

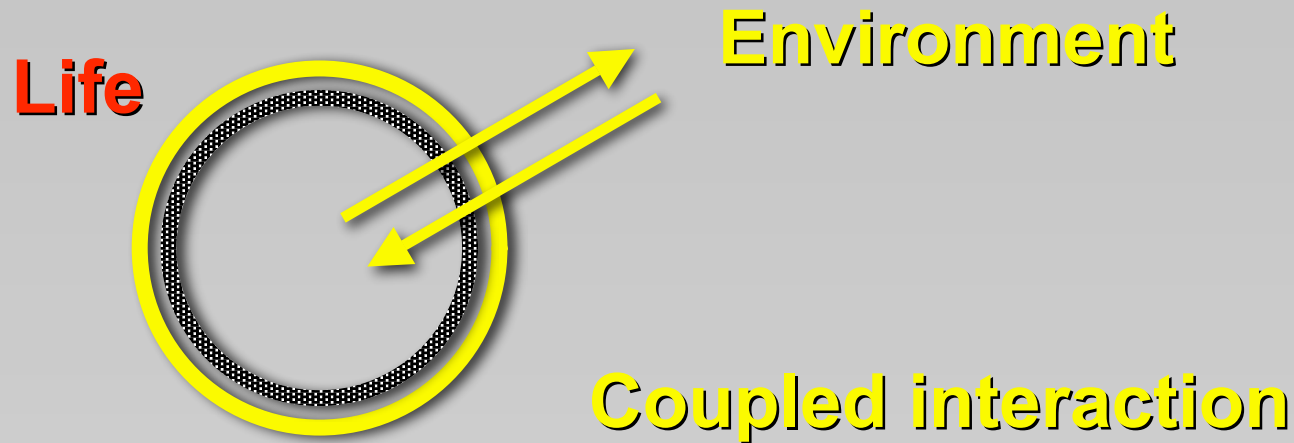
Norcia,
luglio 2005

AUTOPOIESIS AND COGNITION

THE BRIDGE BETWEEN BIOLOGY AND COGNITIVE SCIENCE

What is life?

What is cognition?



SANTIAGO THEORY :

**Life = interaction
with the environment → cognition**

As Varela puts it, “*There is no particular nutrient value in sugar, except when the bacterium is crossing the sugar gradient and its metabolism utilizes the molecule so as to permit the continuity of its identity.*” (Varela 2000) Actually, the compounds that the living organism extracts from the environment to create its own world can be seen as something that the organism itself lacks—something that is missing and therefore must be taken from the outside. The appropriation of these missing parts is what gives ‘meaning’ and unites the autopoietic unit with its world. At this point the Santiago school introduces the term ‘cognition’.

Although the environment is independent of the organism, it does not prescribe or determine changes to the organism. It induces a reaction in the organism, but the changes are determined by the internal structure of the organism itself. It is the structure of the living system and its previous history of perturbations that determines what reactions the new perturbation will induce. Accordingly, changes, mutations, and evolution are seen as the result of the maintenance of the internal structure of the autopoietic organism.

Maturana and Varela arrived at the conclusion that the two notions, life and cognition, are indissolubly linked to each other in the sense that one cannot exist without the other.

Quite in general, autopoiesis has to do with organization, and cognition with the interaction with the environment.

The starting point is the interaction between the autopoietic unit and the environment. The living unit is characterized by biological autonomy and at the same time is strictly dependent on the external medium for its survival. There appears to be an apparent contradiction here: the living must indeed operate within this contradiction.

The interaction with the environment, according to the theory of autopoiesis, must be seen from the internal logic of the living.

In other words, the consequence of the interaction between an autopoietic unit and a given molecule X is not primarily dictated by the properties of the molecule X, but by the way in which this molecule is ‘seen’ by the living organism.

Varela (2000) recognizes that the choice of the term ‘cognition’ is not an ideal one, as it has a strong anthropomorphic connotation.

One thinks immediately of human cognition.

According to Varela and Maturana there are however various levels of cognition, including those at lower degrees of life’s complexity, proceeding from one level to the next: from unicellular to multicellular organisms, from plants to insects and fish and mammals, each with its own type and degree of cognition.

**As the organismsevolve, they develop a sensorium with increasing sophistication-Flagella, skin, receptors for smell, arms, eyes, brain...)
- and each corresponds to a different level of life’s complexity.**

LINK WITH EVOLUTION

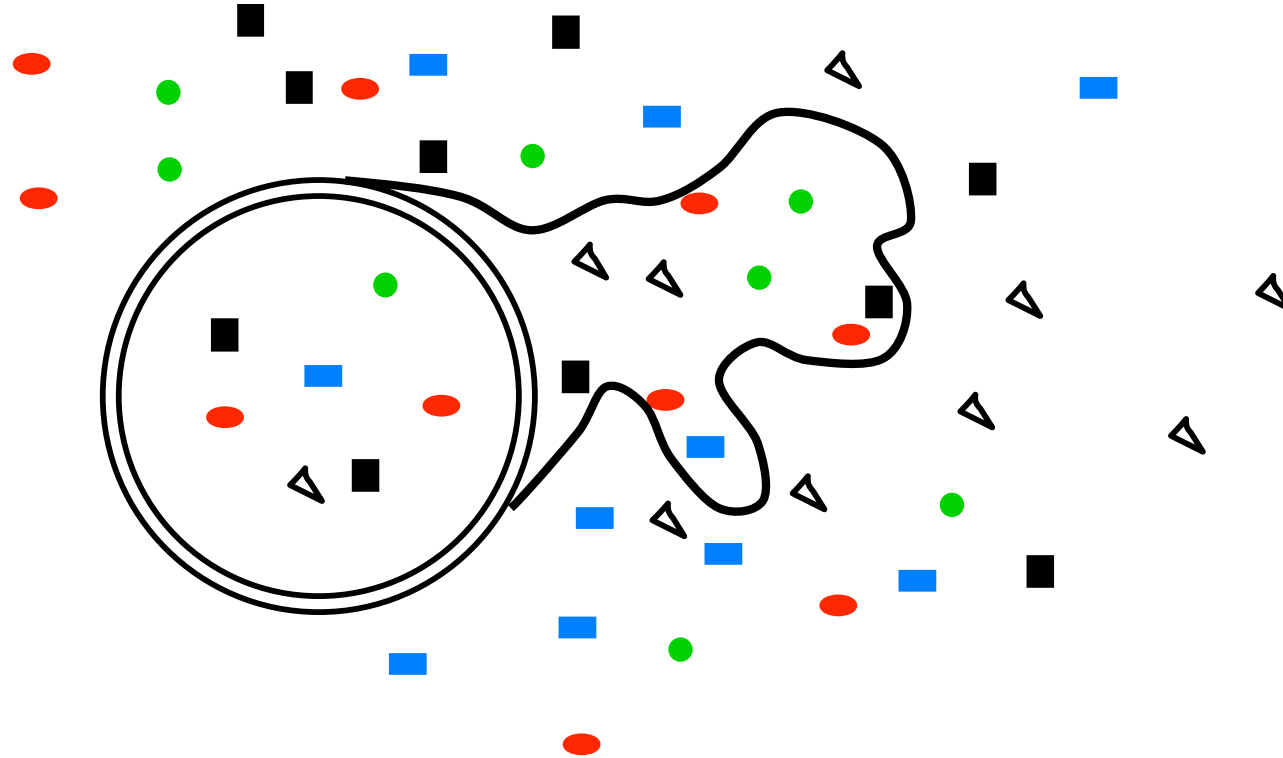
Since the dynamic of the environment may be erratic, the result in terms of evolution is a natural drift, determined primarily by the inner coherence and autonomy of the living organism. In this sense, Maturana and Varela's view (Maturana and Varela, 1980; 1986) is close to Kimura's (1983) theory of natural drift and to Jacob's (1982) notion of 'bricolage'. Evolution does not pursue any particular aim—it simply drifts. The path it chooses is not, however, completely random, but is one of many that are in harmony with the inner structure of the autopoietic unit. These coupled interactions, accumulated over time, give a particular historical perspective to the autopoietic system. It becomes a historical product, the result of a long series of coupled interactions.

..A HISTORY OF COUPLING INTERACTIONS, FROM WHICH THE COGNITIVE DOMAIN IS CONSTITUTED NEITHER INTERNALLY (A SOLIPSISTIC VIEW) NOR EXTERNALLY (THE TRADITIONAL VIEW).

THE ALTERNATIVE THAT ELIMINATES THESE TWO EXTREMES IS BASED ON A CO-DEFINITION BETWEEN THE INTERNAL AND EXTERNAL SYSTEM. THIS IS THE NOTION OF **ENACTION.**

ENACTING MEANS TO MAKE EMERGE

ONE CAN USE THE TERM „CO-EMERGENCE“



the organism creates from the environment
its own world
(→ cognition, → enacting)

**...it is the organism itself,
with its receptors, nervous centers,
movement of the organs,
which chooses the stimuli,
to which it is sensitive.**

**The environment comes out
of the world with the actualization
of the organism's essence...**

**Merleau –Ponty, „The structure
Of Behaviour“**

R. C. Lewontin (Lewontin, 1991) mentions that the atmosphere that we all breathe was not on earth before living organisms and adds:

... there is no “environment” in some independent and abstract sense. Just as there is no organism without an environment, there is no environment without an organism. Organisms do not experience environments. They create them. They construct their own environments out of the bits and pieces of the physical and biological world, and they do so by their own activities.

And furthermore (Lewontin, 1991):

A living organism at any moment in its life is the unique consequence of a development history that results from the interaction of and determination by internal and external forces.

The external forces, what we usually think as “environment”, are themselves partly a consequence of the activities of the organism itself as it produces and consumes the conditions of its own existence.

...think to a beaver

To an anthill

To a spider and its web

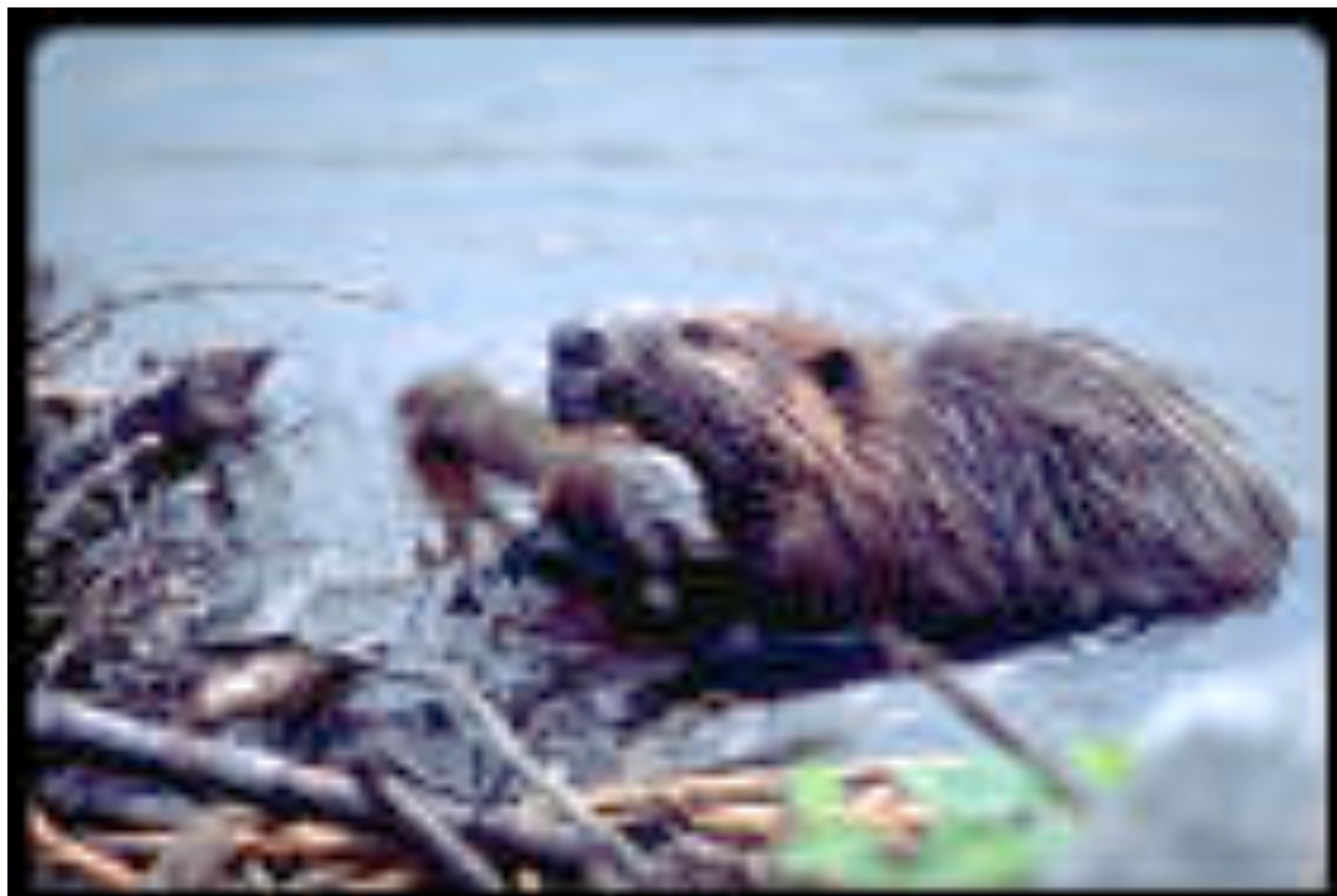
To people and their cities

















**THE MAIN ASSUMPTION OF THE SANTIAGO SCHOOL
IS THE EQUIVALENCE BETWEEN THE PROCESS
OF COGNITION
AND THE PROCESS OF LIFE**

**ACCORDING TO THIS VIEW, BRAIN IS NOT
NECESSARY FOR COGNITION: BACTERIA AND
PLANTS DO NOT HAVE A BRAIN,
THEY POSSESS HOWEVER COGNITIVE CAPABILITY**

“..the Varela’s school is emphasizing that the external world acts as a mere “kick”, which motivates the system to establish a new equilibrium characterized only by the necessities of self-support. For a biosemiotic approach this means that it is no longer concerned with the constraints of the mind-body-problem. Dualism becomes obsolete by the material circularity of autopoiesis. In a self-referential system, meaning is the “inner side” of the material aspect of the system’s closure.”

(Weber 2001)

CONSEQUENCES OF THE AUTOPOIETIC VIEW:

**..THE ACCEPTANCE OF MANY INDEPENDENT
WORLDS**

**THE NOTION OF GROUNDLESS-NESS(lack of an absolute
Objectivity)**

THE IMPORTANCE OF THE FIRST PERSON ANALYSIS...

CONNECTIONS WITH BUDDHISM

ON THE BASIS OF THE EQUIVALENCE
BETWEEN LIVING STRUCTURE AND
THE ACT OF COGNITION, THE OLD
CARTESIAN
SEPARATION BETWEEN MATTER AND
SPIRIT
IS SUPERSEDED.

THESE TWO CATEGORIES
ARE NO LONGER DISTINCT ENTITIES,
THEY ARE TWO FACES OF THE SAME
PHENOMENON:
LIFE

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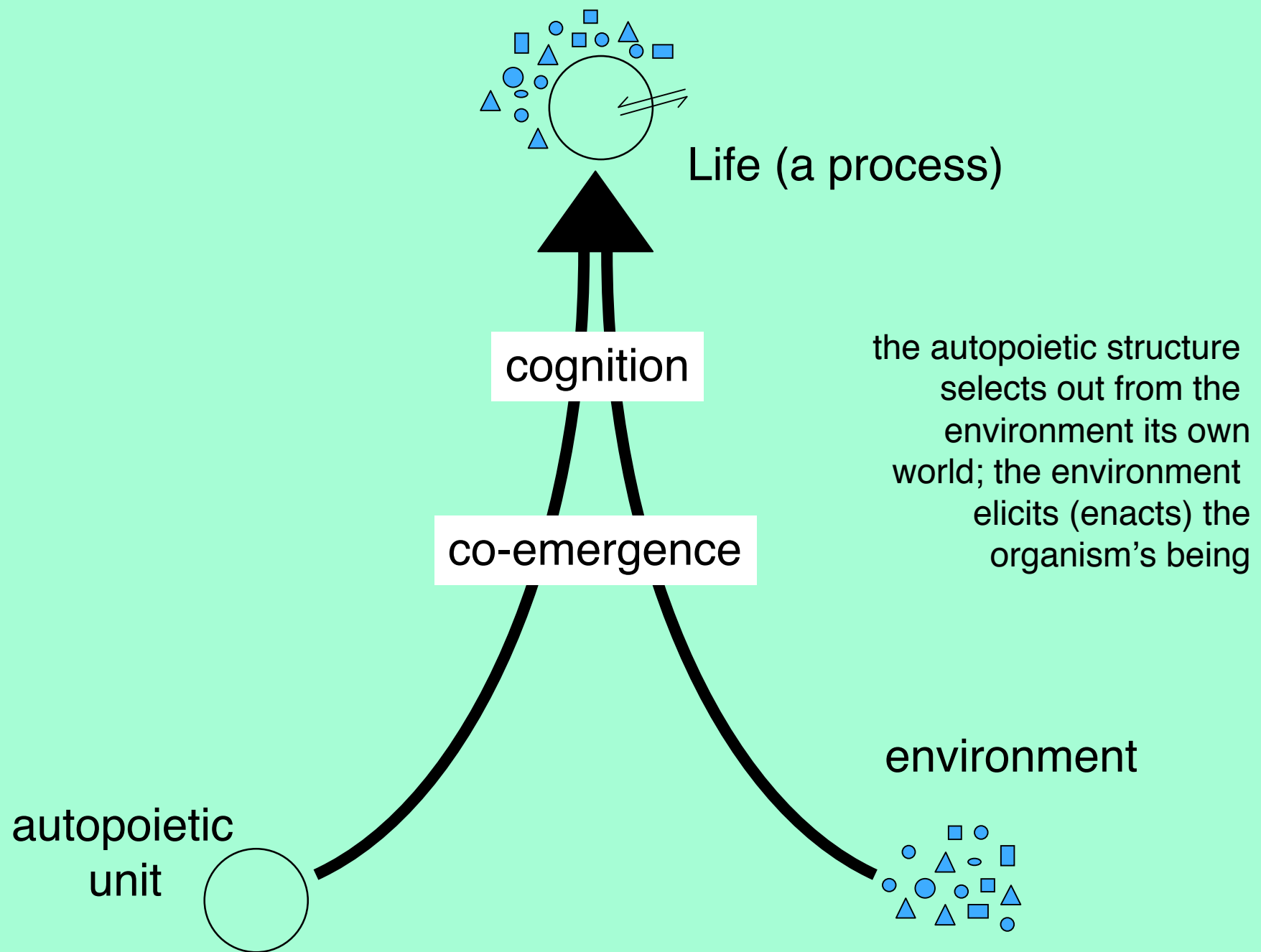
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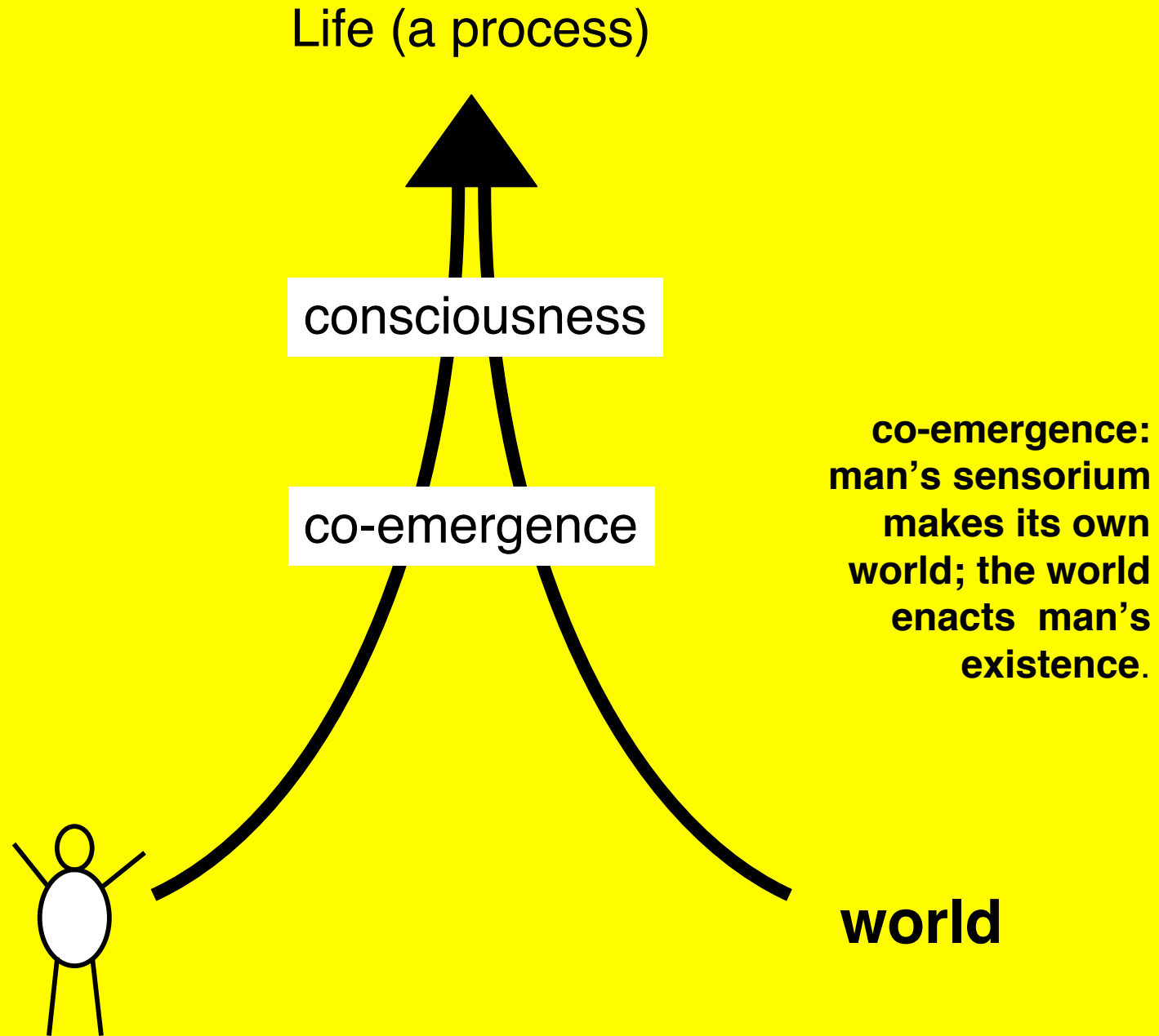
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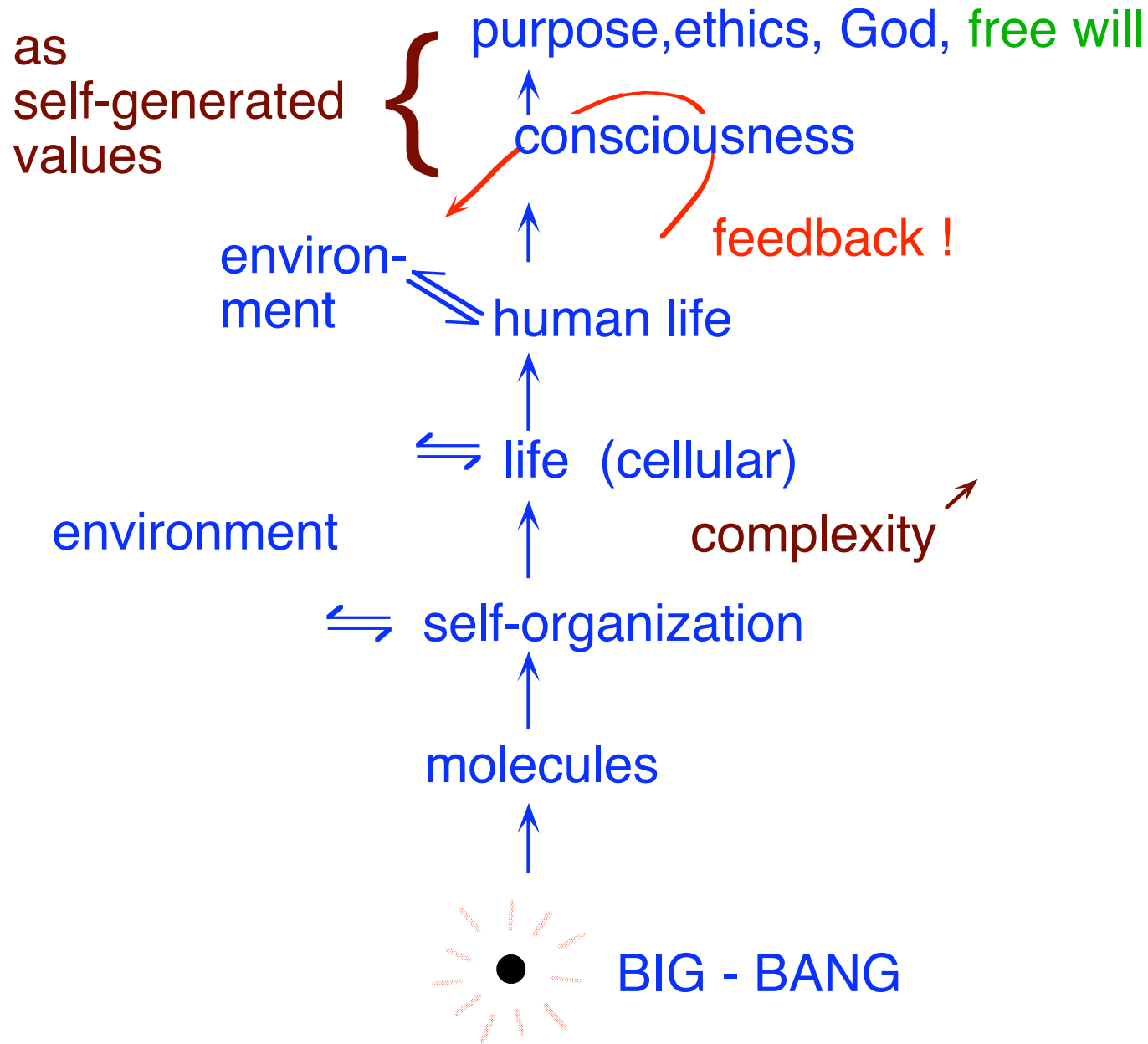
THE NOTION OF EMBODIED MIND

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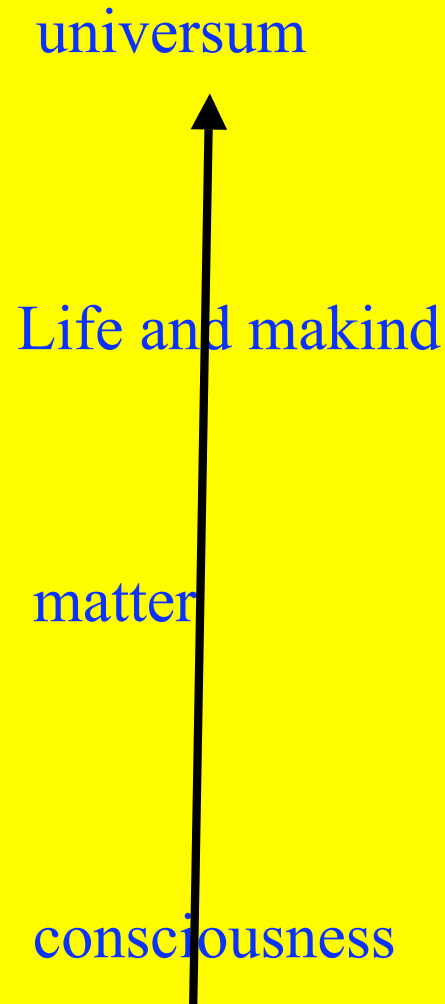
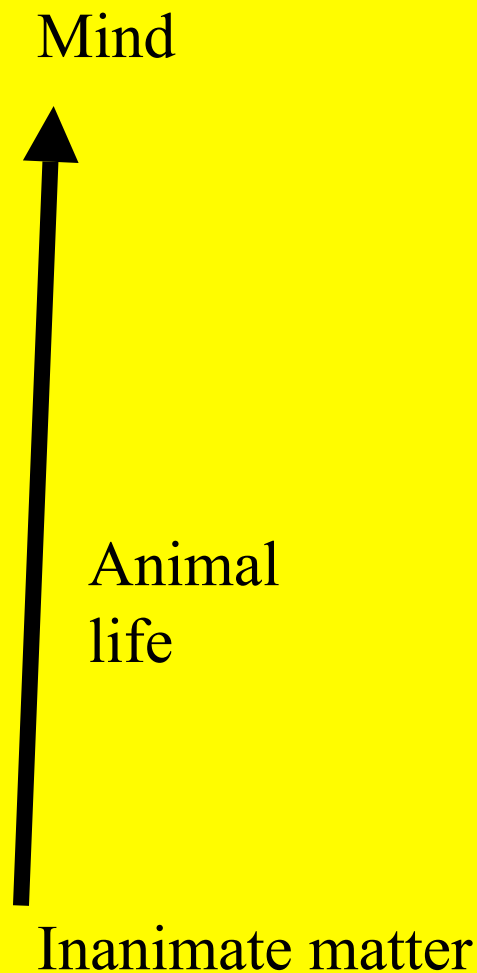
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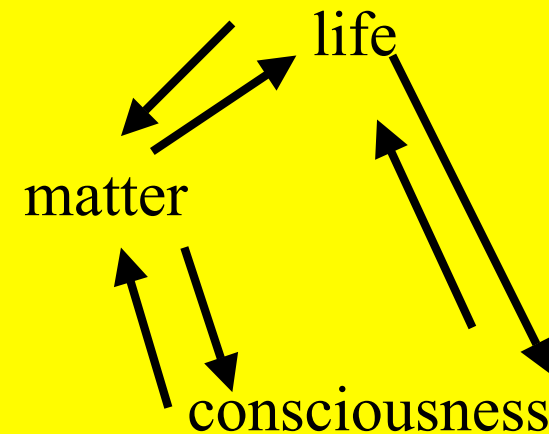
QUESTIONS FOR THE DIALOGUE SCIENCE/BUDDHISM:

The science view

The Buddhist view?



Do we need a Beginning?



THE LEGACY OF FRANCISCO VARELA:

HARMONISE THE SCIENTIFIC MOLECULAR VIEW
*(THERE ARE ONLY MOLECULES AND
THEIR INTERACTIONS)*

WITH
THE HUMANISTIC AND SPIRITUAL ASPECTS
OF LIFE
*(CONSCIOUSNESS, ETHICS, ART, POETRY,
RELIGIOSITY)*

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ECOLOGY

the interaction between organisms and their environment is part of the more general scenario of ecology. It has been in fact stated that living organisms make and continuously change the environment in which they live, and vice versa, so that every act of consumption is also an act of production; also, that we must forget the idea that there is a constant and fixed world – as we are constantly changing it and cannot live without changing it. (Lewontin, 1991). From that, the difficulty of finding a healthy equilibrium that preserves as much as possible the identity of the living.

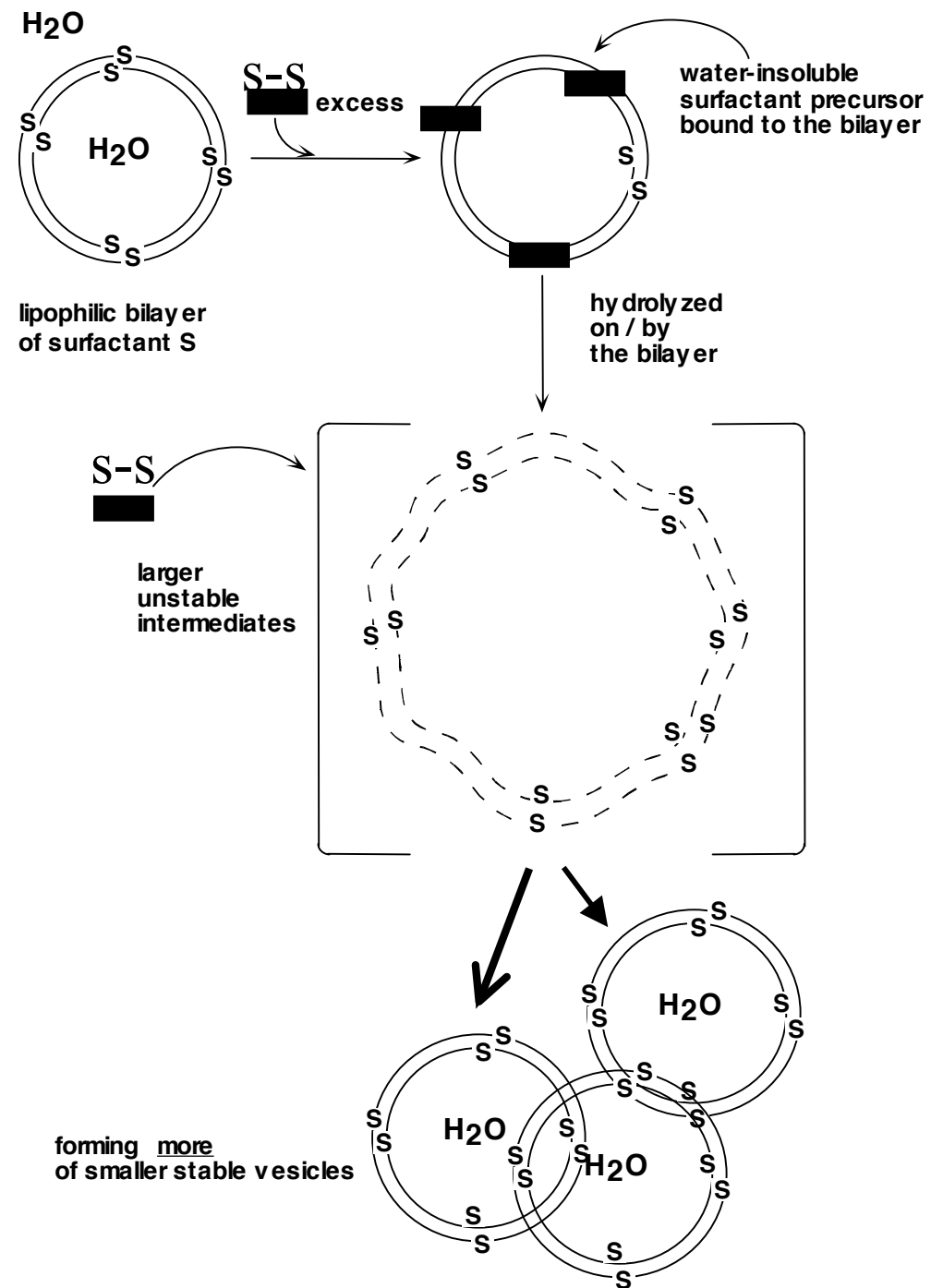
Autopoiesis and cognition:

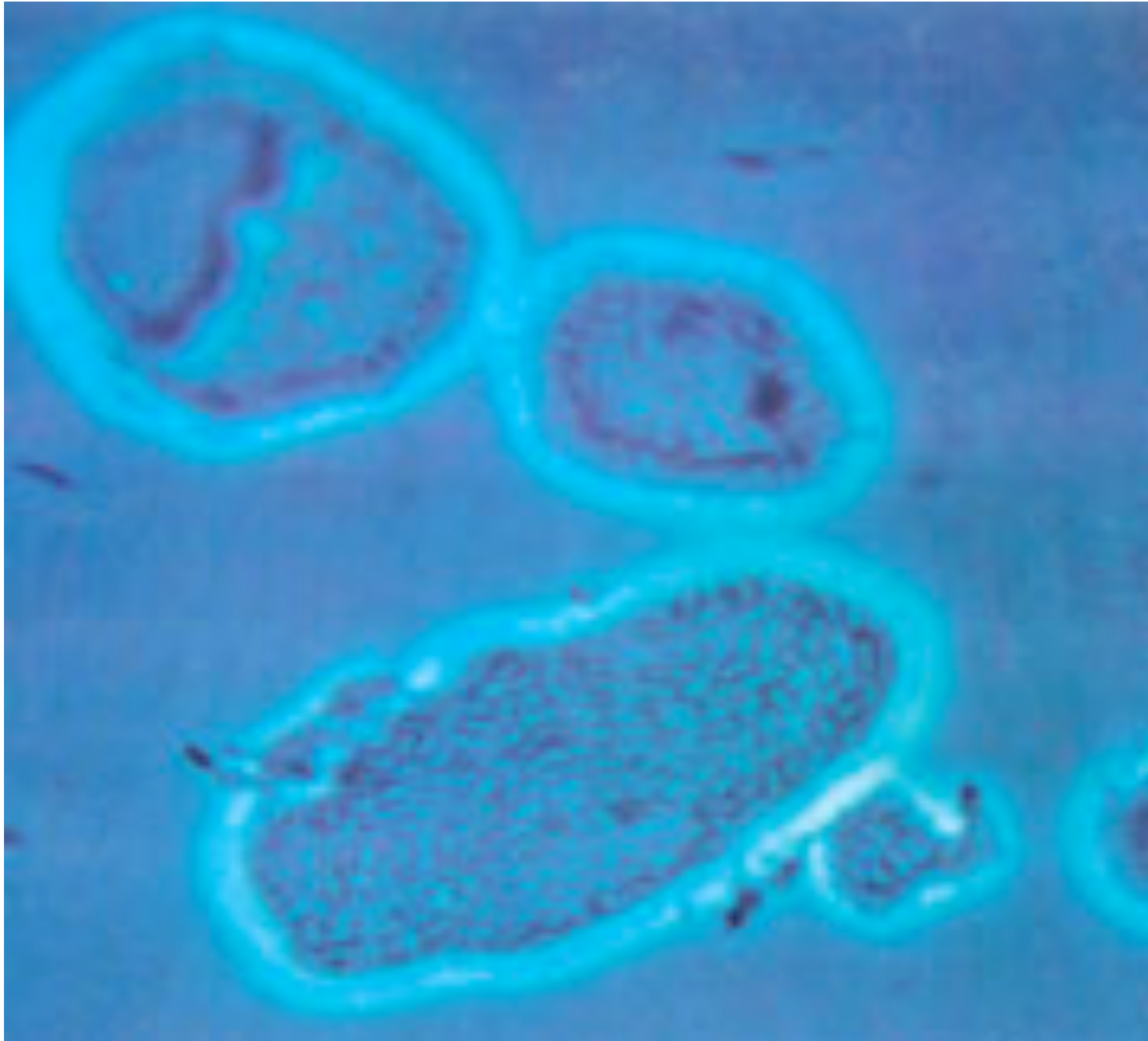
**Is autopoiesis the necessary and
Sufficient condition for life?**

...or only necessary, but not sufficient?

Compare an amoeba feeding on sugar

With a self-reproducing vesicle that binds a precursor





SOME INCONSISTENCIES IN THE PRIMARY LITERATURE

Autopoiesis and cognition are two different levels, the one being mostly concerned with organization, the latter with the interaction with the environment.

However, if autopoiesis is sufficient to characterize life, as the Authors claim, then it is not clear how and why cognition should be a primary feature of life.

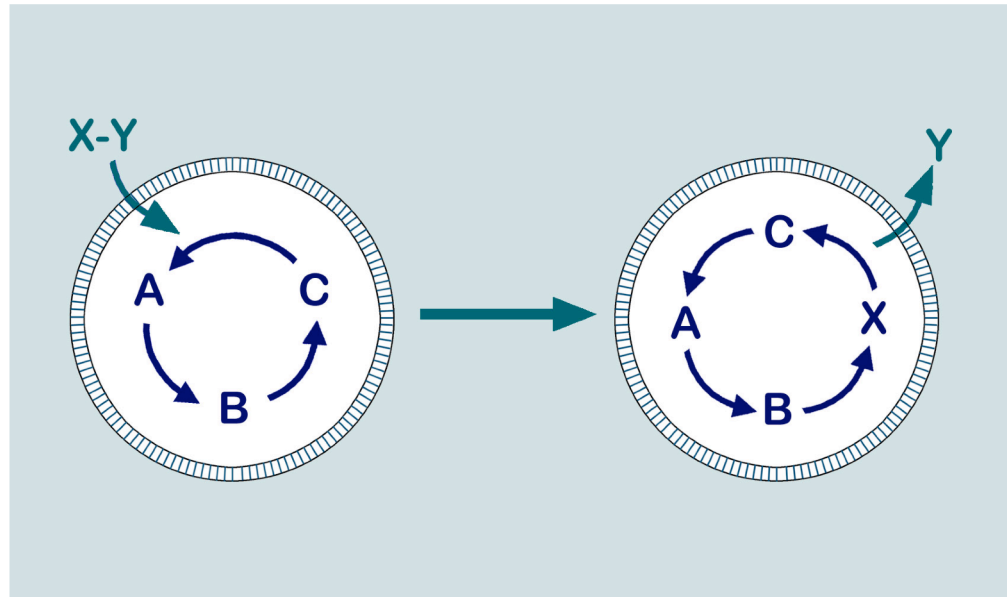
And if cognition is so essential for life, it should have been included expressly in the criteria of autopoiesis, which has not yet been done in the primary literature.

....each living system is a complex of circular interactions with its own environment, and this ensemble can be viewed as a continuous flow of mutual and coherent changes that have the aim of maintaining the equilibrium of the self-identity. It seems clear from these considerations that for the biological cell is the **metabolism itself that is the link between the internal and the outside world**. Metabolism is the result of the internal organization of the cellular system, but it is implemented by the interaction with the environment that feeds the cell and accepts its expelled byproducts. Thus, **metabolism itself is equivalent to the notion of cognition** in the simple case of unicellular organisms. The autopoietic system and the environment change together in a congruent way induce changes and adaptation in each other.

From the above, one can elicit that autopoiesis is not the necessary and sufficient condition for life. It is a necessary condition, but then it takes cognition, at least stage one of cognition, to arrive at the process of life. The union of autopoiesis and the most elementary form of cognition is the minimum that is needed.

Bitbol and Luisi, 2004

, Bourguine and Stewart(2004) independently arrive at the same conclusion



STATEMENTS:DIRE SE SIETE D'ACCORDO- O NO-E PERCHE'

1.COGNITION IS AN EMERGENT PROPERTY
OF AN AUTOPOIETIC SYSTEM, CAN BE SEEN AS A
CO-EMERGENCE BETWEEN THE LIVING AND THE
OUTSIDE WORLD

2.CONSCIOUSNESS IS A PARTICULAR-VERY HIGH-
LEVEL OF COGNITION

3.TO ARRIVE AT COGNITION AND CONSCIOUSNESS
OF THE LIVING THERE IS NO NEED OF TRASCENDENT
POWER . YOU ONLY NEED MOLECULES,THEIR
COMPLEXES AND THE CORRESPONDING EMERGENT
PROPERTIES

Risposte

m. cini: 1. Tutti d'accordo; differenza tra singolo individuo e popolazione, co-emergente tra vivente e mondo esterno. Quindi Sia a livello di popolazione che a livello del singolo. Ewsempio della produzione fdi ossigeno

2. Maggioranza e minoranza. La minoranza dice che c'è un salto qualitativo tra cognizione e nascita della coscienza umana; la maggioranza indica che tale salto non c'era, la coscienza ha subito una evoluzione tra forme più semplici a forme più complesse. Per la minoranza c'è invece un salto per andare agli Uomini

3. Unanimità di escludere il trascendente, ma con sfumature a proposito soprattutto della definizione di coscienza e trascendenza.

Francesca: 1.: cognizione ok, l'ambiente e' necessario, ma si pone
Il problema del confine e dell'esterno, c'e' la
Interazione della unita' autopoietica con se stessa,

2. Coscienza e' di un grado di complessita' superiore, ok, ma si deve distinguere tra coscienza e mente. D'accordo sul fatto che c'e' un aumento di complessita' a livello della mente, ma non c'e' una uguaglianza mente-coscienza. *(in corsivo i commenti nella discussione generale: Problema pero' della definizione della mente, per es. Mente e' anche negli animali, le funzioni mentali non Sono tipiche dell'uomo, la coscienza si, mente e' una proprieta' . emergente del cervello. Differenza tra coscienza e consapevolezza Coscienza e' una proprieta' transitiva, consapevolezza e' riflessiva)*

3.*se per trascendente intendiamo qualcosa di biblico, questo e' Da escludere; ma se intendiamo qualcosa che non conosciamo, non Possiamo escluderlo*

Tiziano, 1. Più domande che risposte. Cognizione può essere come definita, però c'è il problema di capire bene cosa sia cognizione, e poi cosa sia emergenza, in particolare se c'è causa ed effetto.

2. cosa si intende per coscienza? Non si può rispondere senza aver chiarito questo. (*Cini: esisteva la coscienza dieci milioni di anni fa? Franco: se la coscienza è un elemento della esistenza, forse allora non ha bisogno della materia. Quindi la sua risposta è: sì, la coscienza esisteva anche dieci milioni di anni fa*)

3. Non c'è stato tempo

Piras: 1. Ipotesi di lavoro

1. SI CORREGGE IL TESTO DELLA DOMANDA, „OF THE LIVING DIVENTA „AUTOPOIETIC SYSTEM“ e in questo caso la risposta sarebbe NO. Giovanni: cosa significa cognizione, capacità di apprendere? A livello della popolazione, e.g. di batteri, legame con la evoluzione.

2. Necessità di definire prima cosa è la coscienza, come capacità di vedere se stessi dall'esterno. Non è chiaro cosa significhi „livello più alto“, se viene definito Come proprietà emergente, allora ok. Altro punto di vista:

3. conseguenza della precedente, se si tratta di proprietà Emergenti non c'è bisogno di potere trascendente esterno. Qualcuno ha risposto: non so, posizione agnostica.