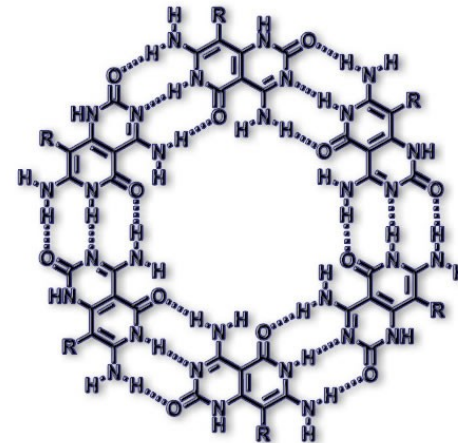


Rhythm and Self-Organization
By Eric Barnhill MM, GCFP, License J-D
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The University of Edinburgh

Self-Organizing Systems

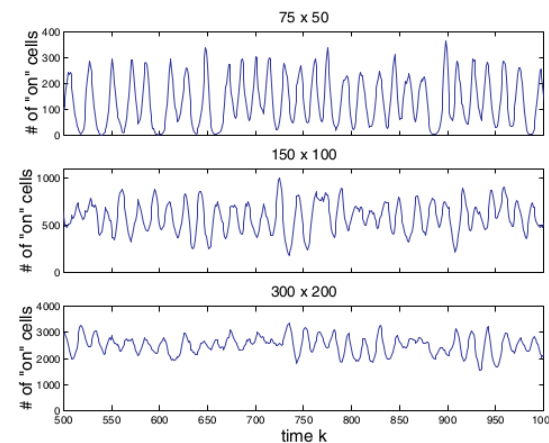
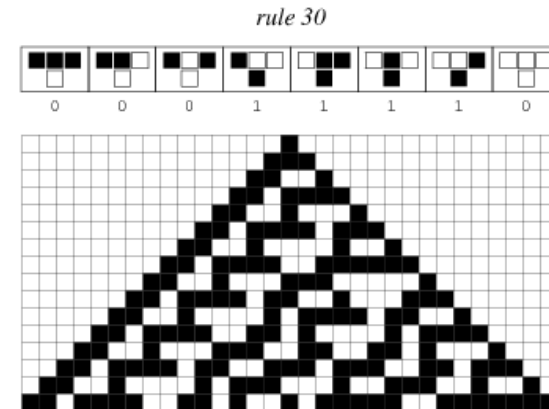
- Systems with fixed energy (closed systems) tend toward stasis and disorganization (law of entropy)
- Systems inside an energy stream (open systems), organized structures dissipate energy more quickly than disorganized structures
- As a result, matter will self-organize within a stream of energy

H-Bond directed self-organization



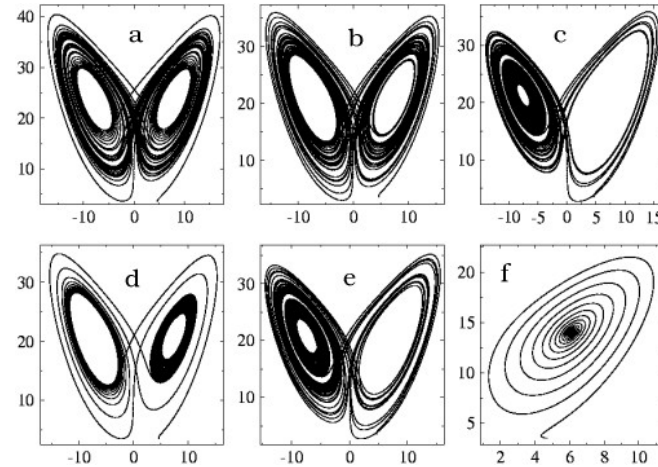
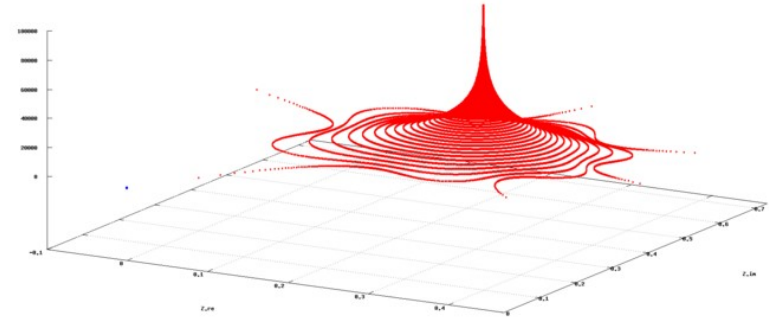
Oscillation: A Property of Self-Organization

- A dynamic system can maintain its identity in time through oscillation
- Even cellular automata can organize into patterns that oscillate



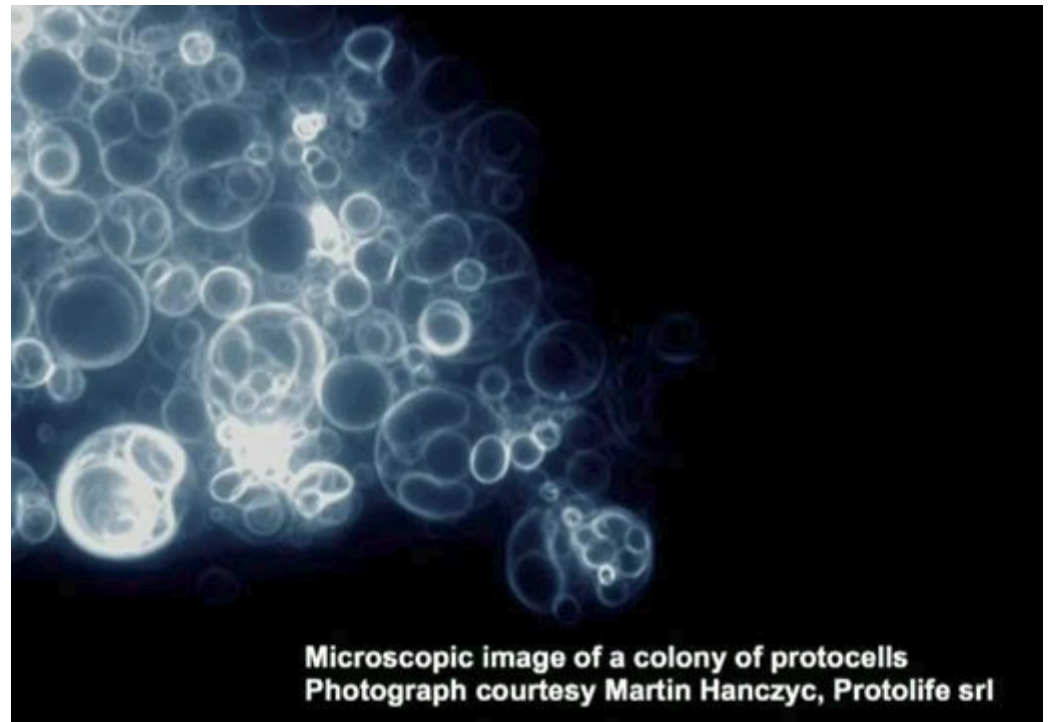
Attractor States: Paths to Dynamic Stability

- An attractor state can stay stable in the face of perturbation or unexpected events
- Most prosperous systems sit on the edge of order and chaos



Life: Self-Sustaining (& Replicating) Oscillations

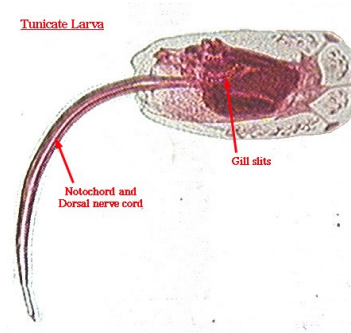
- Given the environment of the “primordial oil slick”, life is now considered highly probable
- Functional cells require boundary and semi-critical energy releasing core



Microscopic image of a colony of protocells
Photograph courtesy Martin Hanczyc, Protolife srl

Multicellular life: need for communication

- Cells are better off together, if they can communicate. Specialised *sense* and *movement* organs need to interact
- While some chemical means of communication are available (e.g. sponges), nature found the most efficient solution by harnessing *electricity*: the neuron
- Adult tunicate consumes its nervous system for food



Simple motor patterns: self-organizing oscillations

- Sea angel: motor system is two interlocked neurons, triggered by ganglion coming from sense organ
- System either oscillates rhythmically (on) or does not move (off). Action potential spike recovery depresses charge enough to release opposite neuron

