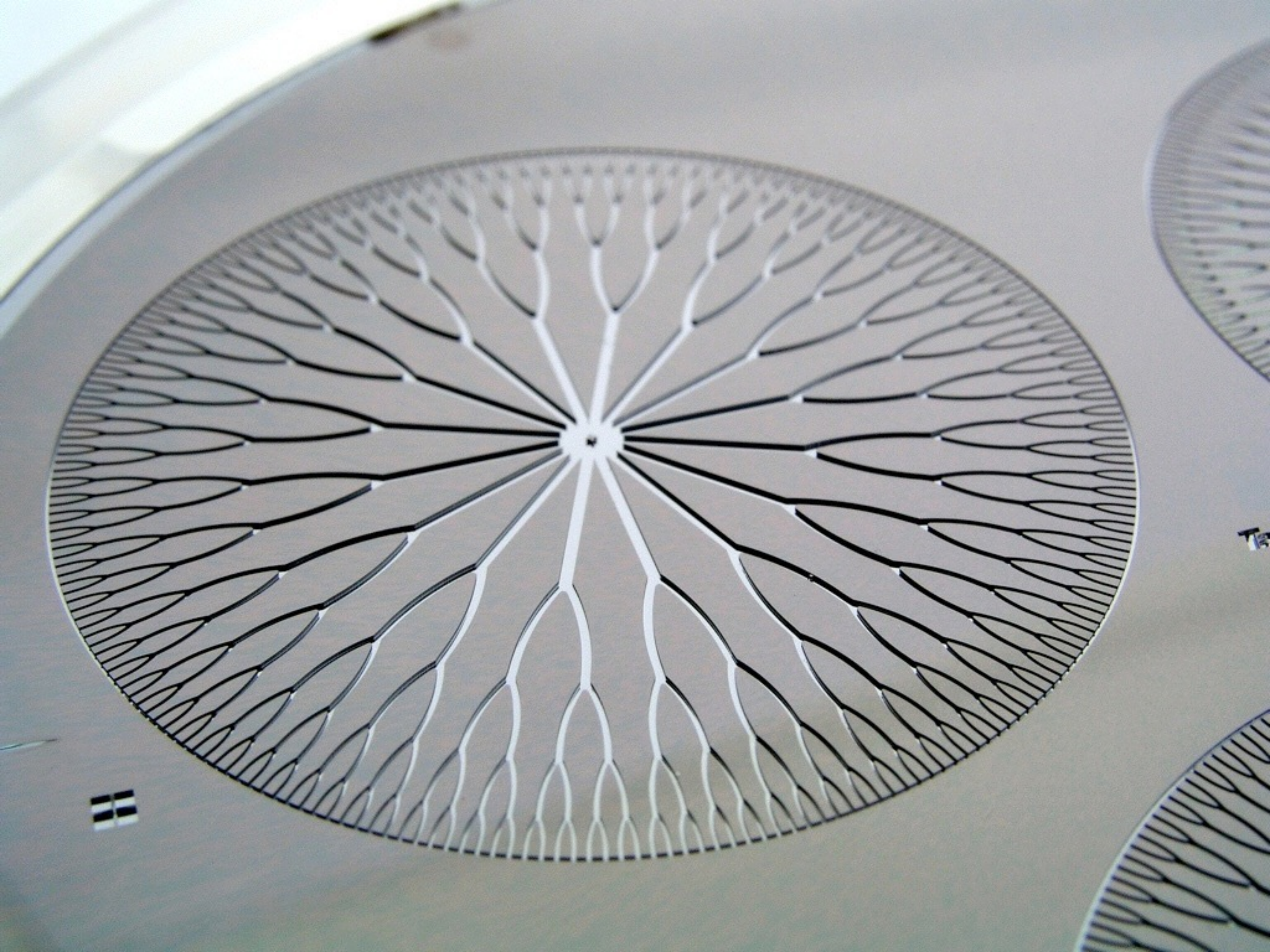




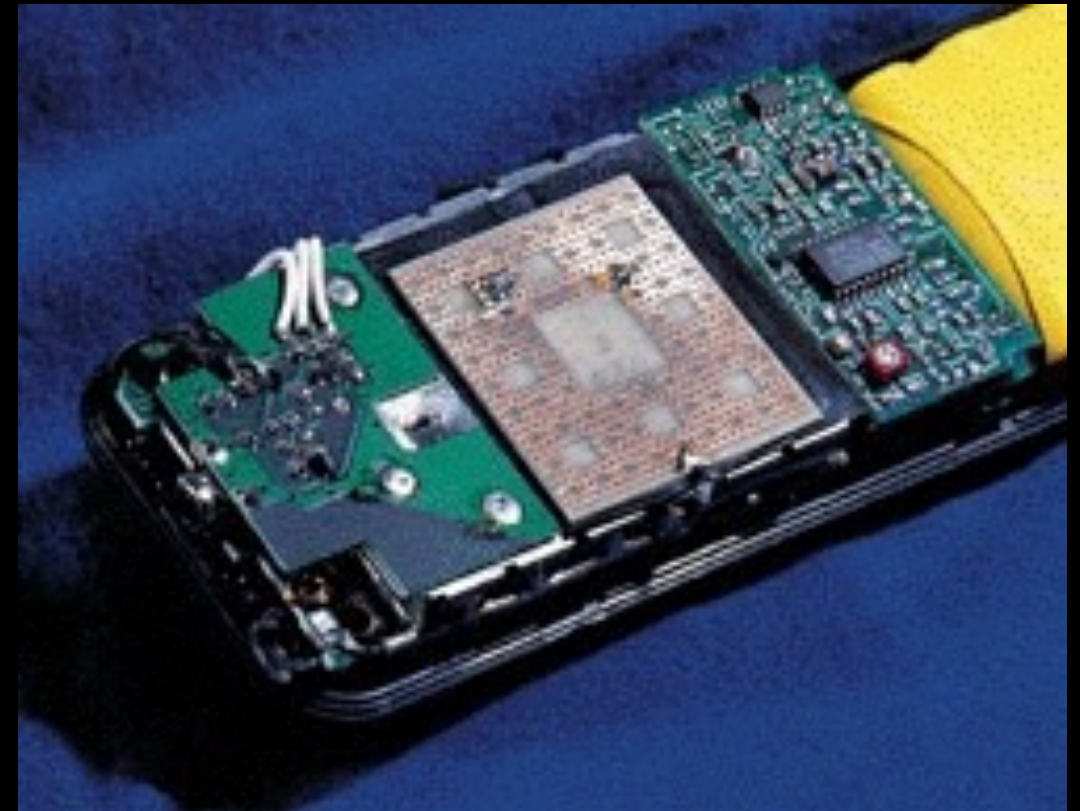
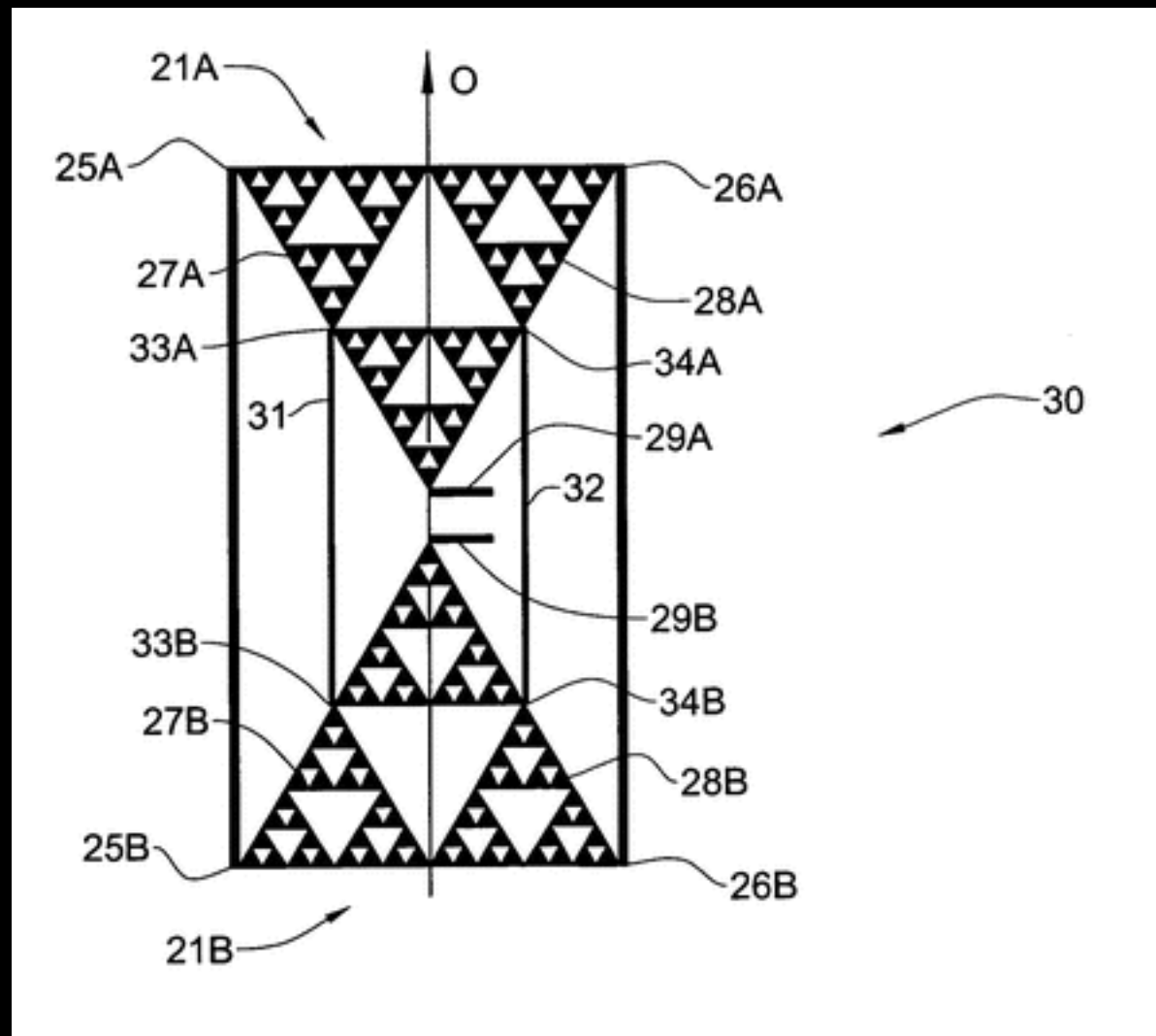
A. Normal

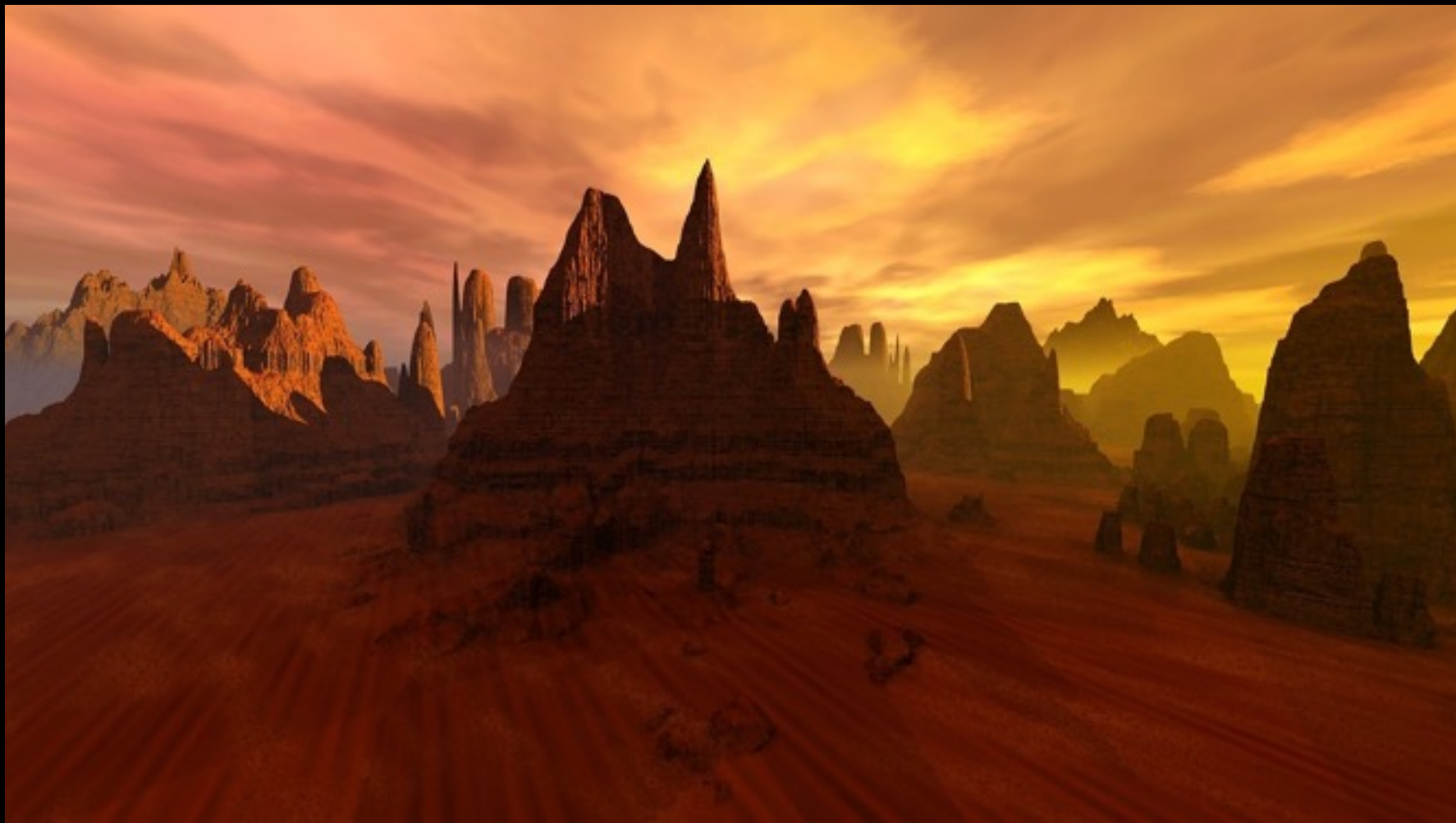
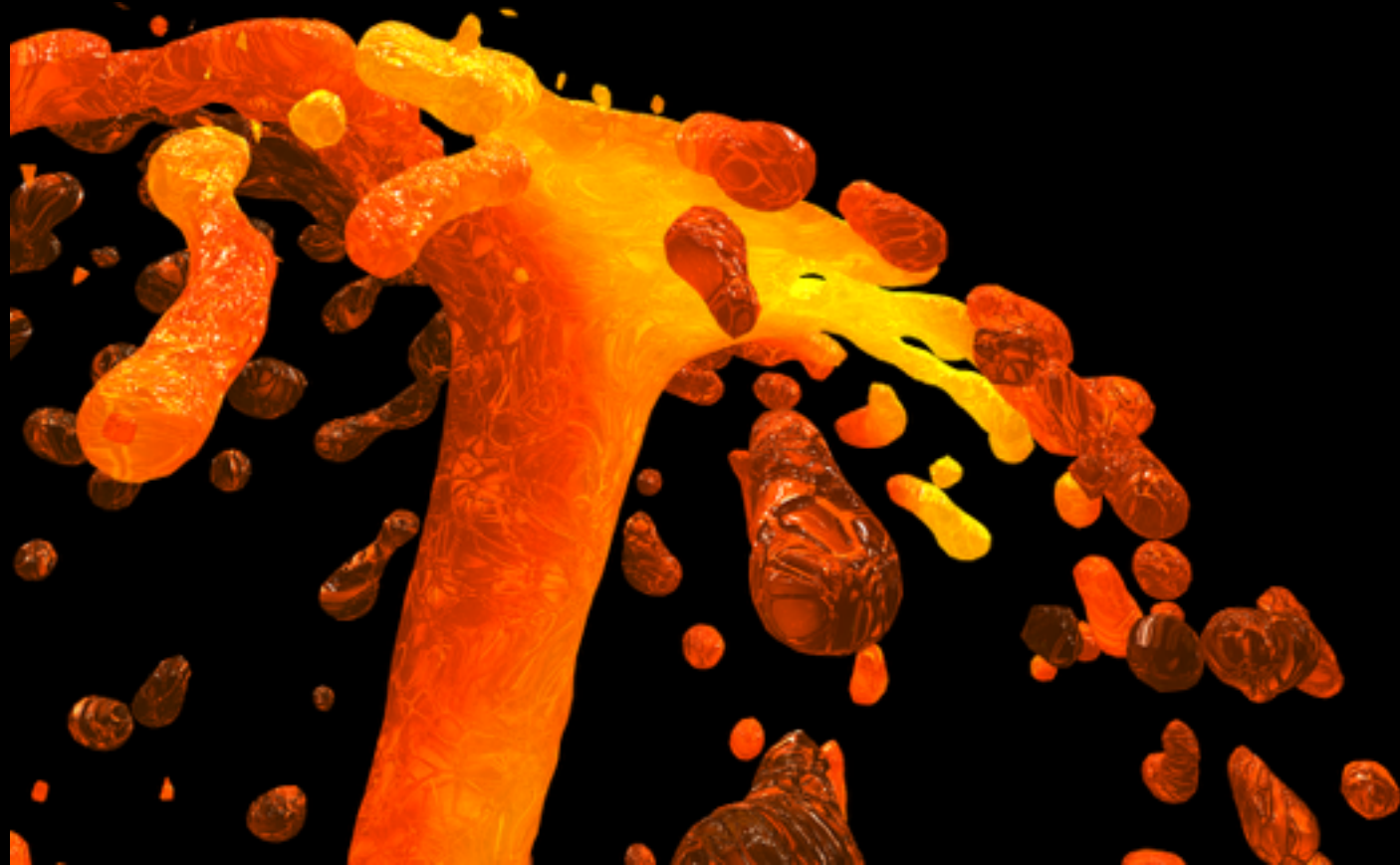


B. Abnormal

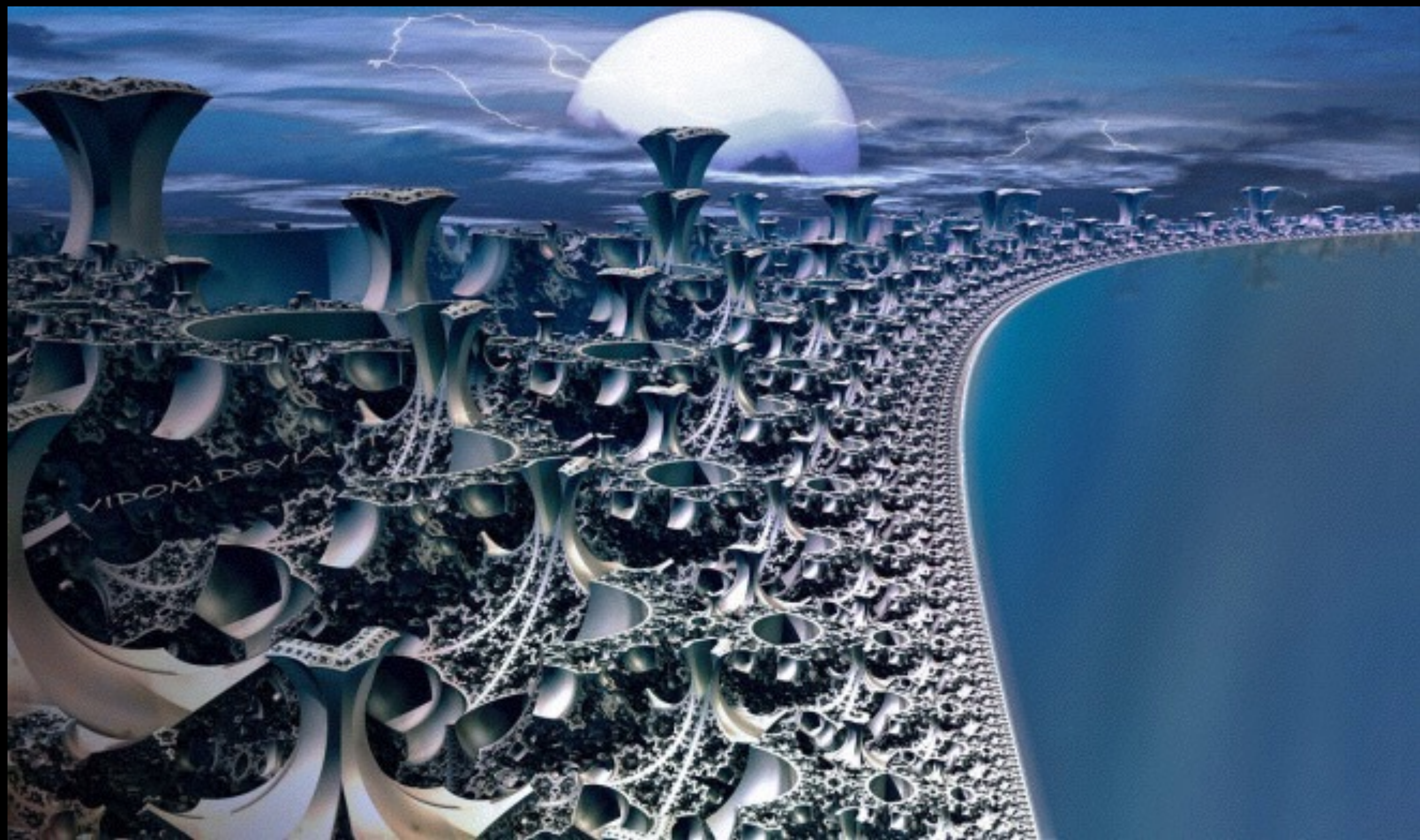


Cell phone antenna patent drawing

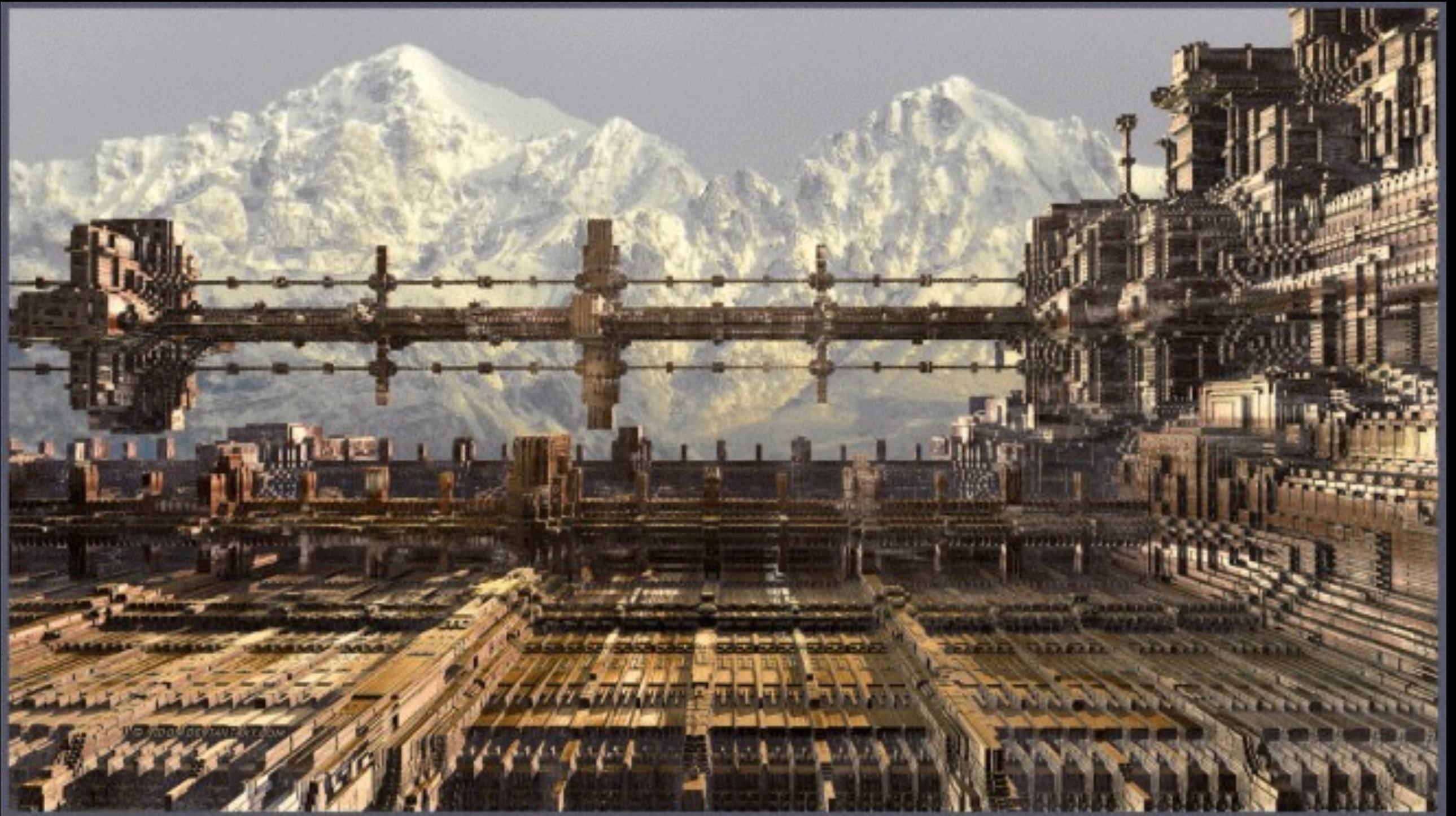


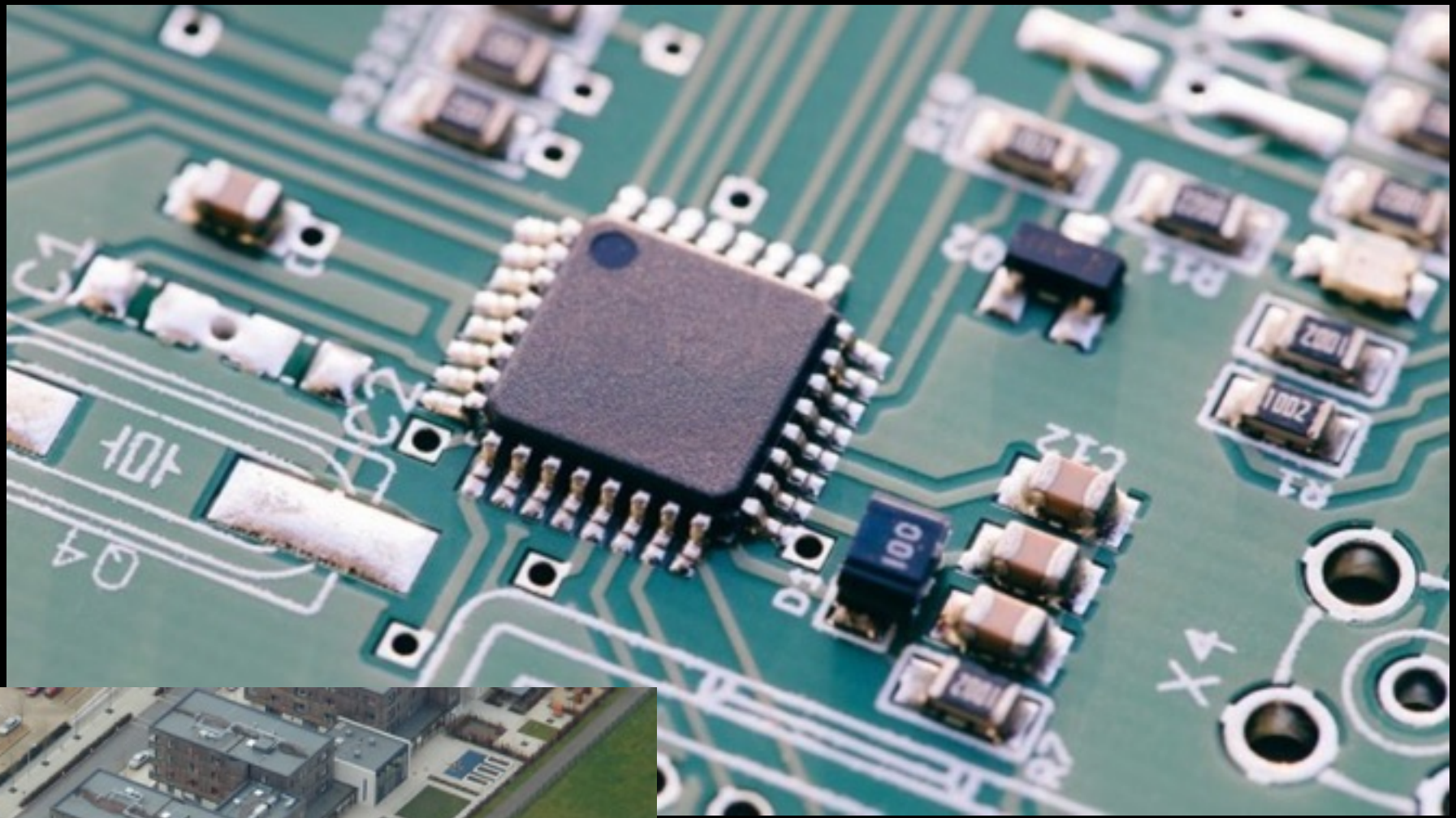




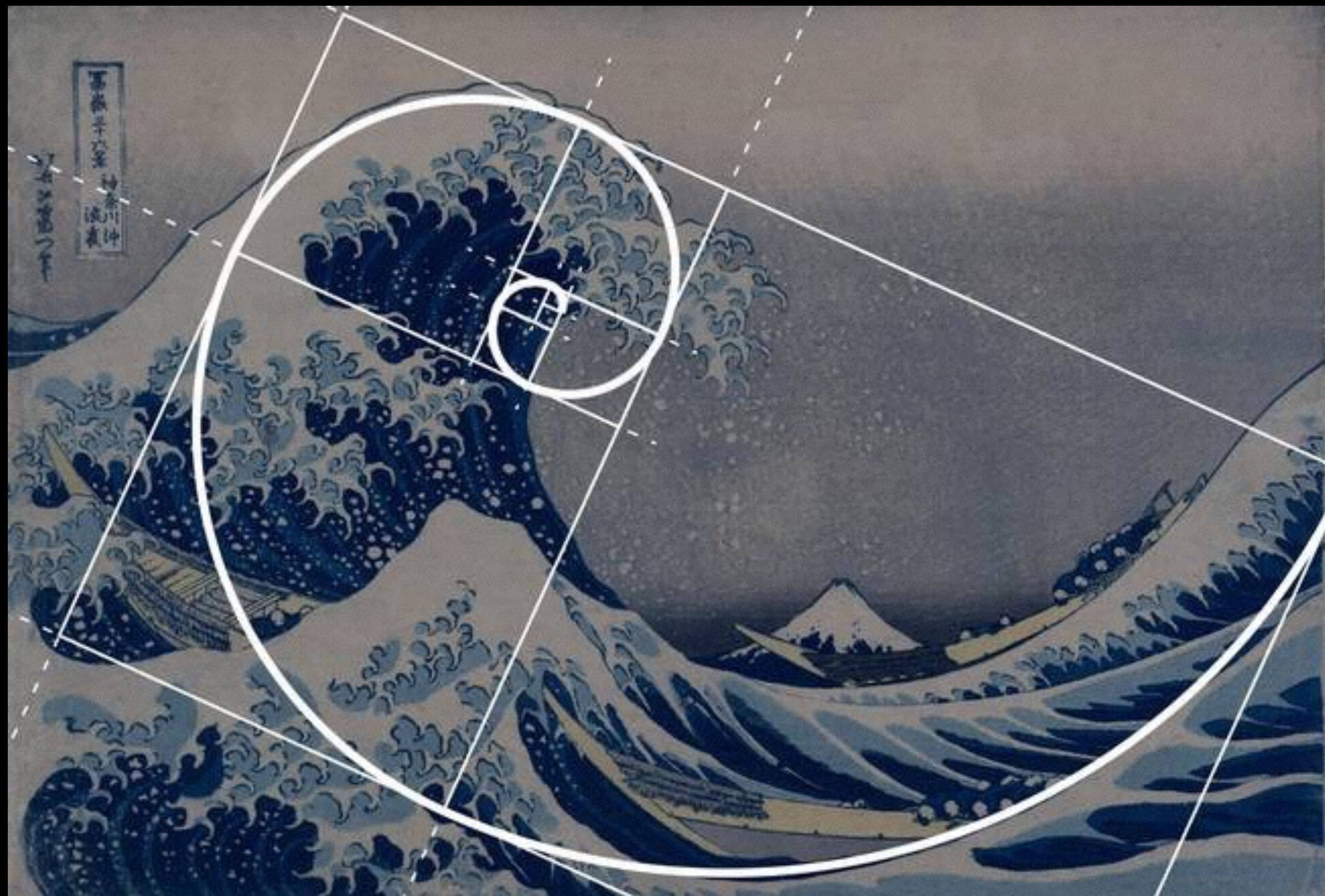












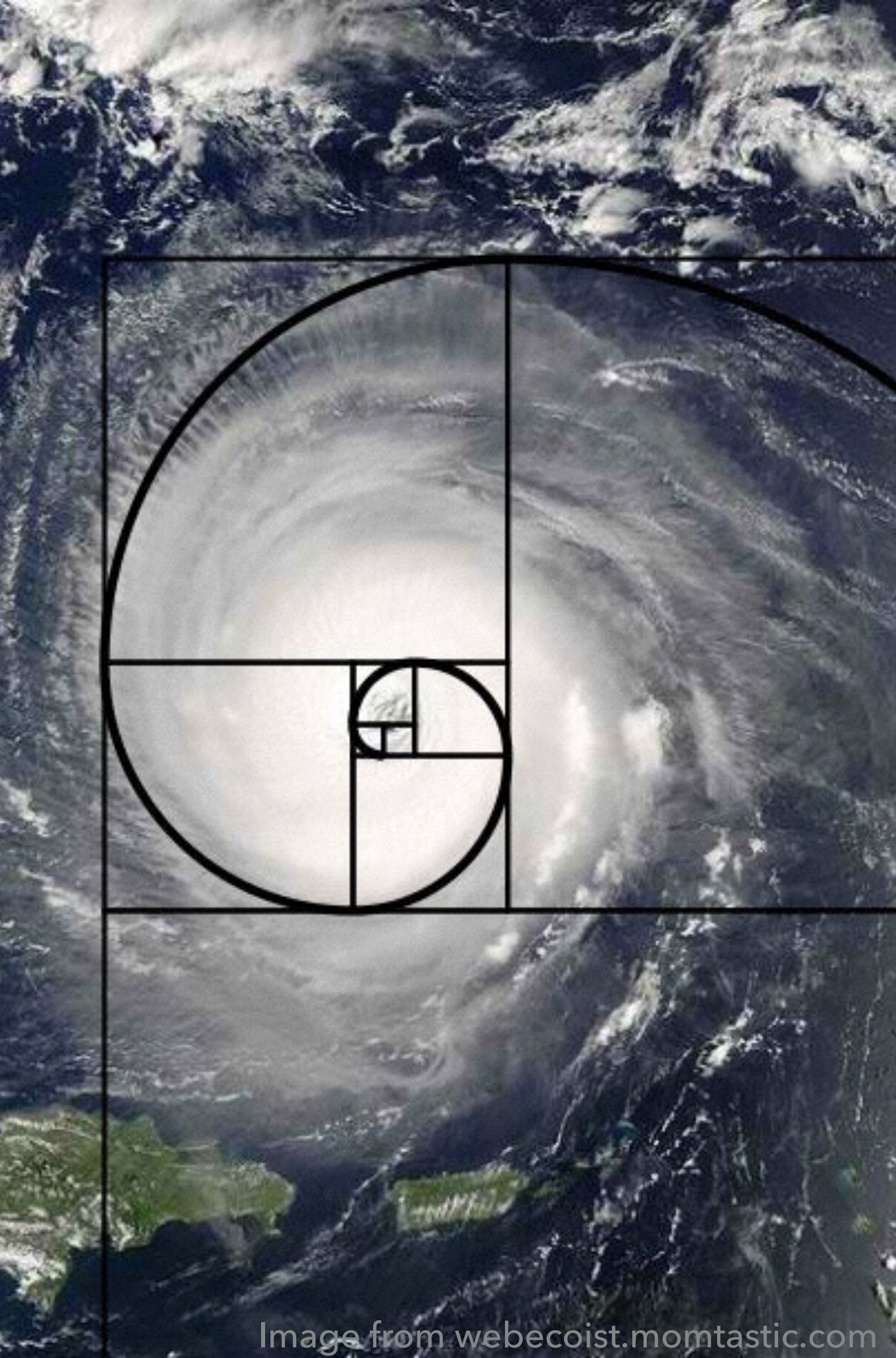


Image from webecoist.momtastic.com

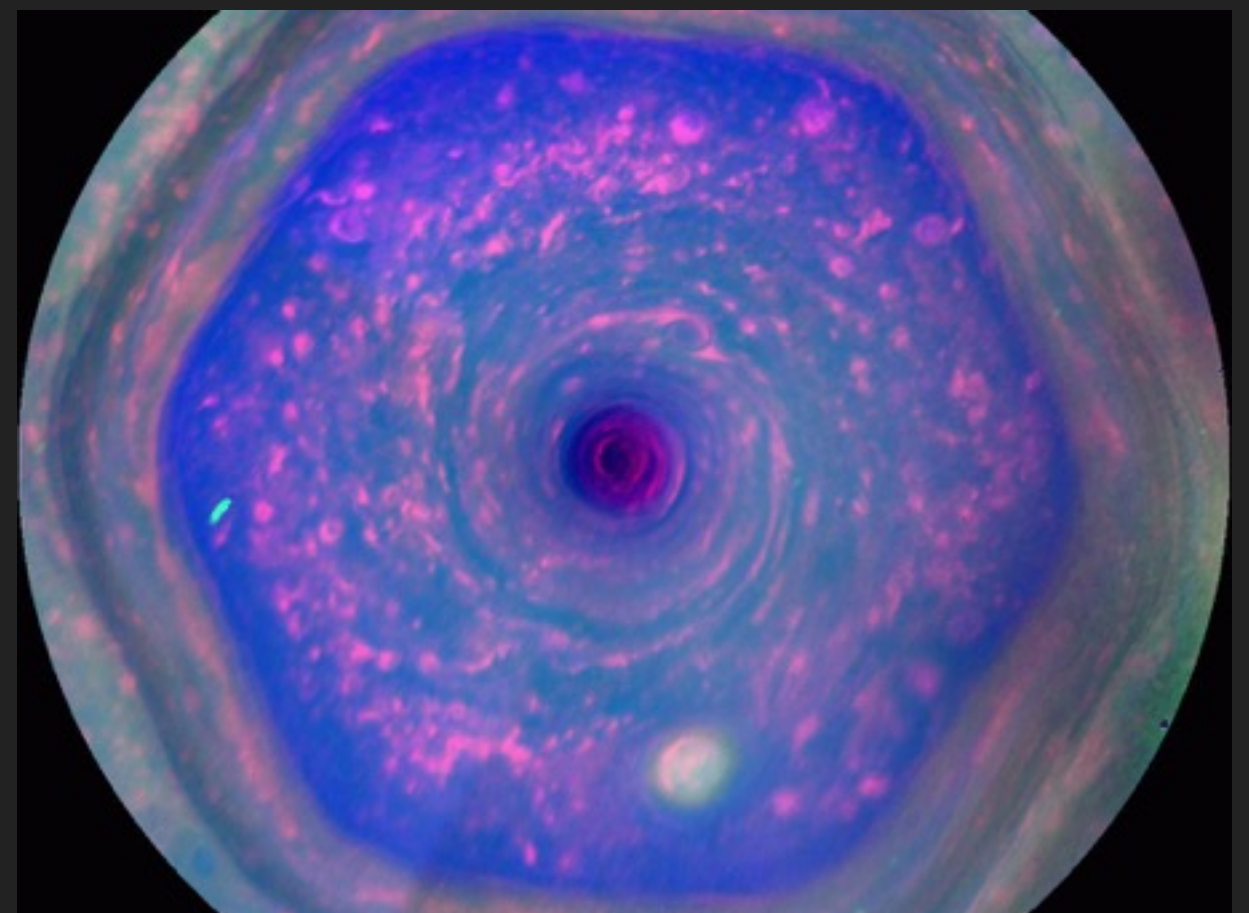
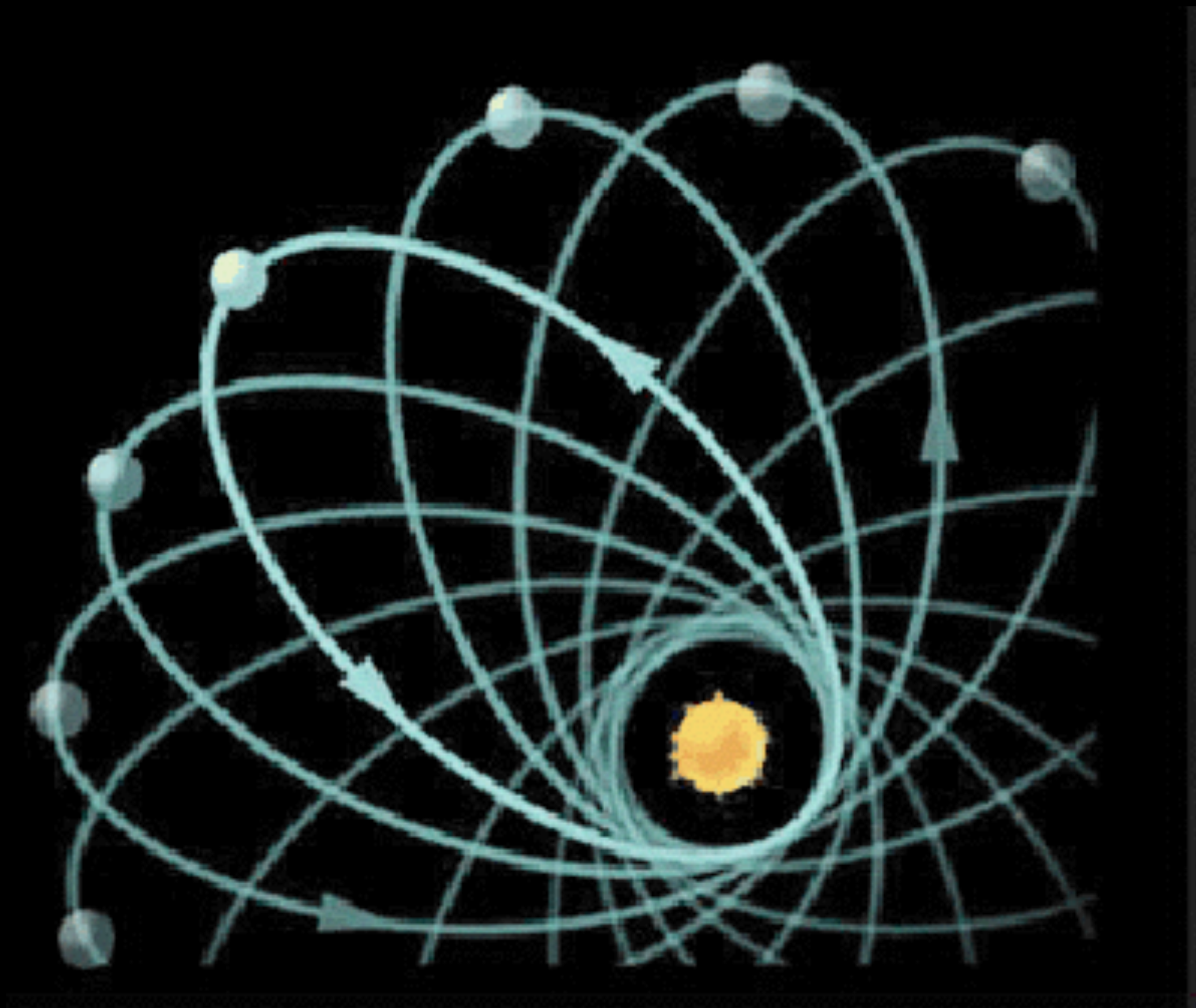
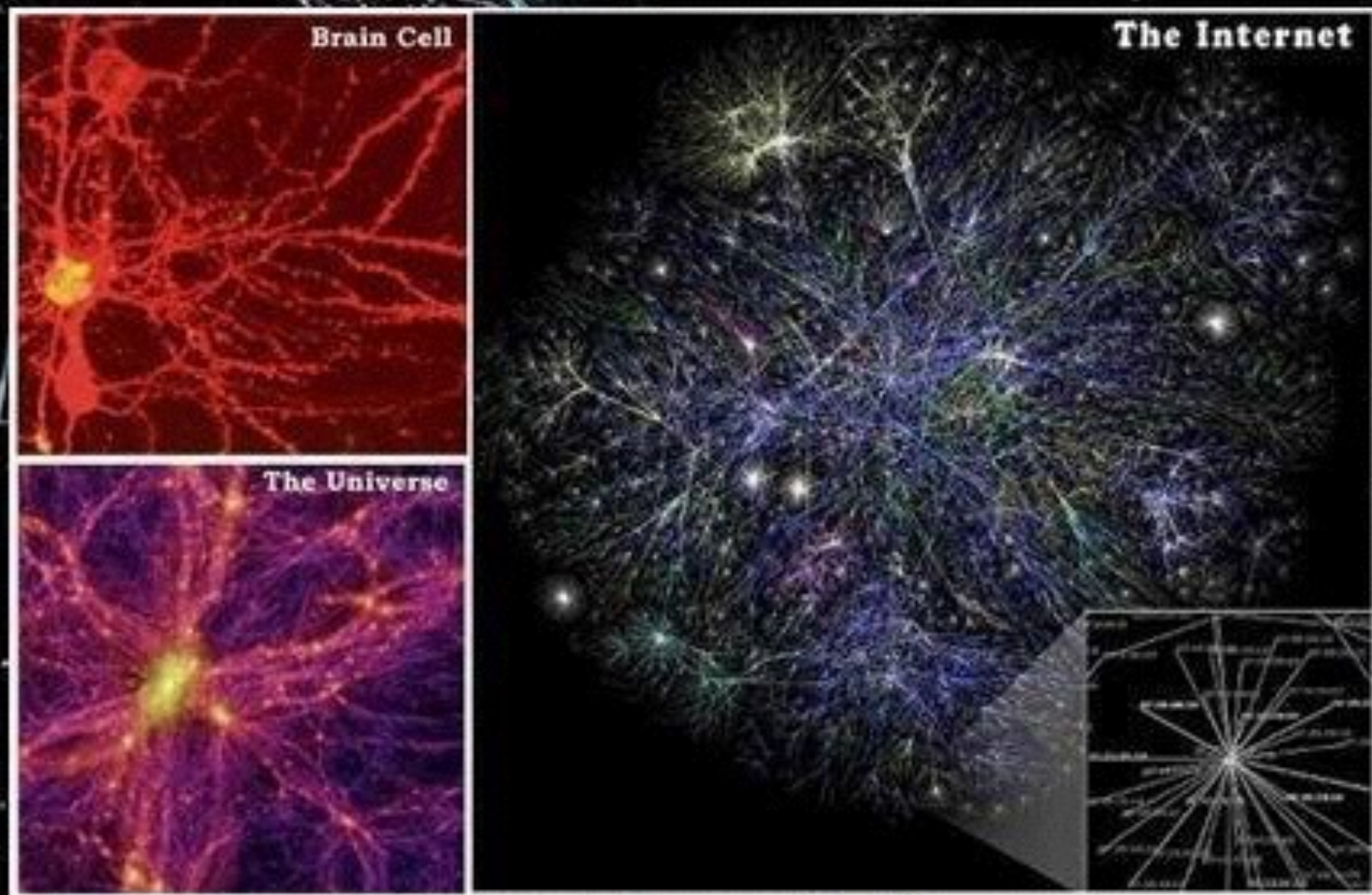


Image from jpl.nasa.gov

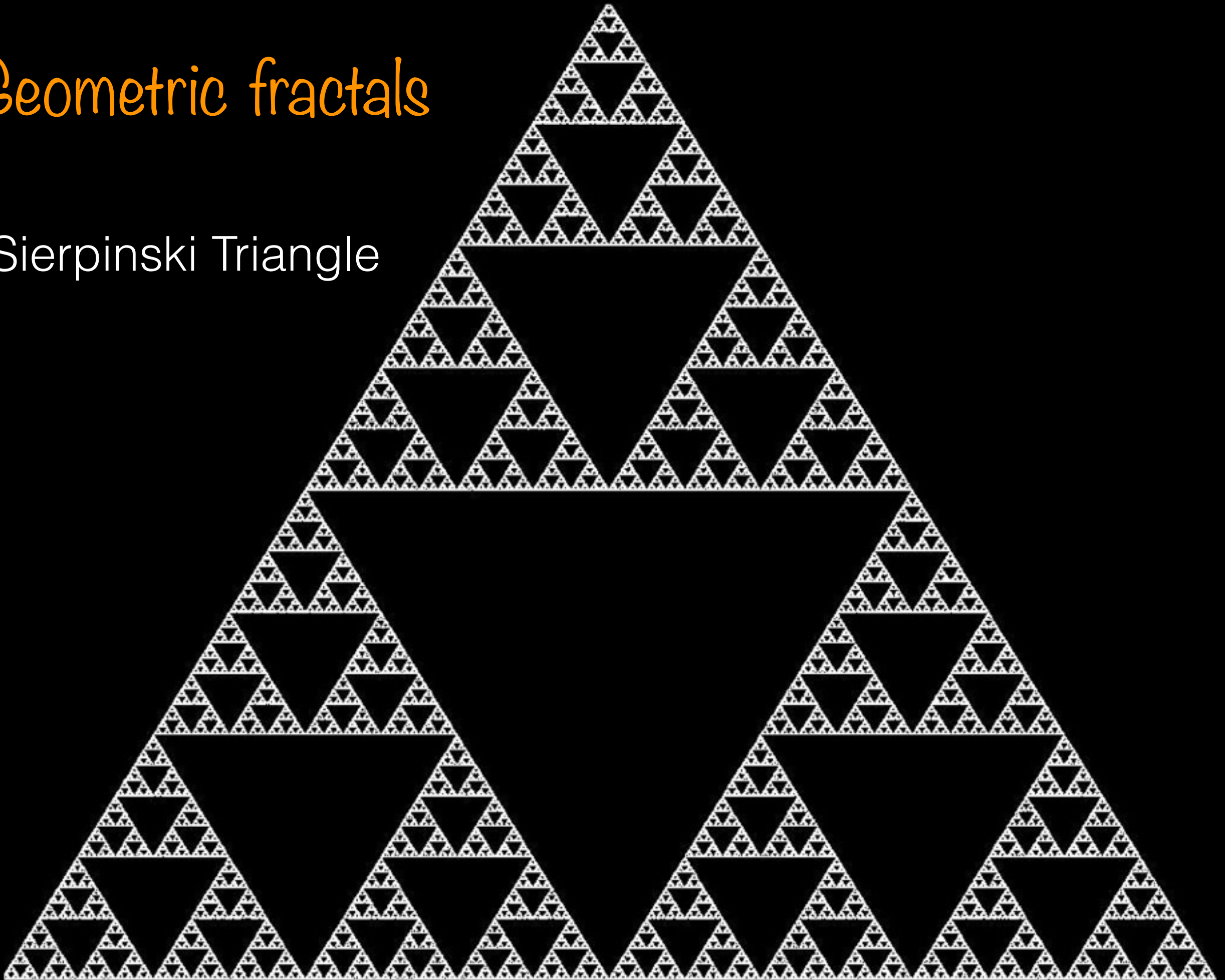


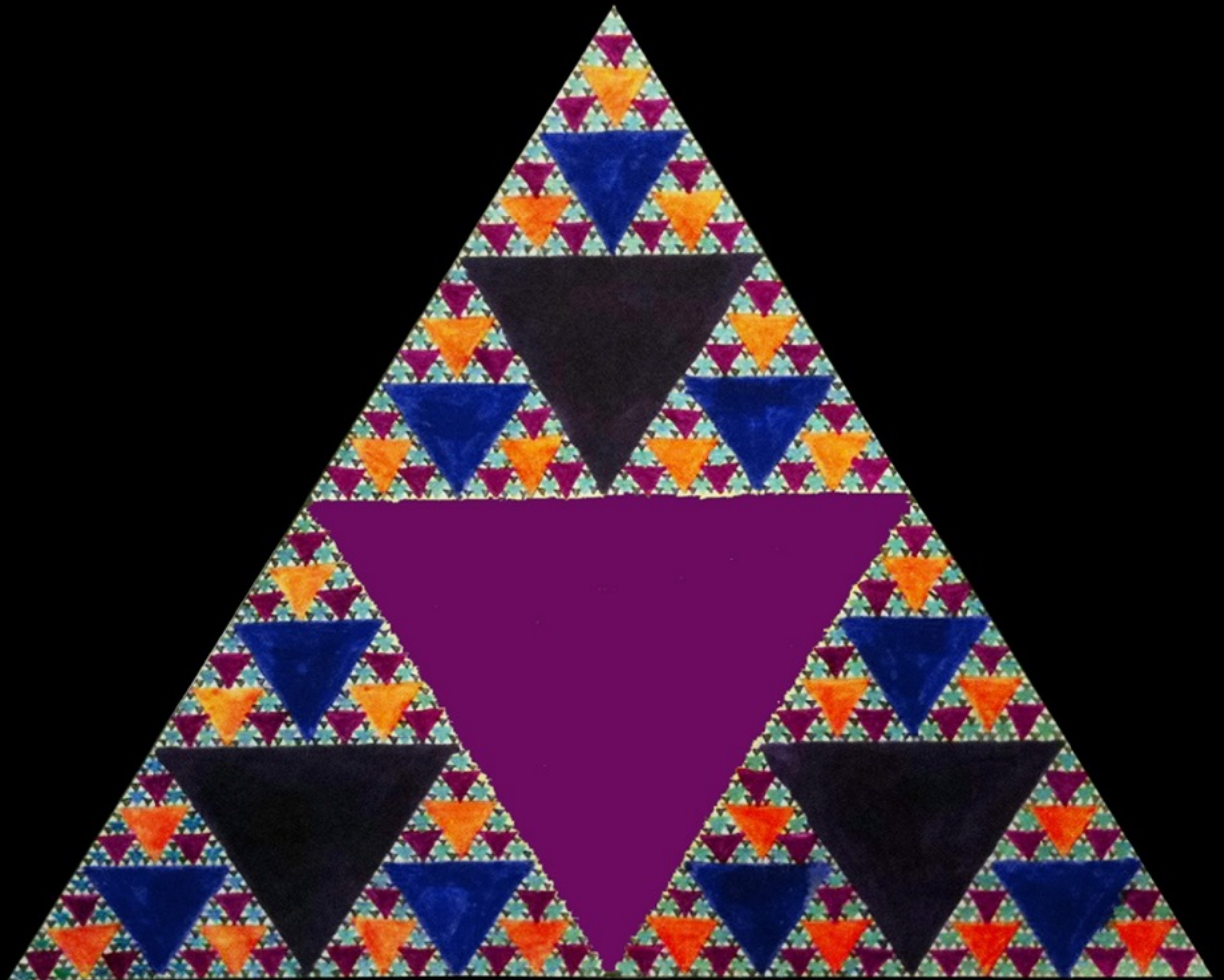


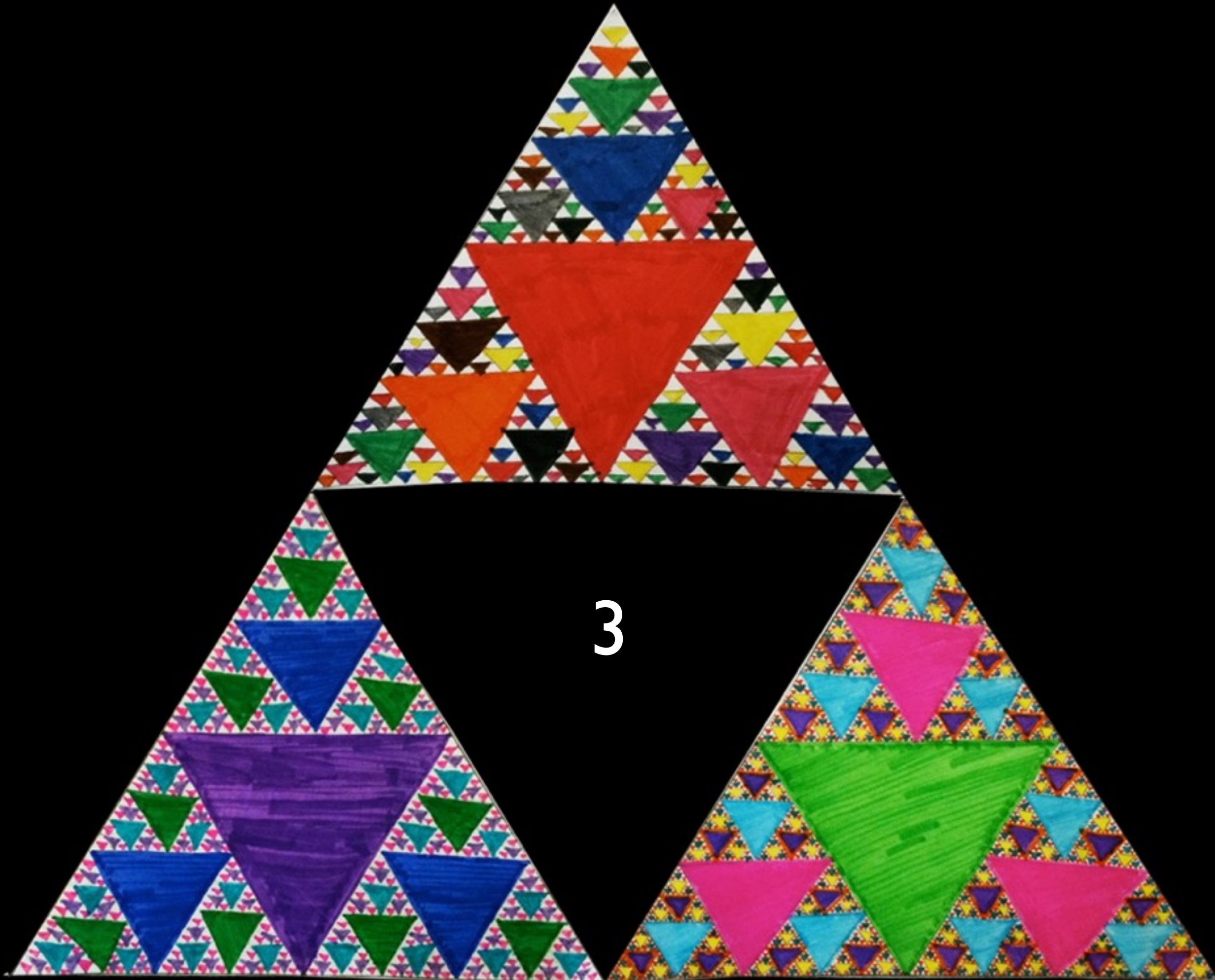
Human brain cells, the universe and the internet all have similar structures.

Geometric fractals

Sierpinski Triangle

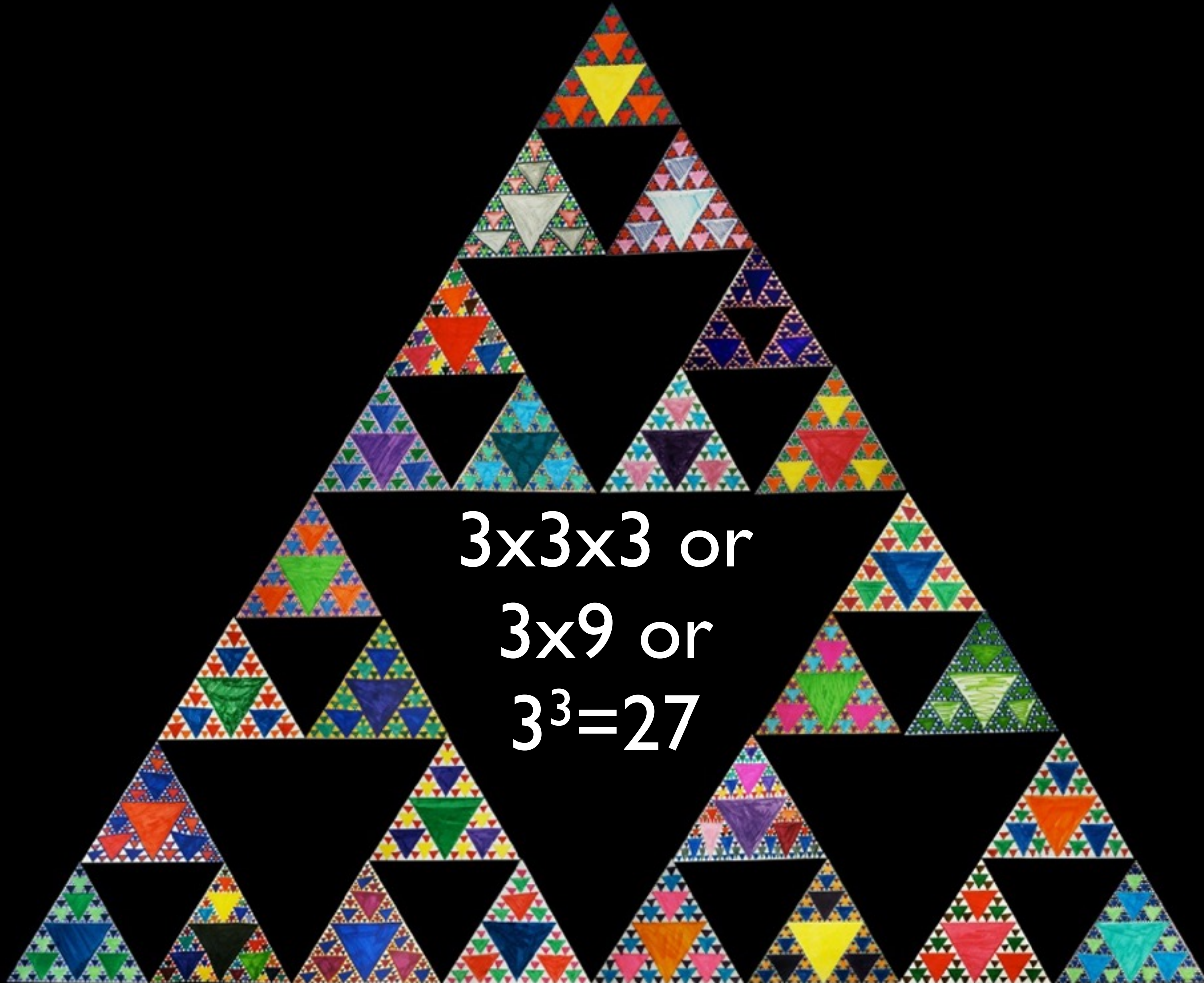






A large equilateral triangle is composed of many smaller equilateral triangles. The triangles are colored in various colors including red, blue, green, yellow, and purple. The central part of the large triangle is a large black triangle. The text "3x3 or 3^2=9" is written in white in the center of the black triangle.

3x3 or $3^2=9$

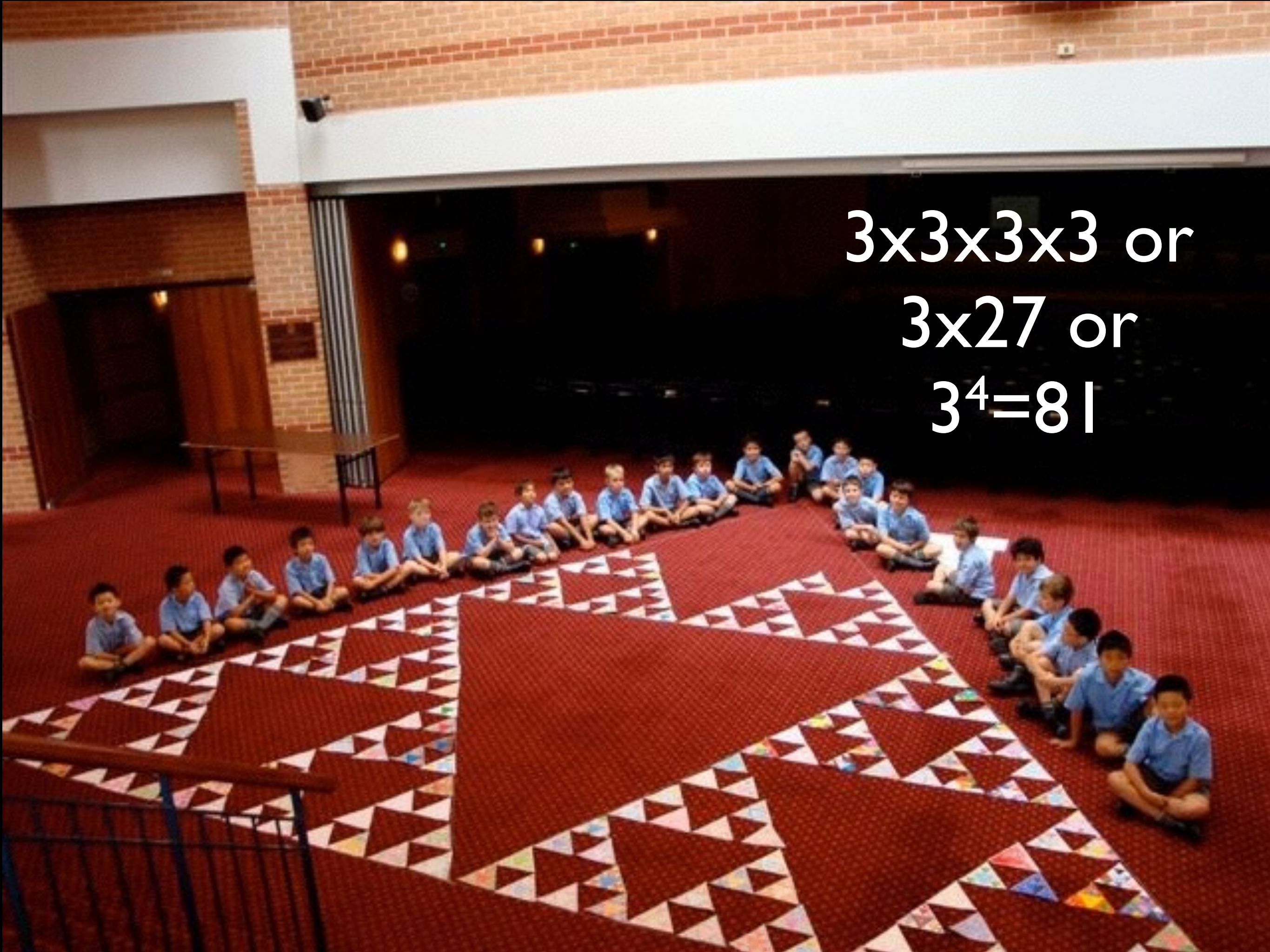


3x3x3 or
3x9 or
 $3^3=27$



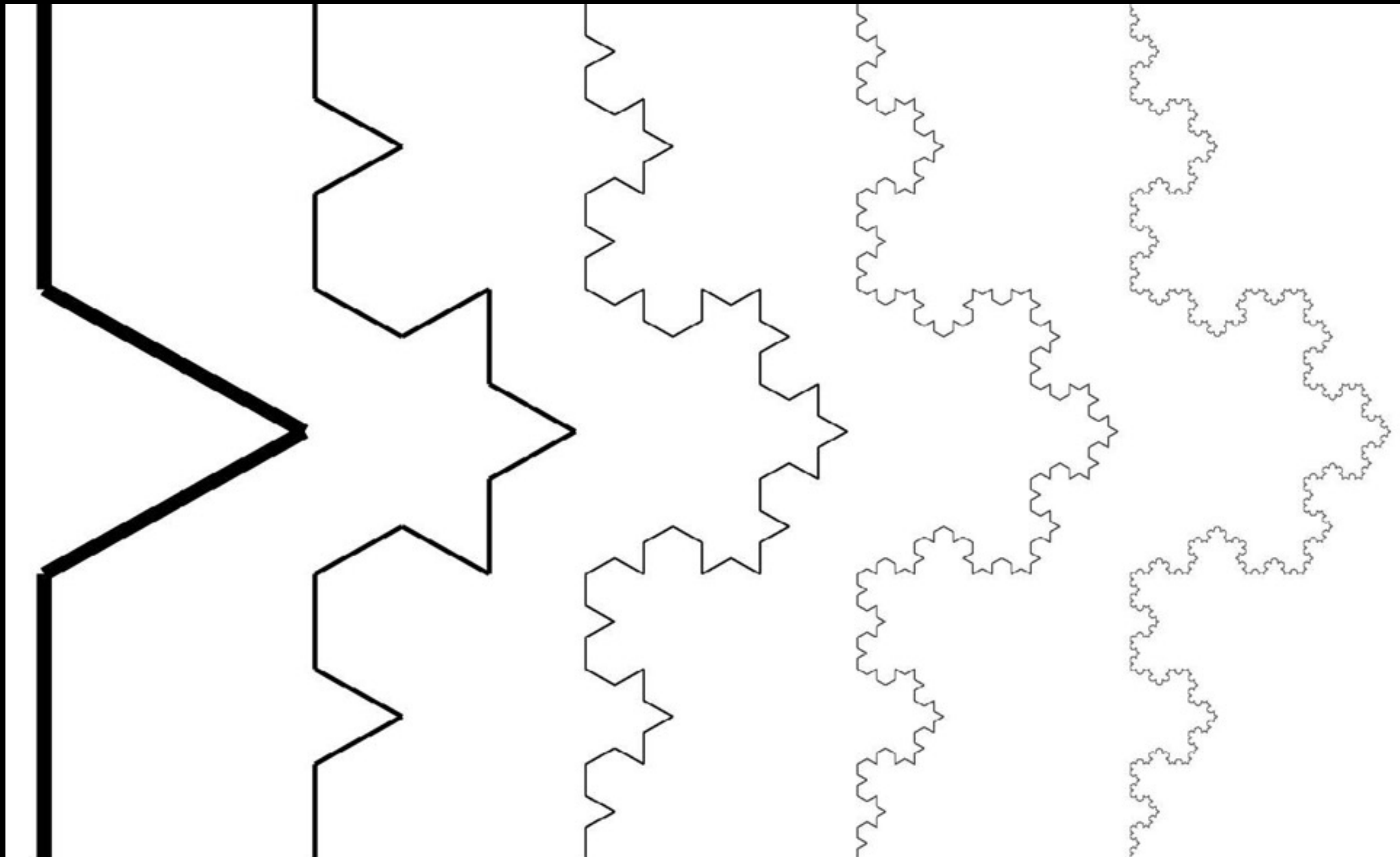
$3 \times 3 \times 3$ or
 3×9 or
 $3^3 = 27$

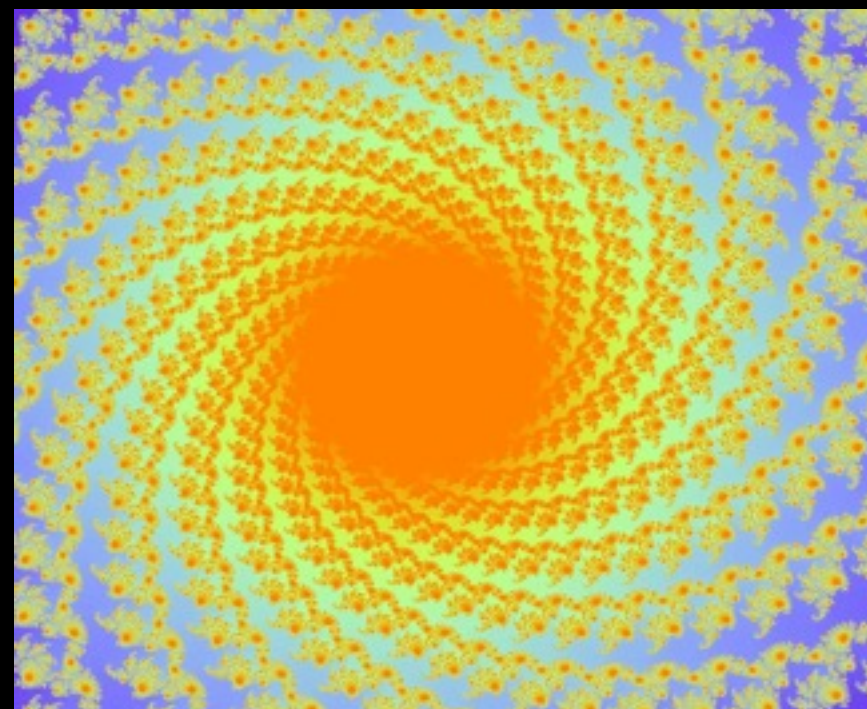
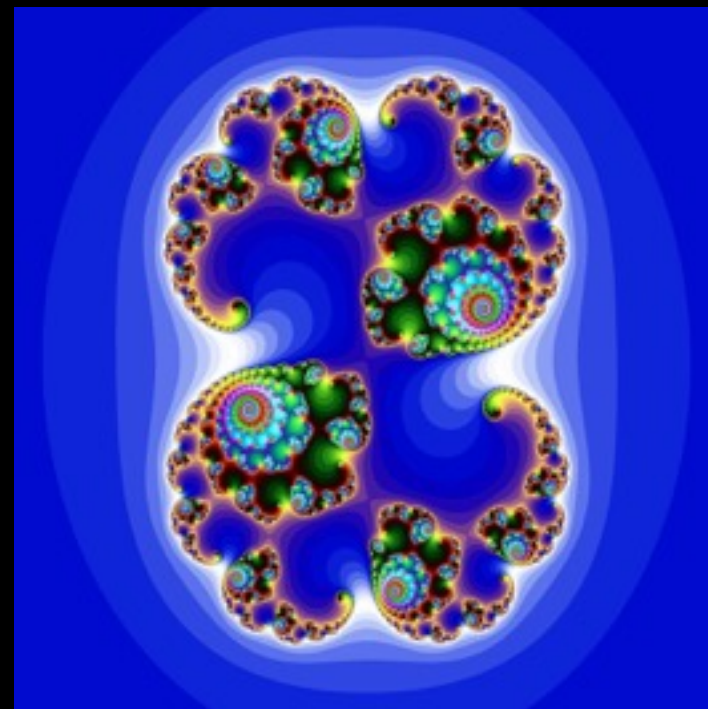
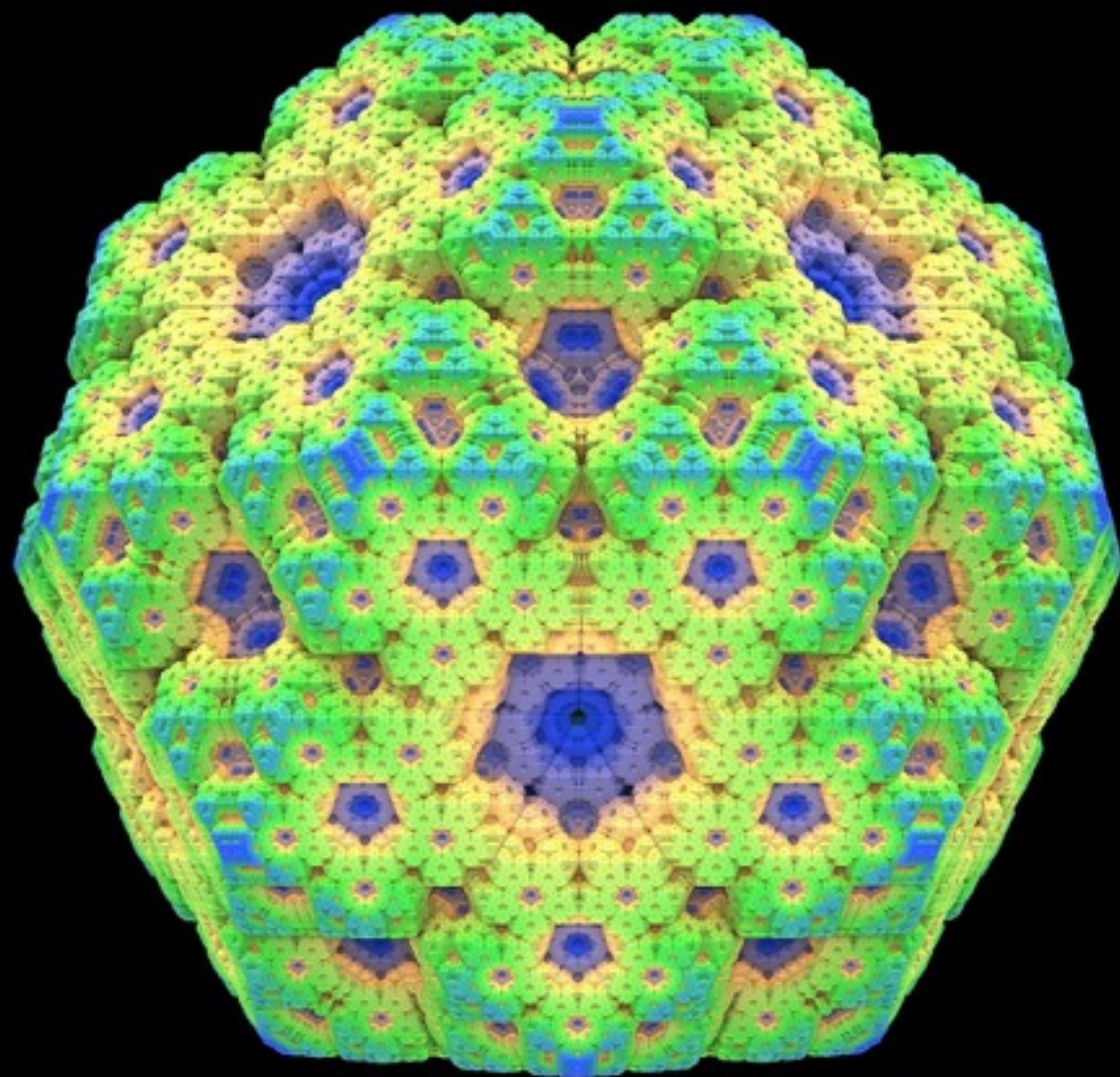
$3 \times 3 \times 3 \times 3$ or
 3×27 or
 $3^4 = 81$





$3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ or
 $3^7 = 2187$



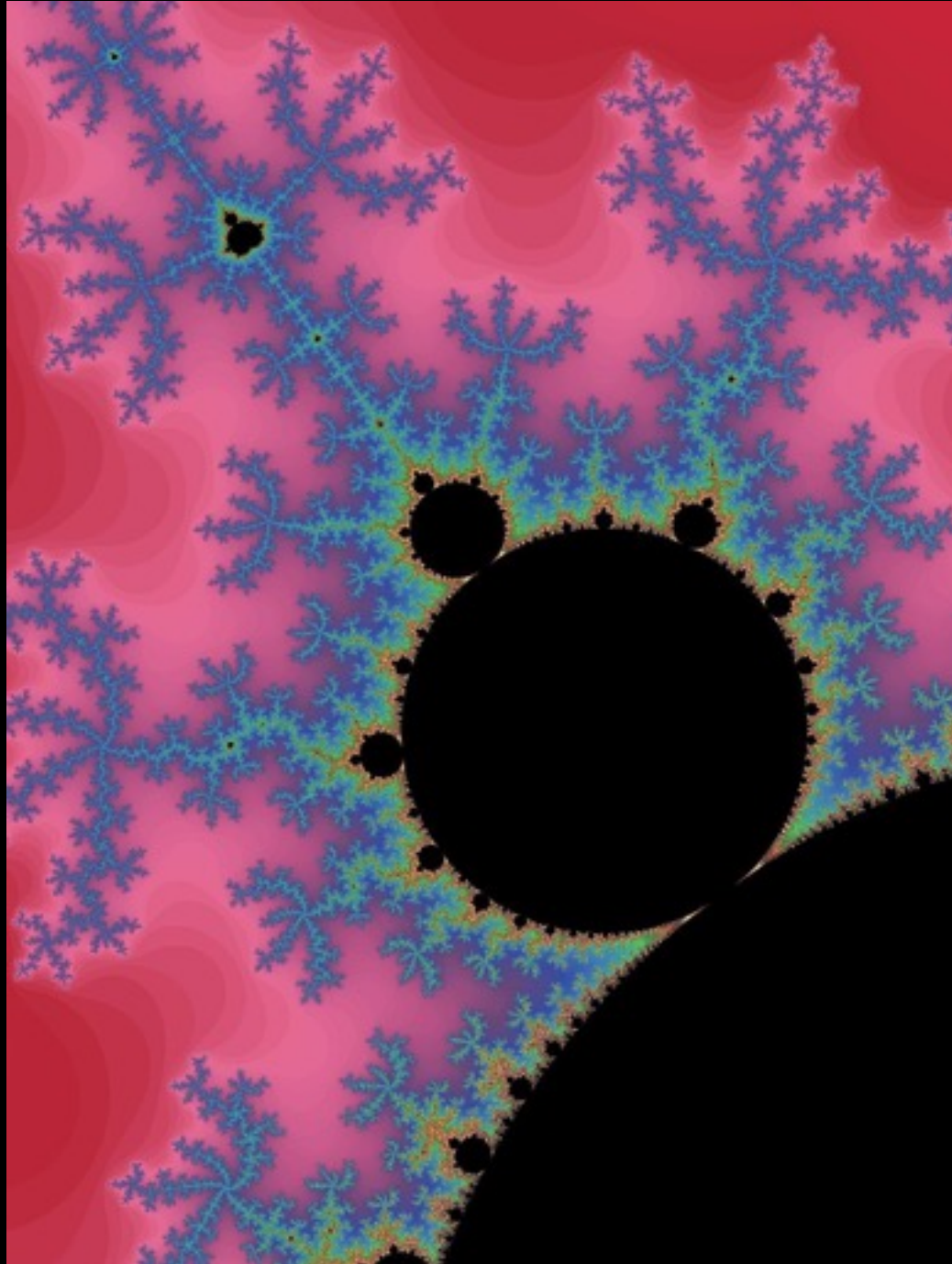


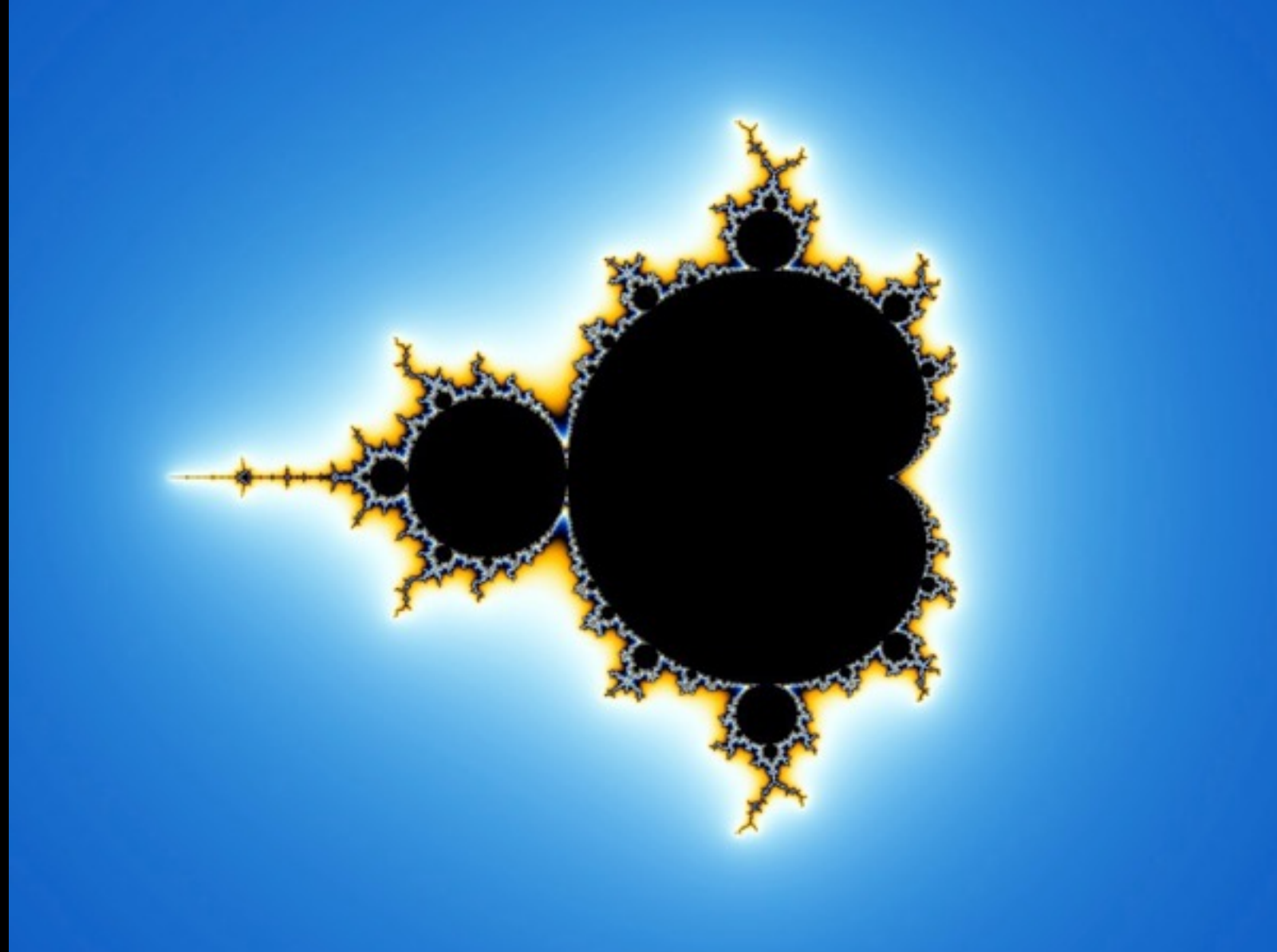
Algebraic Fractals

Mandelbrot Set

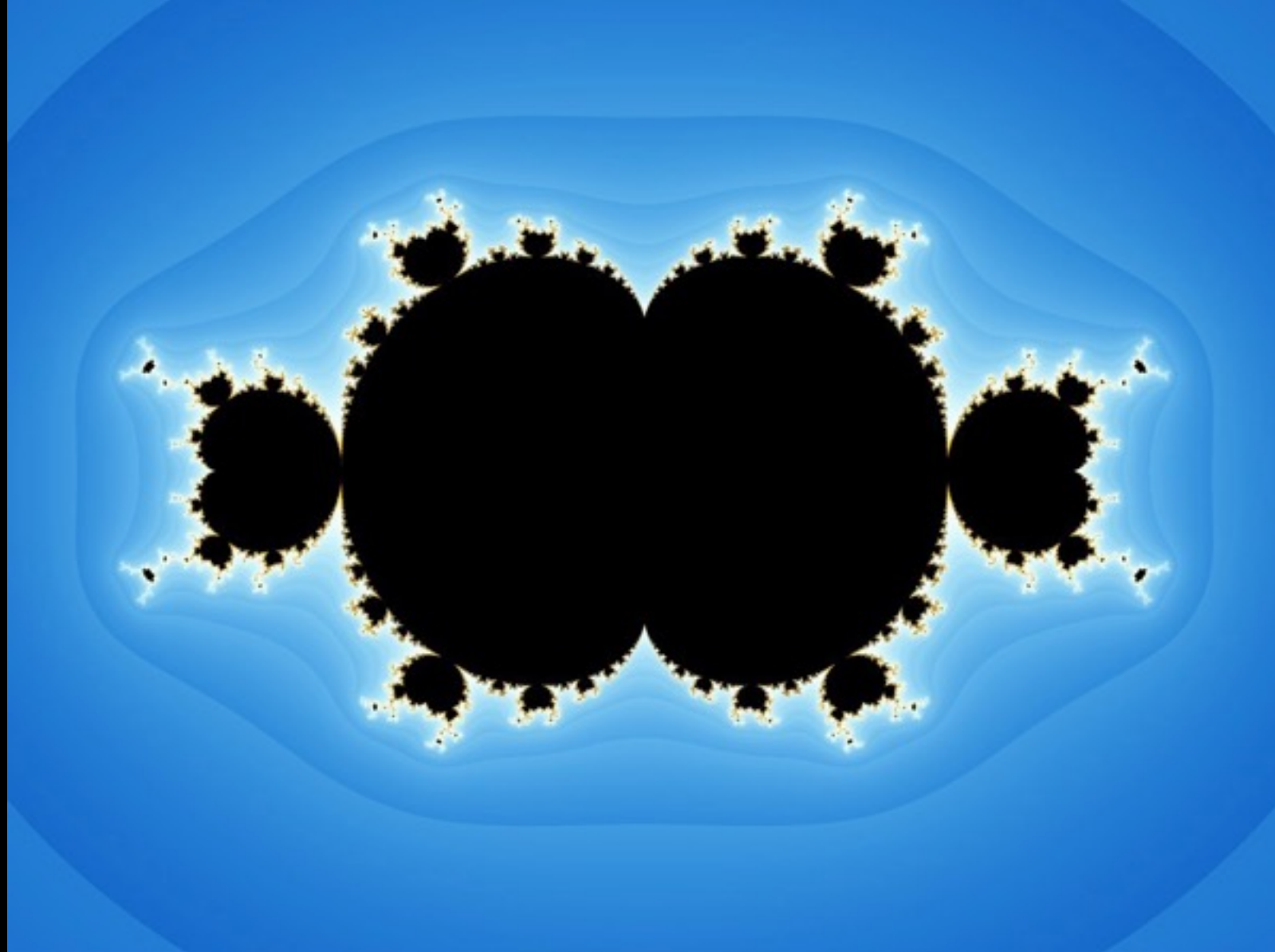
Named after
mathematician
Benoit Mandelbrot

Coined the word
'Fractal' in 1975

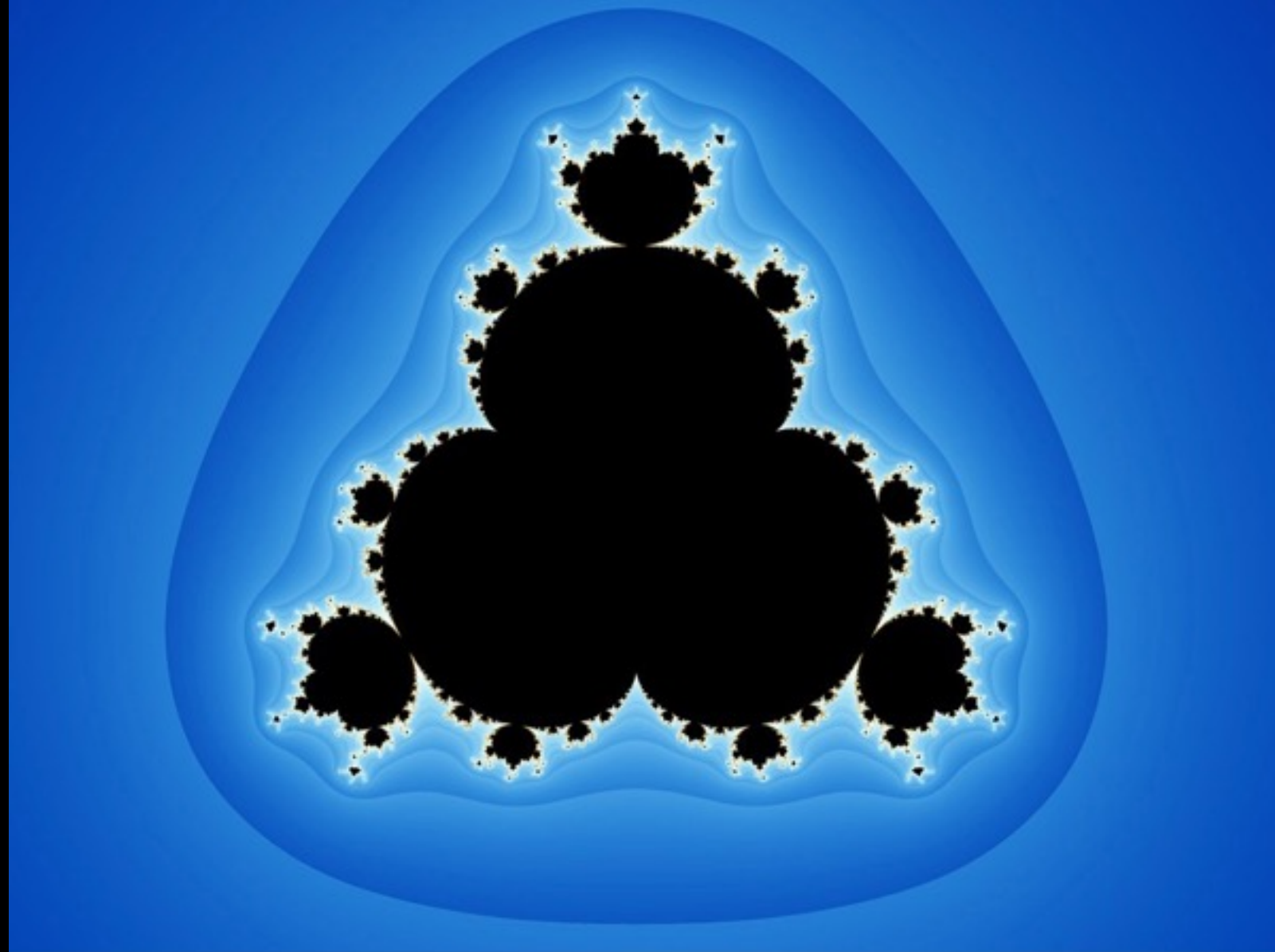




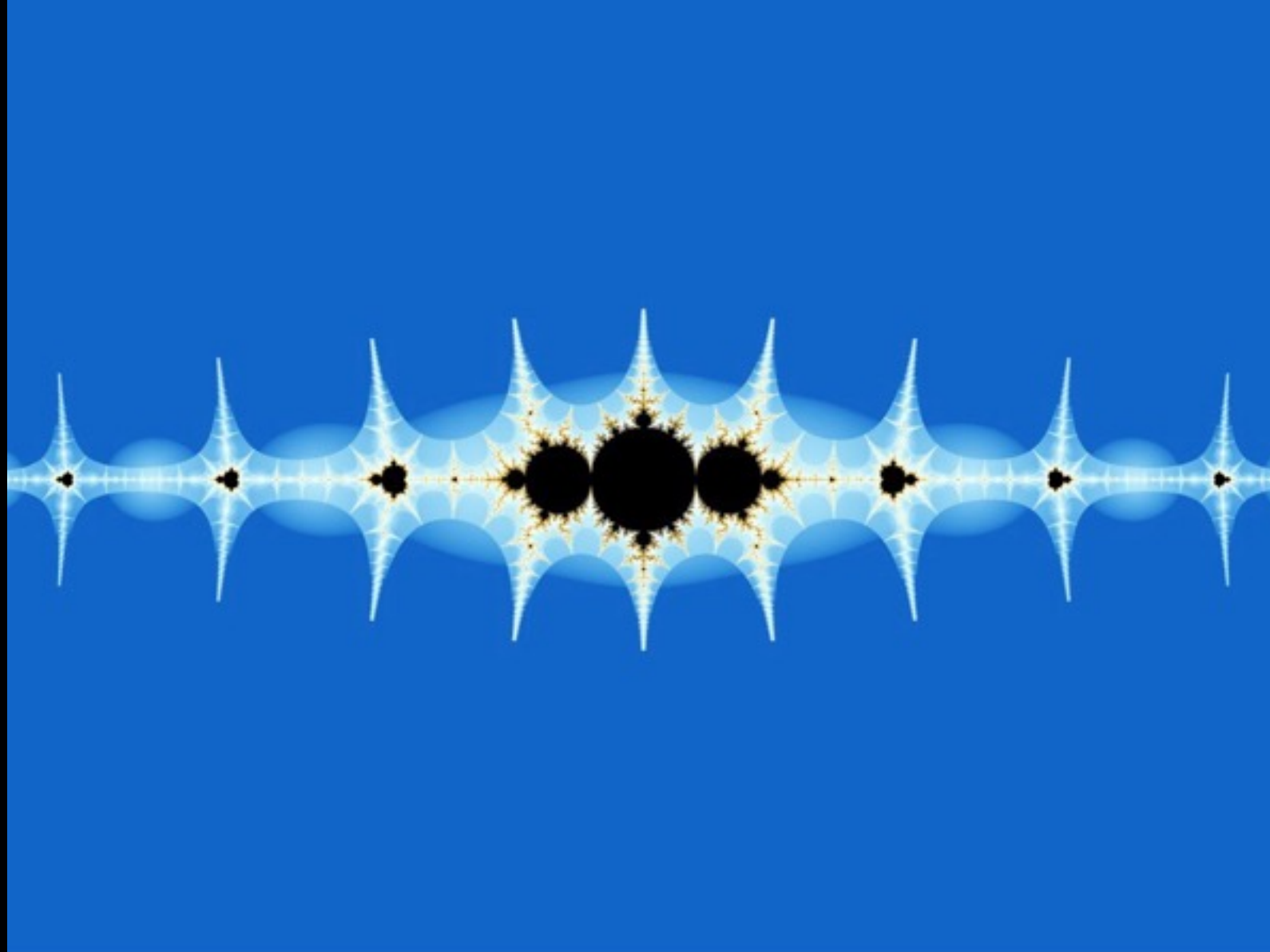
$$Z_{\text{NEW}} = Z_{\text{OLD}}^2 + C$$
A diagram illustrating the iterative mapping of the Mandelbrot set equation. It features two white curved arrows on a black background. One arrow starts from the 'Z' in 'Z_OLD' and points to the 'Z' in 'Z_NEW'. The other arrow starts from the 'Z' in 'Z_NEW' and points back to the 'Z' in 'Z_OLD', forming a cycle that represents the iterative nature of the calculation.



$$Z_{\text{NEW}} = Z_{\text{OLD}}^3 + C$$
The equation $Z_{\text{NEW}} = Z_{\text{OLD}}^3 + C$ is displayed in white text on a black background. The number 3 in the exponent is highlighted in yellow. Two curved white arrows are drawn around the equation: one starts from the Z_{NEW} term and points back to the Z_{OLD} term, and the other starts from the C term and points back to the Z_{OLD} term, indicating a feedback loop in an iterative process.

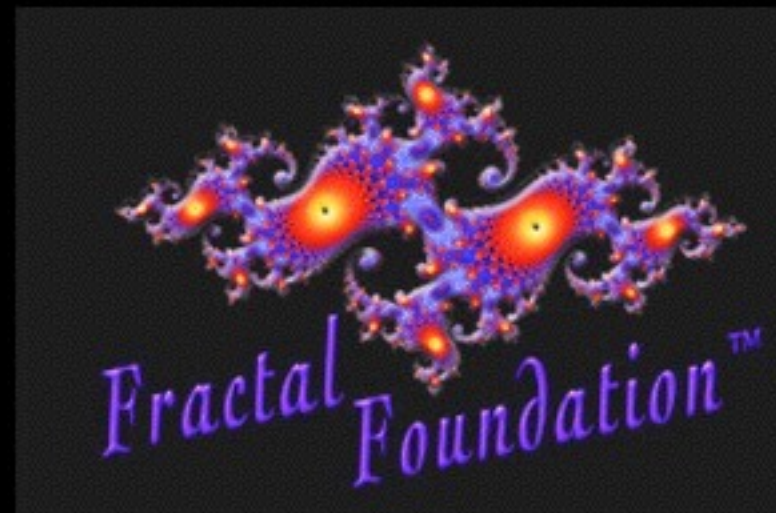


$$Z_{\text{NEW}} = Z_{\text{OLD}}^4 + C$$
A diagram illustrating a feedback loop. Two white curved arrows connect the variables Z_{NEW} and Z_{OLD} . One arrow points from Z_{NEW} to Z_{OLD} , and the other points from Z_{OLD} back to Z_{NEW} , forming a continuous cycle.



$$Z_{\text{NEW}} = \sin(Z_{\text{OLD}}) + C$$
A diagram showing a feedback loop between Z_{NEW} and Z_{OLD} . Two curved arrows form a cycle: one arrow points from Z_{OLD} to Z_{NEW} , and the other points from Z_{NEW} back to Z_{OLD} .

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