Should we tell the truth?

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A mechanical world: what is determined is also previsible (Laplace)

A first challenge : the “butterfly wing effect” (meteorology) unpredictability because of border conditions effects

A logical and algorithmic world: Cells a Turing Machines

Because relationships between physical objects are at the core of life, the study of living organisms stems from symbolic abstraction.

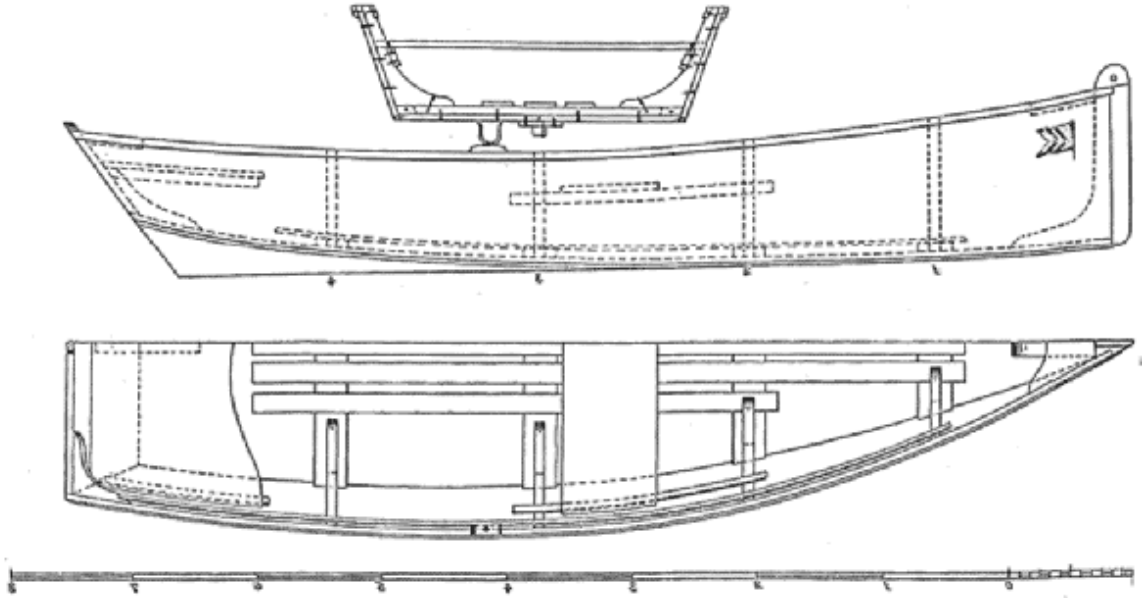
More often than not, the objects that create biological functions have no straightforward and "mechanical" coupling with them, they are only their mediator, their symbol.

The Delphic Boat

At the genome level, it is the relationship the genes have with each other, and with the signals that control them, that gives life to an organism.

- ***Genes do not operate in isolation***
- **Proteins are part of complexes, as are parts in an engine**

➔ **It is important to understand their relationships, as those in the planks which make a boat**



.... And within every cell, something is passed on from generation to generation, transmitting what common sense calls information, by a process which current models of heredity compare to the running of a program, in a sense that is close to the way this word is used in computer sciences.

The underlying logic is different from that in mechanics, except for that part of mechanics that involves “feedback loops”. However, the corresponding situation in logics, “recursivity” has the property to place the output at the input level once the computation of the recursive routine has been performed…

The machine performs the following operations, all easily carried out (the operations performed by computers are the same conceptually speaking, although they are carried out in a more condensed and therefore more complicated fashion):

- **changing a symbol in a finite number of places, after reading the symbols found there (note that changing more than one symbol at a time can be reduced to a finite number of successive basic changes).**
- **changing from the point which is being read to other points, at a given maximum distance away in the message**
- **changing the state of the machine**

All this can be summarized a *Turing machine*. It can be specified by a finite set of 'quintuples', each of which has one of three possible forms:

$$p\alpha\beta Lq \text{ or } p\alpha\beta Rq \text{ or } p\alpha\beta Nq$$

A quintuple indicates that the machine is in configuration *p*, where it reads the symbol α, and replaces it by β, before changing to the configuration *q*, moving to the left (*L*), to the right (*R*), or not moving (*N*).

In a Turing machine the machine is separated from the data, and the program

Data and program play the same role (*i.e.* they can be thought of as ‘declarations’)

The question therefore is to ask whether the « alphabetic metaphore » holds for living organisms. Is there the equivalent of the programme, and is it separated from the machine ?

Genetic engineering
Viruses
Horizontal gene transfer
Cloning animal cells

all point to separation between

Machine
Data
Programme

In brief, one can consider cells as Turing machines. This creates a paradox, however, as noticed by John von Neumann in the early sixties: a Turing machine does not make Turing machines. How is this paradox resolved? Where is the operating system, and what does the machine read?

What functions for Life ?

*3D organism filling (skeleton)

*Reproduction

*Respiration

*Locomotion

*Perception

*Circulation (internal fluxes, external fluxes)

*Digestion

*Assimilation

*Accomodation (regulation)

*Maintenance (repair)

Conclusion 1

Life leads to two properties that are not shared with usual physico-chemical systems:

Delocalized amplification

Unpredictability of future behaviour

The Game of Life

Living organisms must interact (creating a second self is the first interaction)

Three major interactions exist:

- **Indifference**
- **Cooperation**
- **Competition**

Evolution led to an infinite variety of behaviours:

- **commensalism**
- **parasitism**
- **symbiosis**
- **virulence**

The last stage, virulence, exists in a variety of degrees. In general however it tends to be attenuated over time, leading to milder and milder forms which can result in simple commensalism or in the mutual benefits of symbiosis.

All this is related to a hosting – hosted relationship which is highly specific.

A main cause of return to virulence is host change
Hence "live" contact with similar organisms is potentially very dangerous (cf orgin of AIDS in "bush meat" butchery); also, experiments such as xenotransplantation will lead to catastrophies.
A second cause is willful design… and this is why bioterrorism is so frightening.

A moral conclusion

One should avoid to spread knowledge when it may lead to warfare. We should promote epidemiological studies about pathogenicity induced by human practices (such as butchery) while understanding that the most dangerous organisms are those that are nearest to us (this means that plant GMOs would be much less dangerous, if dangerous at all, than animal GMOs, that practices using virus parts, such as in “gene therapy” are potentially very dangerous, etc…). This means that we have to go against current beliefs…