
I lucidi di Mandelbrot


Benoit Mandelbrot

# FRACTALS, PURE MATHEMATICS, NATURAL SCIENCES, CULTURE AND TEACHING

Scale invariance = fractality

# FIRST OBSERVATION:

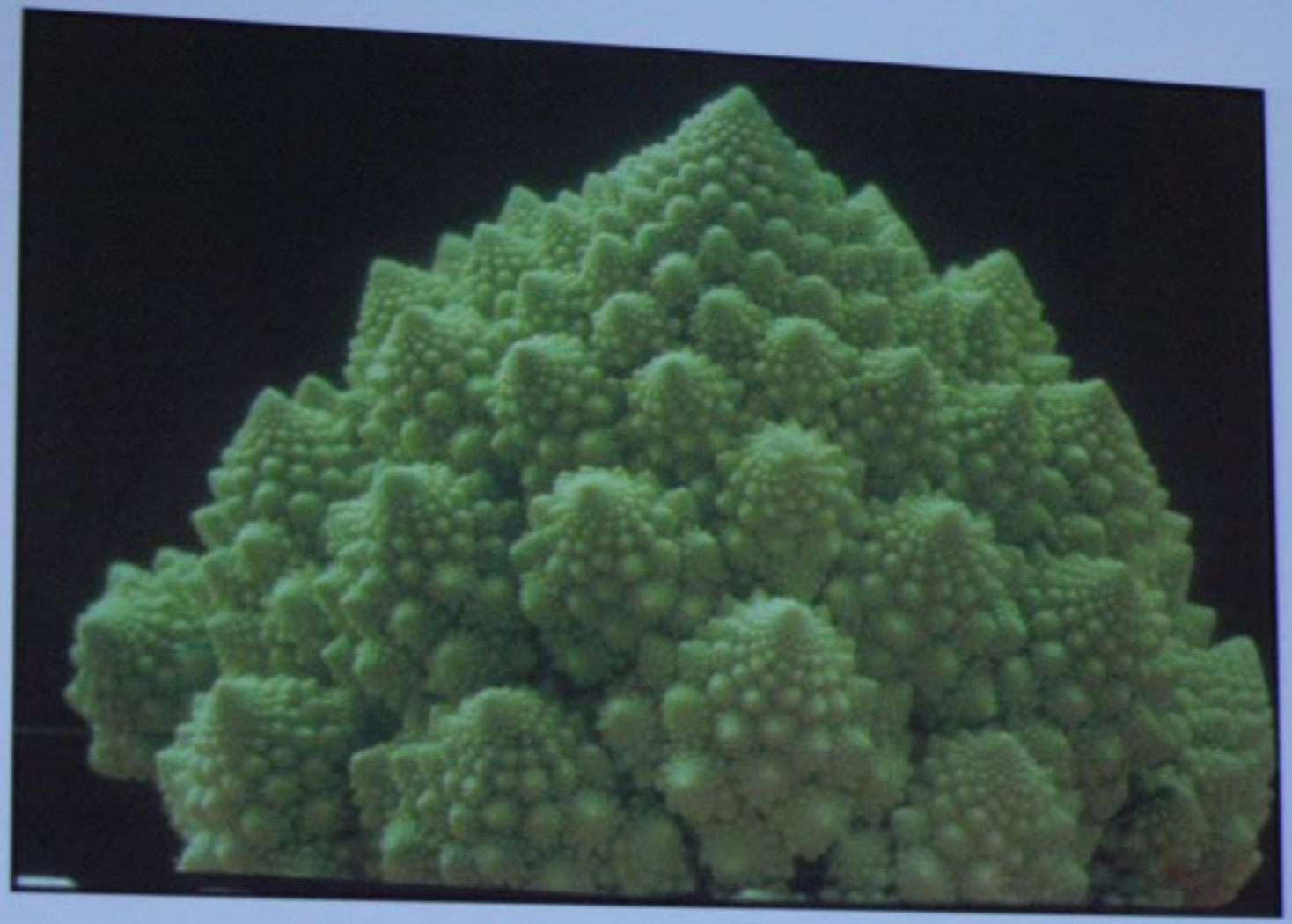
Scale invariance is common in nature

This has long been known but could not be measured and could not be taken account of

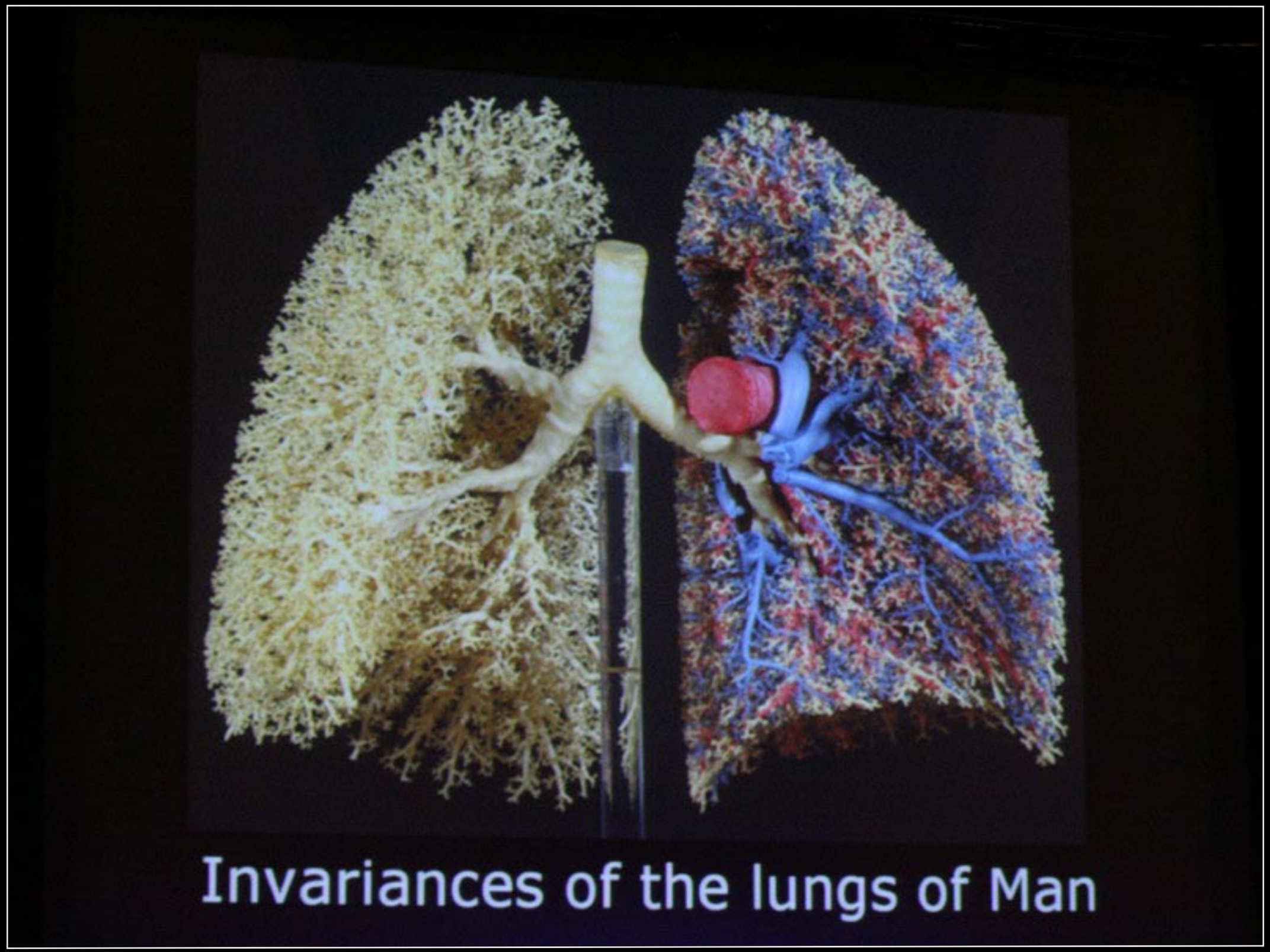
Tests of the roughness of surfaces:

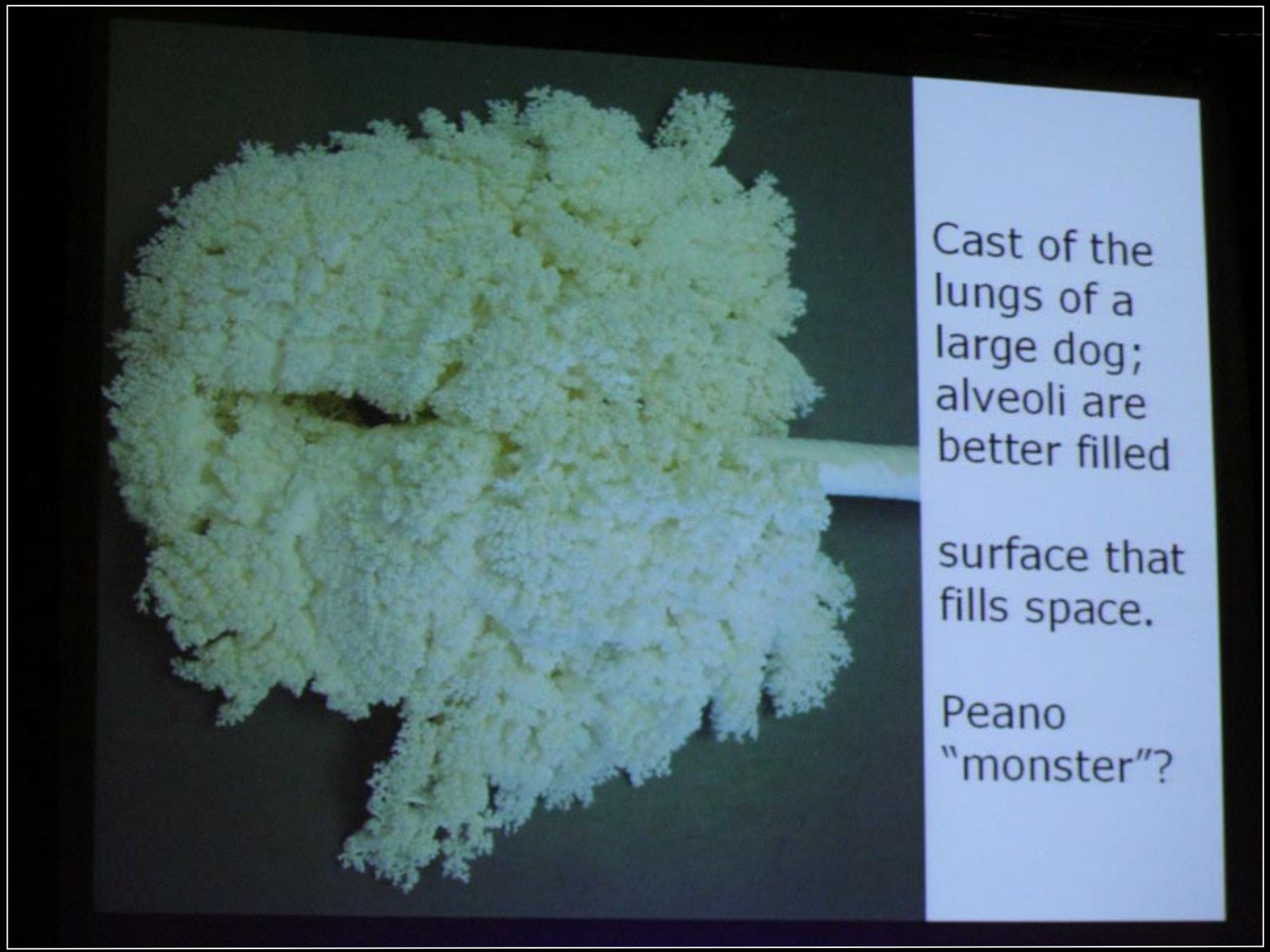
# PROGRAM FOR A "RUGOMETRY"

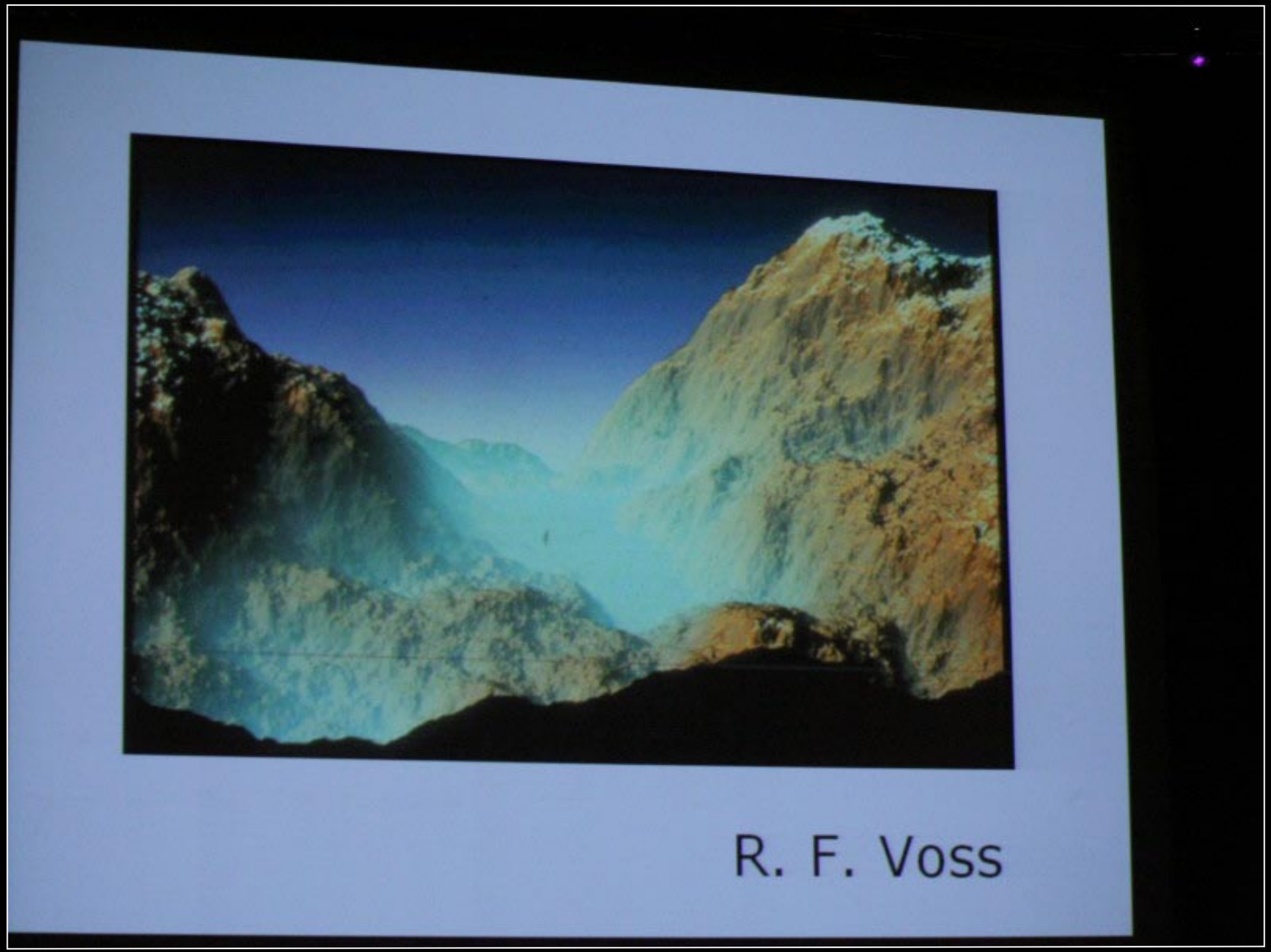
1. Identify cases of scale invariant roughness
2. Identify or invent suitable tools
   - 3.1 Explain roughness
   - 3.2 Learn how to avoid or minimize it
   - 3.3 Learn how to take advantage of it



Cauliflower romanesco: its invariances


Invariances of the lungs of Man


Cast of the lungs of a large dog; alveoli are better filled
surface that fills space.
Peano "monster"?



R. F. Voss

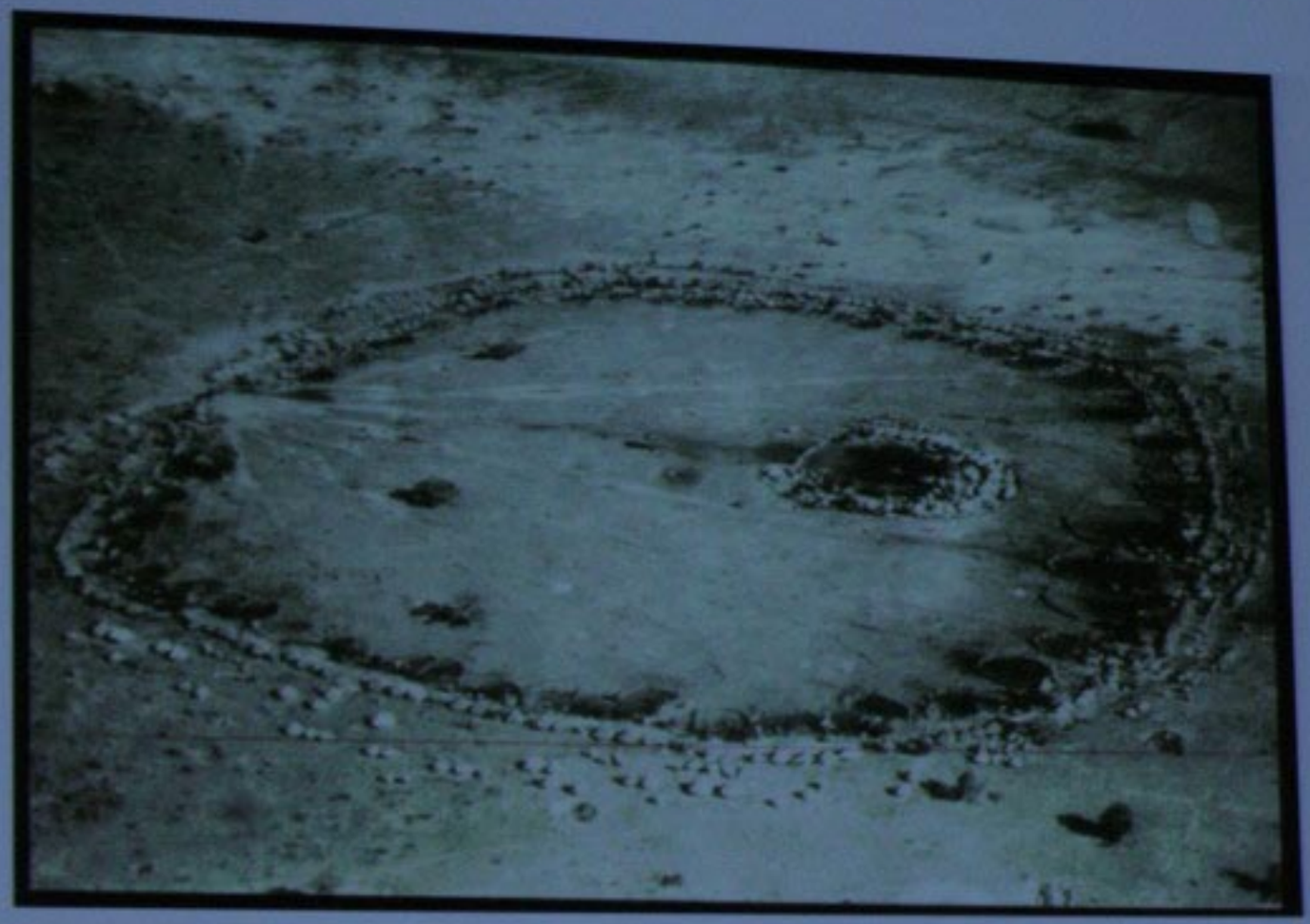
## Language of Nature

Philosophy is written in this grand book – I mean universe – which stands continuously open to our gaze, but it cannot be understood unless one first learns to comprehend the language in which it is written. It is written in the language of mathematics, and its characters are triangles, circles and other geometrical figures, without which it is humanly impossible to understand a single word of it; without these, one is wandering about in a dark labyrinth.

Galileo Galilei, *Il Saggiatore (1623)*

# SECOND OBSERVATION:

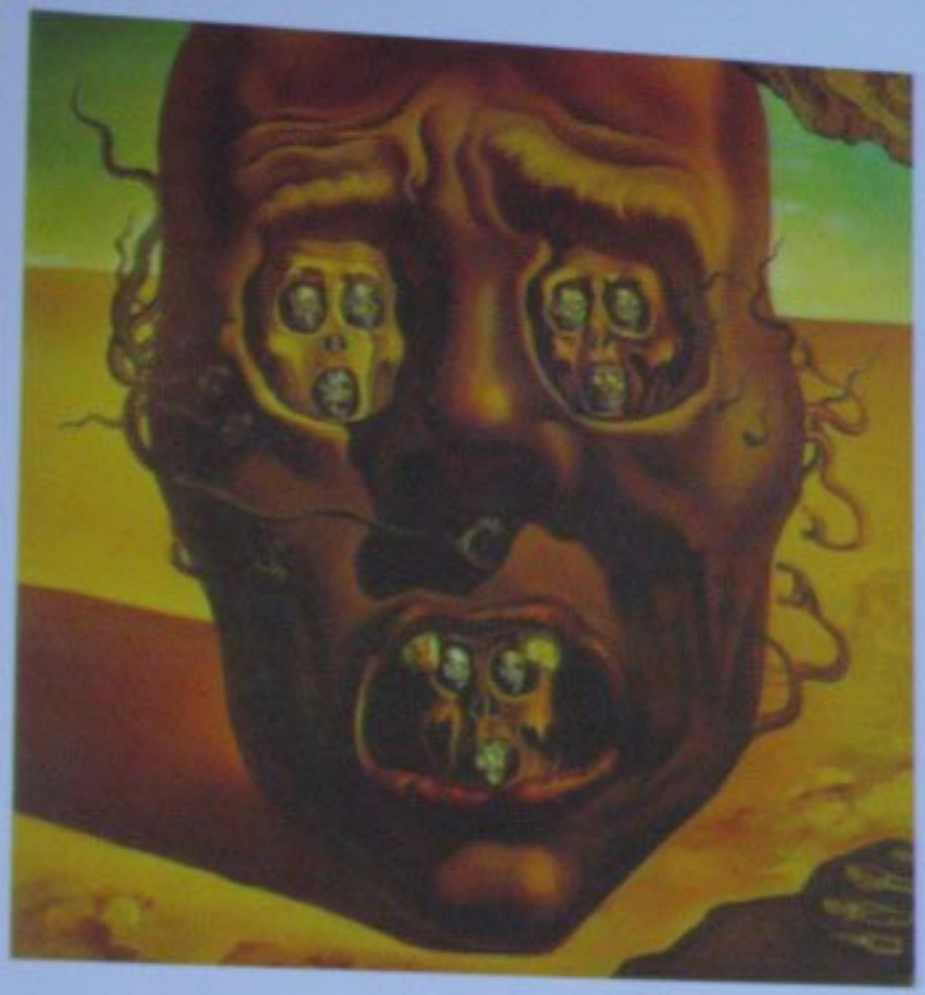
- Since time immemorial, scale invariance has been part of culture
- Here are a few examples:



African village

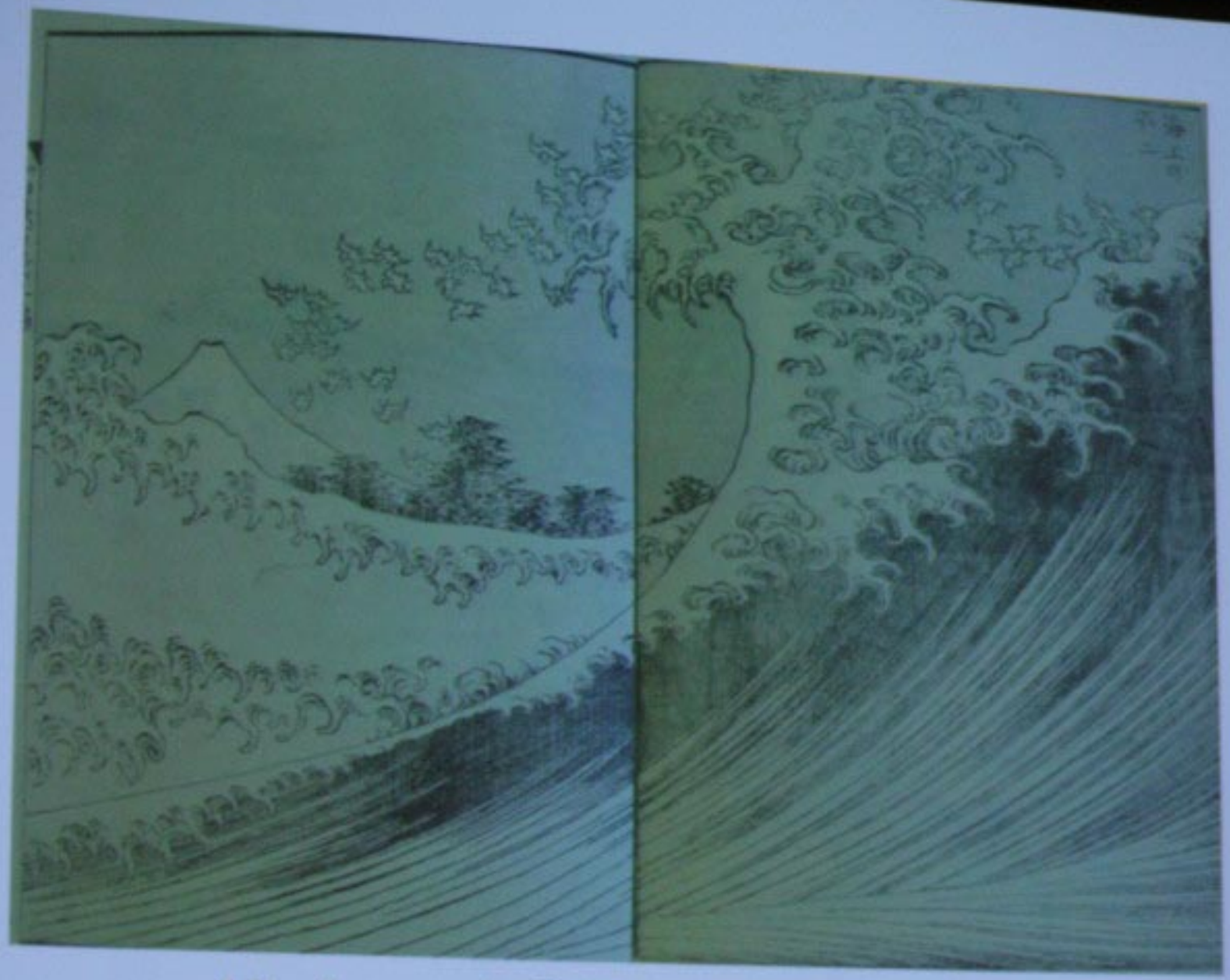
sketch

painting



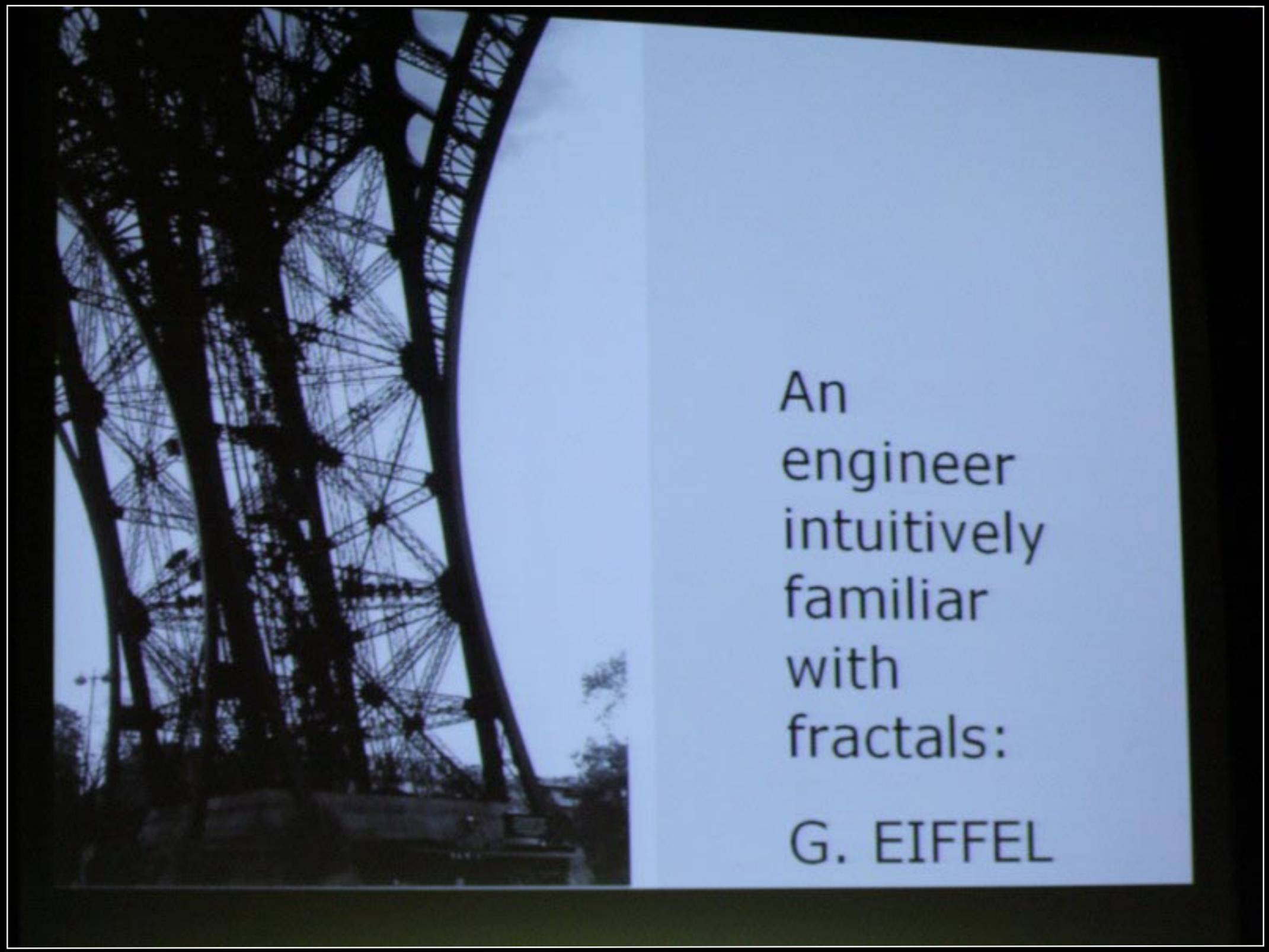
SALVADOR DALÍ

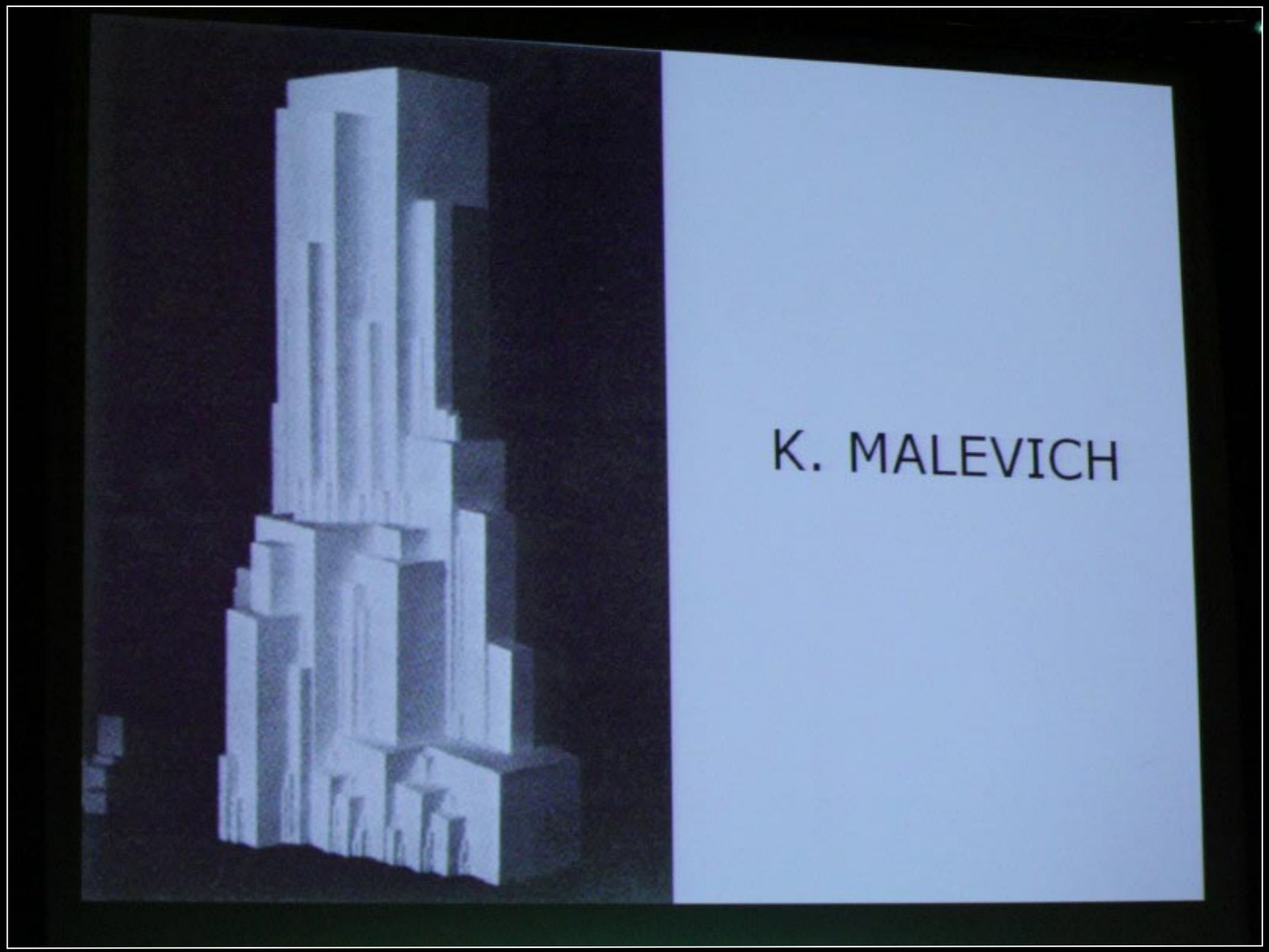
W. SIERPIŃSKI

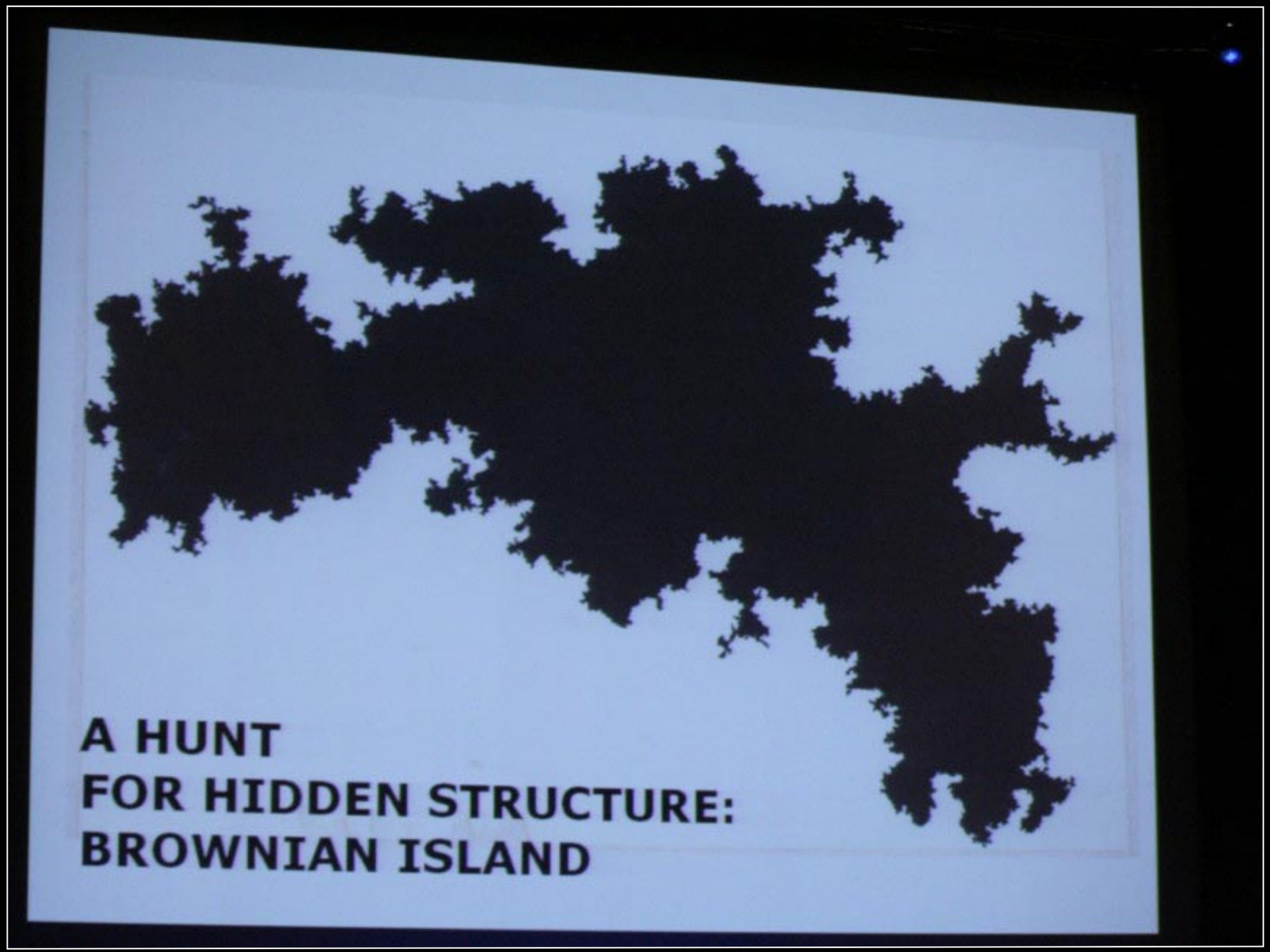


Katsushika HOKUSAI

K. HOKUSAI


An
engineer
intuitively
familiar
with
fractals:
G. EIFFEL


K. MALEVICH


A HUNT
FOR HIDDEN STRUCTURE:
BROWNIAN ISLAND

# "COMPUTER RENDERING" THAT BRINGS NEW IDEAS

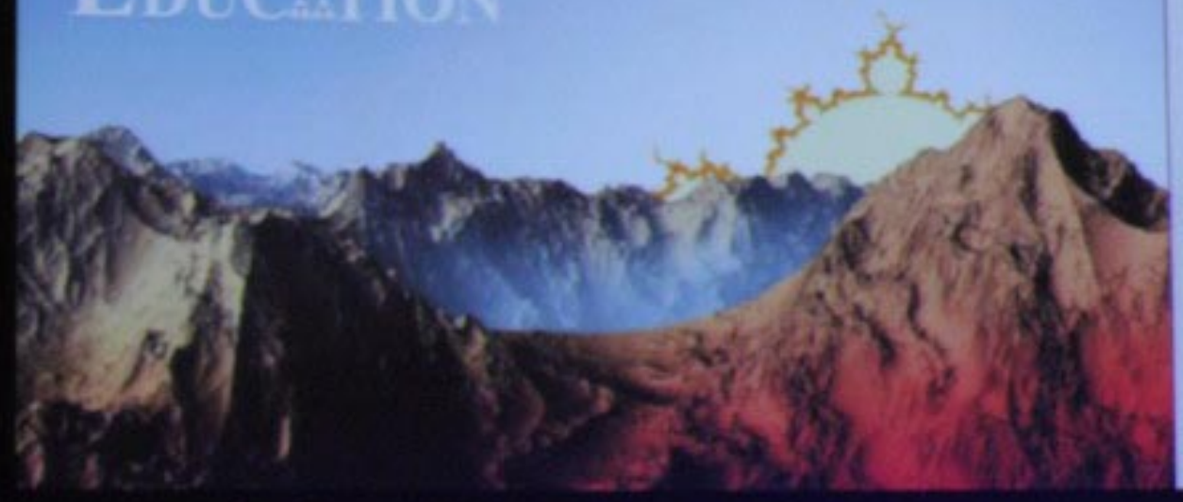
Source: *The Fractal Geometry of Nature* (1982)

CONJECTURE (p. 243 de *F.G.N.):* "The Hausdorff-Besicovitch dimension of the Brownian island is 4/3"

- Triggered great mathematical activity
- "Almost proved" by B. Duplantier
- Proved by G. Lawler, O. Schramm, and W. Werner
- Simpler proofs would be desirable

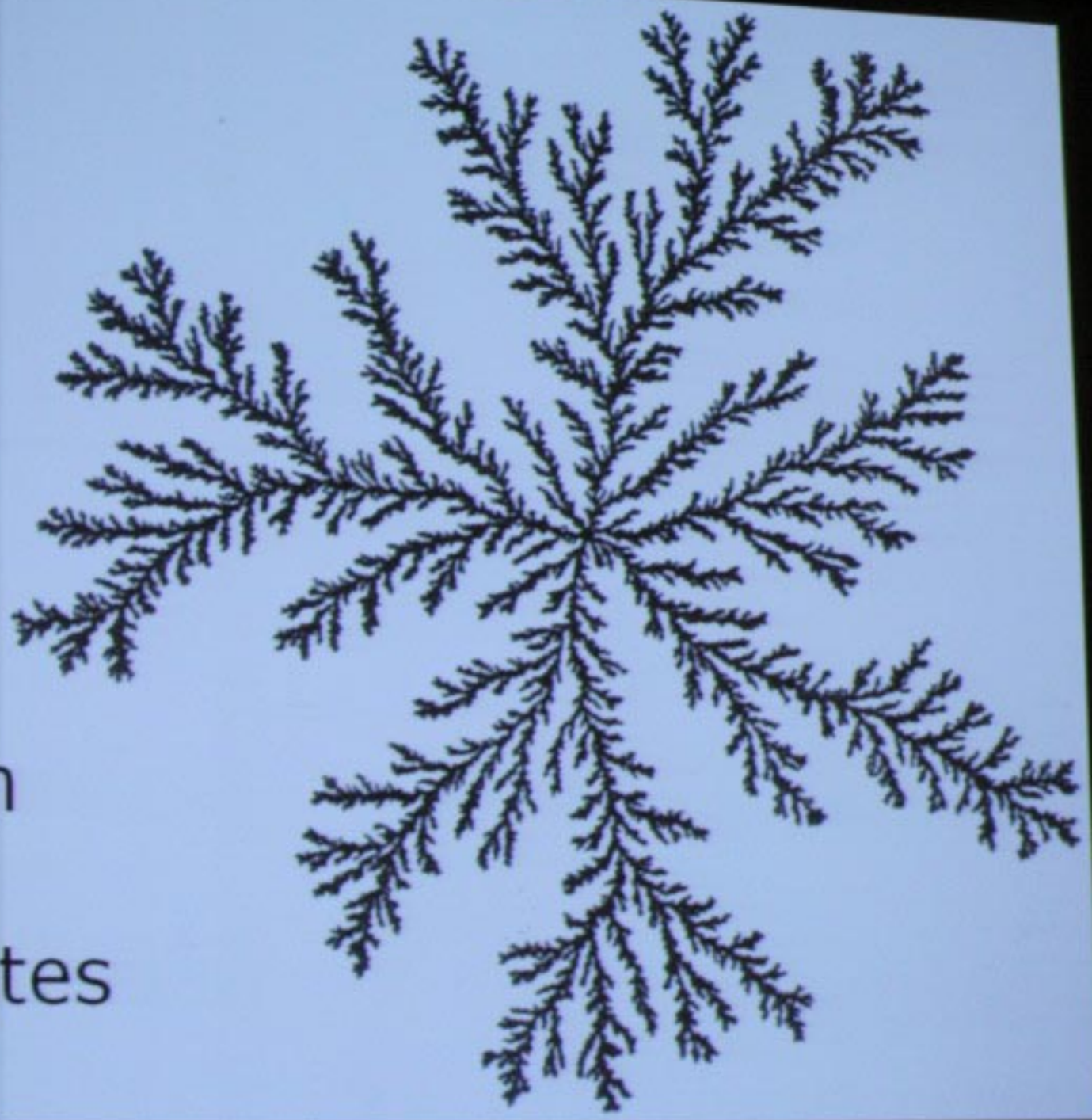
M. L. Frame &
B. B. Mandelbrot

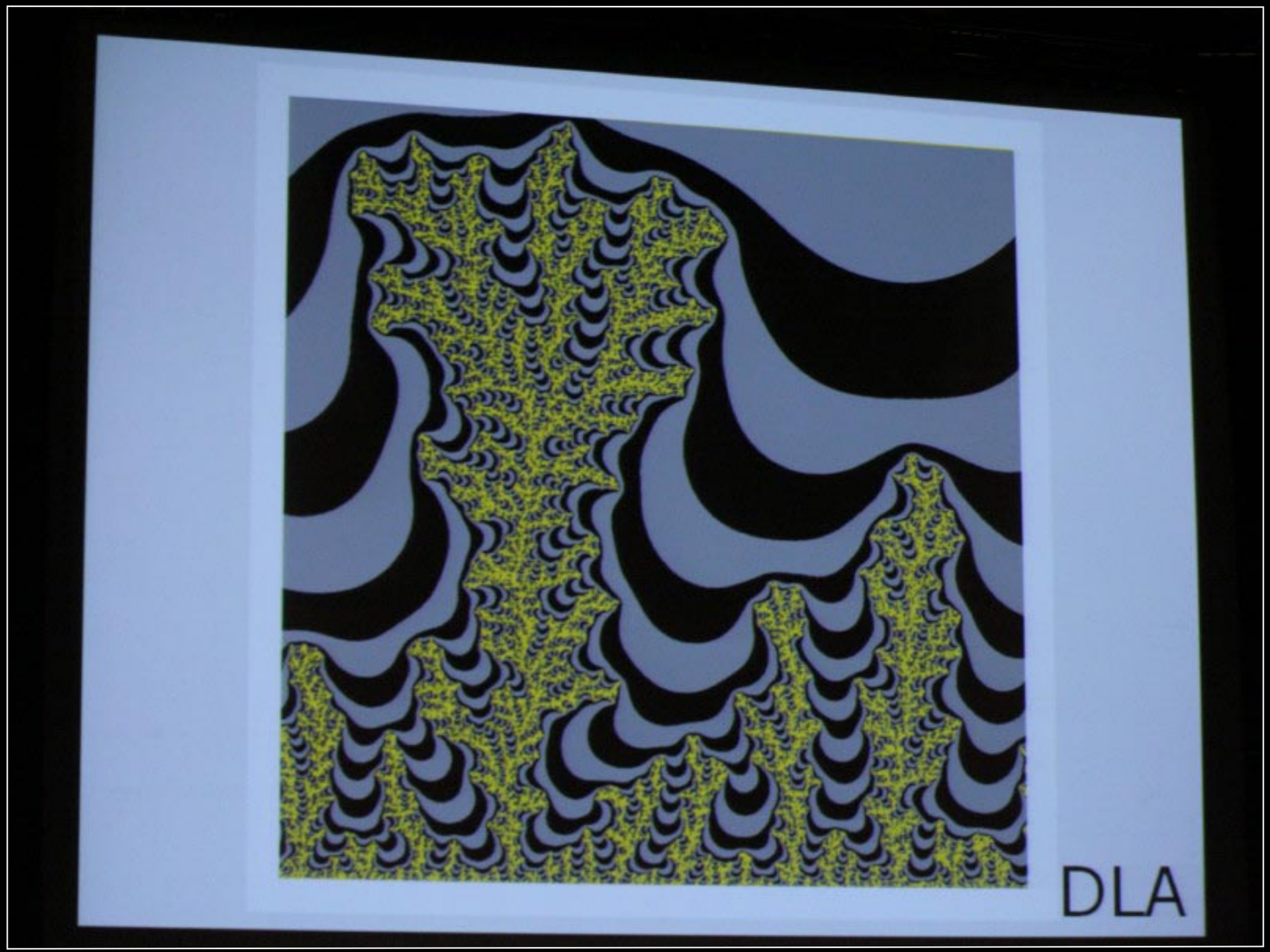
**FRACTALS, GRAPHICS, & MATHEMATICS EDUCATION**

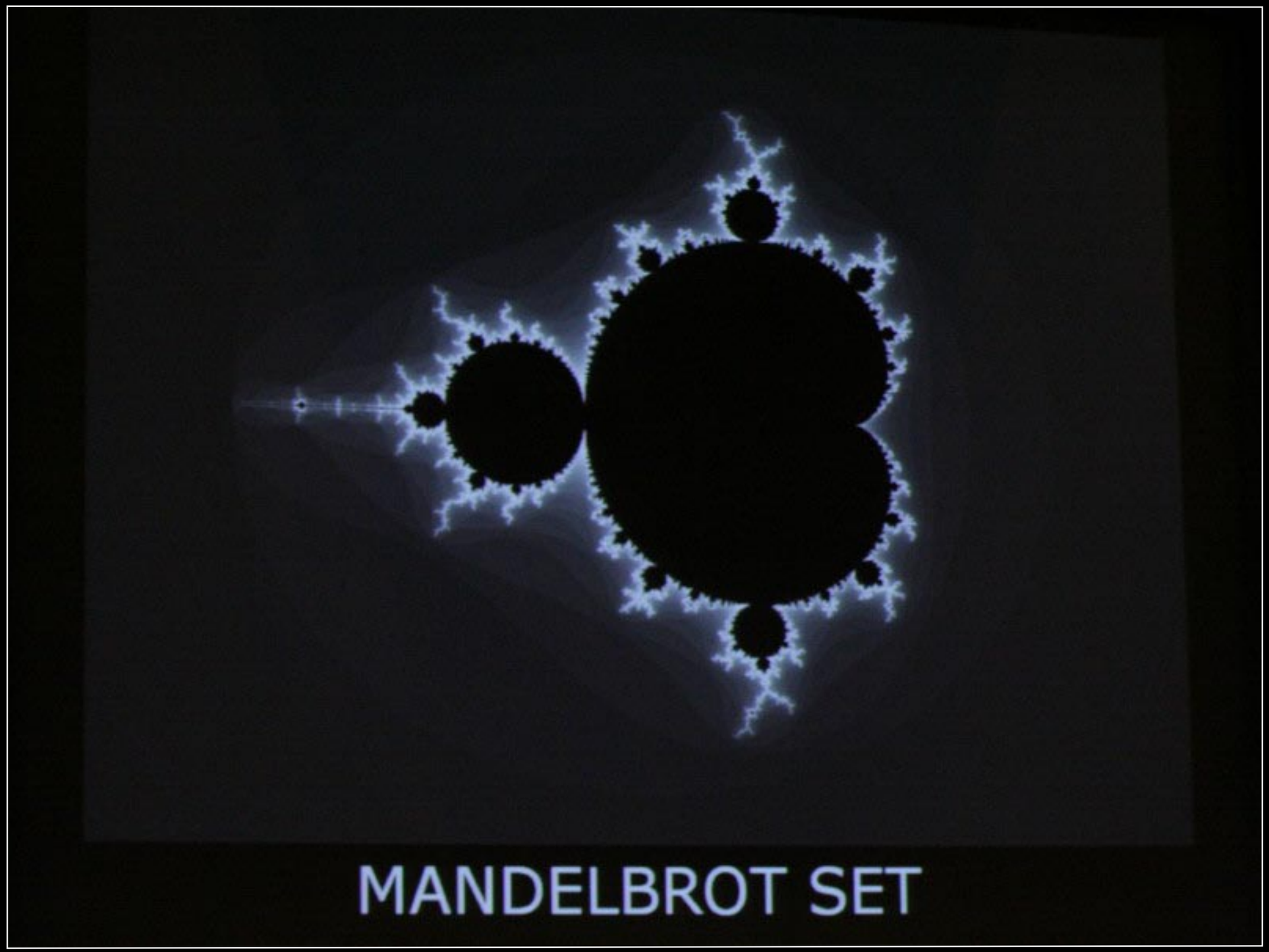


OPENING TOWARDS BROAD PUBLIC AND STUDENTS

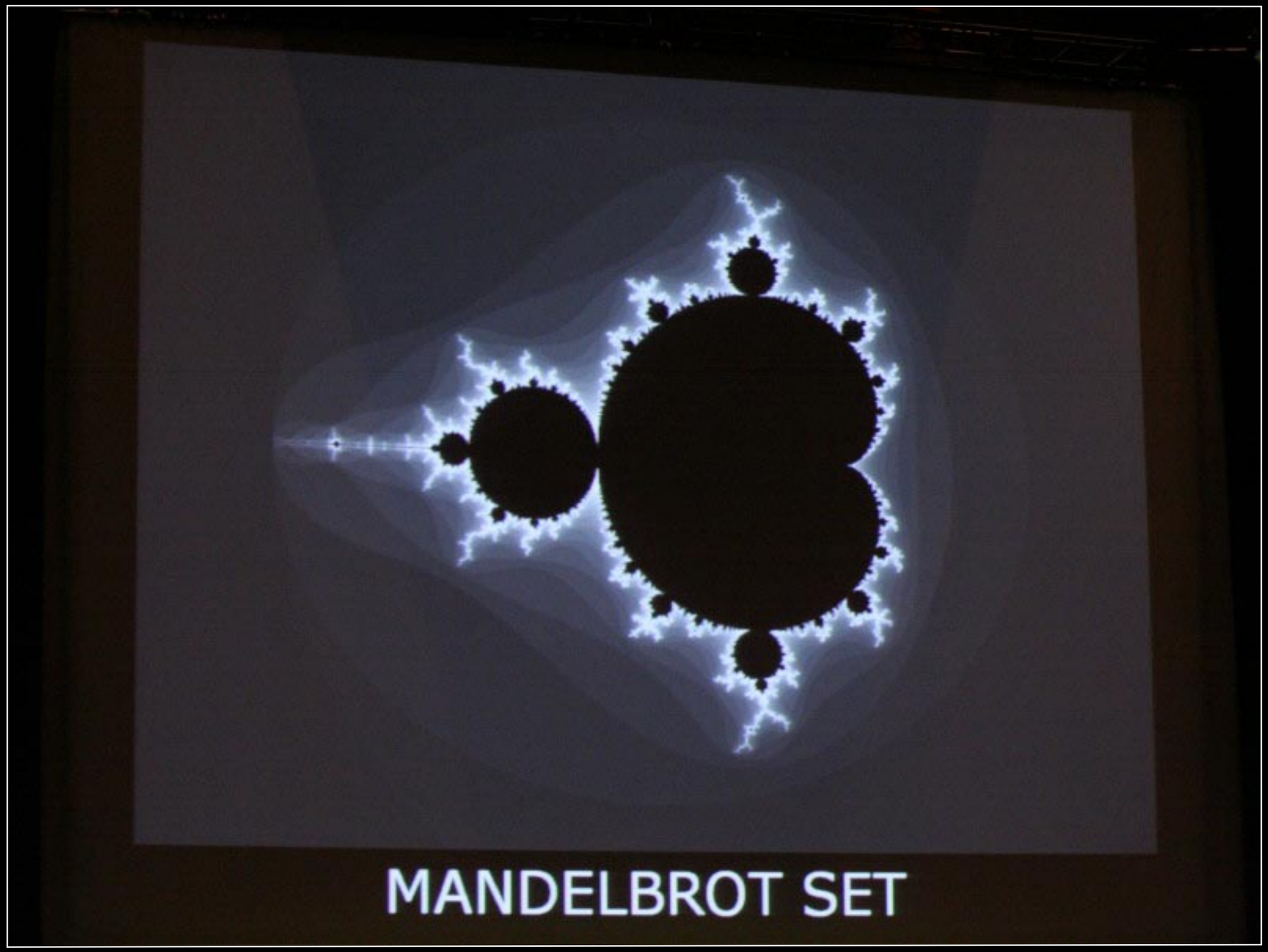
DLA:
Diffusion
limited
aggregates




DLA

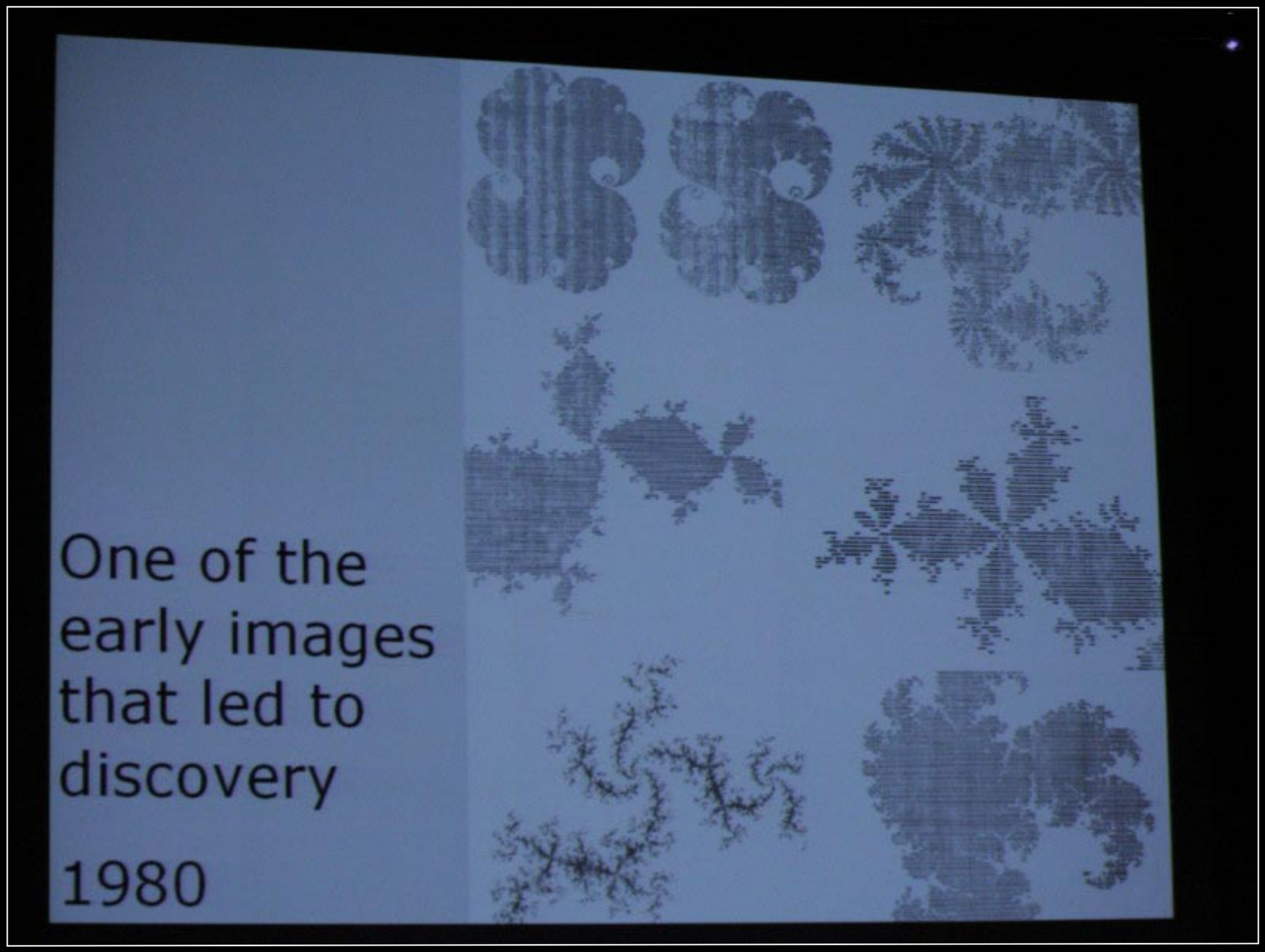


MANDELBROT SET


MANDELBROT SET

Fragment.

The MLC conjecture remains open


One of the
early images
that led to
discovery
1980

An older image, too complex for discovery

1979