

# The systems view of human and global life

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## INTRODUCTION

1. We have at this meeting three different religious traditions confronting each other, and also science. The position of science with respect to religion is generally considered critical. Actually it has not been always a problem, as there was a time when people in this part of the world were pious and good natured and believed that all things in this world were created, once and for always, by God. This peaceful time ended when a British Scholar, by name Charles Darwin, wrote a blasphemous book, called the Origin of species (we are now in 1859) claiming that the species were not fixed, but changed with time-the notion of evolution; and adding blasphemy to blasphemy, this author added that even the origin of life could have been a natural event, with life coming out from the inanimate matter thanks to natural laws. But his most horrible blasphemy, according to several Darwinian scholars, for example Telmo Pievani, was the idea that there would be no plan, no predetermined goal, in the action of nature and evolution-an idea that he considered "a murder"- because of that apparently Charles Darwin lost his faith. As Darwin had predicted and expected, a conflict arose between science and Christianity, a problem which has already been known in the field of cosmology, with Galileo and Copernicus. This conflict is still going on in the life sciences, especially due to the creationist movement in the States, and in its more modern form of the intelligent design. However, also judging from my personal experience, once we disregard the fundamentalists of the creationism, the dialogue between science and Christianity about evolution, about the origin of life, about the plans of nature, can go ahead in a useful and intelligent way. Actually, the dialogue between Christian religion and science can proceed more easily than in the case of the eastern religions.
2. Let us consider for example Buddhism and Induism, in the form for example of Shankara's Advaita/Vedanta. In principle, from an ontological point of view, such a dialogue is not easy-at first sight, it looks impossible. In fact, science' main tenet is that the things of this world-stones and stars, tides and lightening, plants and animals, etc.- are real, are solid object of reality, on which we can build a construction to understand the world, the universe. Conversely, both Advaita/Vedanta and Buddhism consider the things of this world as mere appearances, as mental constructions.  
To consider the objects as real, is part of our ignorance, says Buddhism, and actually things are empty, namely without any intrinsic existence, as each of them is conditioned by a myriad of other causes and conditions; and in the Advaita/Vedanta, all things are part of the initial indivisible one, which coincides with the cosmic consciousness, and our aim is to go back to this indivisible one, the Brahman.  
How is then possible to have a dialogue between these two opposite fronts? Of course the dialogue is possible when the participants are on the same stage, which is the stage of the apparently real world. Starting from this common stage, both science and religious traditions look for the truth, and then the dialogue can be fruitful. I am since almost 30 years, part of the Mind and Life Institute, institute by the Dalai Lama with Francisco Varela back in 1987, and I can testify of the progress made both by Buddhist and scientists thanks to this continuous interchange of ideas and experiences. Things are more difficult with Vedanta people, who, in

my limited experience, are more fundamentalist. I just come from a meeting held at the end of April 2016 in Dharamsala with the Dalai Lama and representatives of the old Indian religious traditions, going back in the Veda and Vedanta thousands of years back, and as a scientist I found very difficult to confront the position of scientists who were holding that naked molecules possess consciousness and the principles of life in themselves.

From this brief introduction, it is apparent that the spectrum of things to discuss is very large and complex, and I will limit myself to simply discuss some main concepts of the modern science, adding whenever possible, and in the stringent limits of my limited knowledge in the field, a confrontation with some analogous concepts in the religious traditions.

## 1: MAIN CONCEPTUAL PILLARS OF MODERN ANTIREDUCTIONIST SCIENCE

3. From a historical perspective, science has been dominated in the last two centuries by the mechanistic view of Descartes and Newton. Accordingly, the world could be seen as a mechanism formed by independent parts, and the emphasis was in the study of the single components-with the idea that putting together the information obtained on the single parts, one could understand the entire system. This view underwent a profound crisis at the end of XX century and very first part of last century.
4. A new wind began to blow in the middle of nineteenth century, with people like John von Neumann, Gregory Bateson, Heinz von Foerster, Alan Turing, Norbert Wiener, Paul Weiss, later Piaget and Ilya Prigogine, who began to study the notion of self-organization in natural and man-made systems, giving also the birth to the field of cybernetics and artificial intelligence. It was becoming clear that some natural systems spontaneously tend to assemble themselves in organized systems composed by more parts- first of all the living organisms, but then also simple physical systems, think of the soap bubbles which form spontaneously, each of them a perfect sphere, and each composed by billions of soap molecules perfectly aligned; or think of a bee hive, or of the regular circular waves when a stone is thrown in the water; or to the helical pattern of a tornado. Which were the forces responsible for this self-organization, and how and why some of these self-organized systems would become living?

The new scientific thinking from 1930 on

- John von Neumann,
- Gregory Bateson,
- Heinz von Foerster,
- Alan Turing,
- Norbert Wiener,
- Paul Weiss,
- Piaget
- Ilya Prigogine
- Maturana and Varela
- emphasizing self-organization, holistic complexity, systems thinking, emergent properties, collective properties

Thanks to the intense discussion and development of these ideas, a series of novel concepts became dominant in our interpretation of the reality of nature. Because of that, broadly speaking, we are now in the sciences of complexity, a very general term, which encompasses concepts and terms which have become popular also in the mass media-and which partly I will try to explain.

## SCHEME OF THE PRESENTATION

### The conceptual pillars of modern science

- Most of modern life science is still molecular: genetics, molecular and synthetic biology, pharmacology, industrial chemistry, cosmetics, petrol chemistry, medicinal and brain chemistry...
- The molecules, their assemblies, and their interactions are the basis of all phenomena of life sciences.
- Molecules are seen as "dead matter", deprived of any kind of life and consciousness.

- PART ONE: SYSTEM THINKING EMERGENT PROPERTIES, NON-LOCALIZATION
- PART TWO: AUTOPOIESIS AND COGNITION OF VARELA AND MATURANA
- CONCLUDING IN A MONASTERY

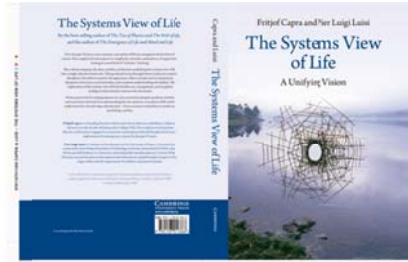
5. I will limit myself to life science, recognizing that quantum physics, which is outside my domain of knowledge, moves with other conceptual principles. Let me then first notice that most of life science, although renovated by these new paradigm, is still grounded on the notion of molecule. We live in the century of the gene, and in our scientific world of life sciences we are dealing with genetics, molecular biology, pharmacology, medicine, industrial and petrol chemistry, agricultural chemistry, cosmetics, ...-In other words, the main heroes are still the molecules of DNA, RNA, as well as antibodies, proteins, drugs.... Thus, life sciences of today are still grounded on molecules, which are seen as inanimate matter deprived of any transcendent attribute. No consciousness, no mind, only matter.
6. This last observation would sound trivial to all modern scientists. I believe that, in this particular meeting, is important however to point out something that for many people is not so trivial: that science denies all kind of transcendence and all kind of divine intervention. God has been excluded by science. It is not so, that all scientists are atheists- some are believers, but they do not use the authority and the miracles of God to explain the phenomena of the world-their faith remains a private act.  
For science, then, all phenomena we are experiencing are necessarily due to matter, in particular to molecules and their mutual interaction. The term "mutual interactions" is a very complex and rich one, certainly not based on simple reductionism- as we will see. But the general vision of science, deprived of transcendence, is in strong opposition, for example, to the Vedanta world and to the Christian world-but in a different way. The Christianity for example does not deny reality, as Advaita/Vedanta adherents do, claiming that all things of this world are mere dream like imagines deprived of reality.

### 1.1. THE SYSTEMS VIEW OF LIFE

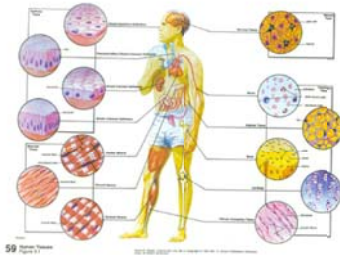
7. It may appear then, if I say that our life science is still grounded on molecules, that I want to give you still a reductionist, materialistic view. As a matter of fact, we have to bring immediately some important addition and correction to this materialistic scenario. In fact, once we say that the ground is molecular, we do not mean that modern science is reductionist, or that all qualia and phenomena can be reduced to molecules and atoms. Not at all, and this is an important point that we have to clarify. In fact, modern science of complexity is based on a couple of interrelated concepts which depart strongly from the reductionist view. They are the notion of **systems view; of emergent properties**; and a corollary of all that, which is the principle of non-localization. What does all this mean? Let us begin with the systems view, and let me add that this concerns me personally, as I am the author of a basic book, together with Fritjof Capra (the author of the Tao of Physics).

SCHEME OF THE PRESENTATION

- PART ONE: **SYSTEM THINKING**, EMERGENT PROPERTIES, NON-LOCALIZATION
- PART TWO: AUTOPOIESIS AND COGNITION OF VARELA AND MATURANA
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8. Our common reality in everyday life is such, that we are surrounded by systems, meaning by that organized assemblies of parts. These can be the parts which make up an organism, the many parts which make a cell, or a flower, or a machine, but also a social system such as a hospital, or a corporation, or a factory. You see here **in the slide** the example of the human body and the **interaction of all organs with each other**. The main tenet of the systems' view is that the property of the system- life in this case- is due not so much to the properties of the single parts, taken in isolation, but to the mutual interactions of all components. What is important is the web of connection, the network of links, to form a whole unity. Actually, the properties of each component are due to the integrated ensemble, and this is the systems view. This view is really at variance with the view of the world as a machine, composed by parts independent from each other, as in the time of Descartes or Newton.



9. The last point is about death, and this is an interesting subject. I have a long experience with dialogue with religious people, and I experienced the following: that it is much easier to get to a common ground between science and religion about the question “what is life?”—than on

LIFE VERSUS DEATH:

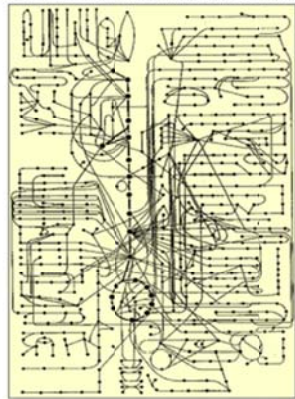
- A CONTINUOUS CONTROVERSY
- BETWEEN SCIENCE AND RELIGION
- ... DOES SOMETHING REMAIN AFTER DEATH OF THE INDIVIDUAL... OR IS SOLELY A RE-SHUFFLING OF DEAD MOLECULES INTO NEW FORMS?

the question “what is death?”.

8. Many other examples on the importance of the mutual interactions can be given. This is for example the common market, or the structure of an hospital, with the interaction between medical doctors, nurses, administrative personnel, cleaning people...Or, in an example which I often use, let us zoom in the metabolism of a simple cell: notice the myriads of reactions and

components. Here, each point is a chemical compound, each line a chemical reaction, catalysed by a large enzymatic, specific protein.

A maze illustrating the chemical reactions that interconvert small molecules in cells.



9. Actually, I have used this picture to explain some of the classic tenet of Buddhism. In fact, each compound conditions the next one, and is conditioned by a previous step. Each compound is actually a case for co-dependent arising. And in all this network, there is no prima causa. If you look for some compound which is not conditioned by any other, which exists per se, you find the classic picture of emptiness. And it is also a representation of impermanence, as each compound exists for only a few seconds, or less: it disappears, transformed into something else. This is just to say that this idea of the mutual co-dependence, where one part is conditioned by all other parts, is present of course in Buddhism, in which the main tenet is the interdependence. Of course from this picture some of the main elements of Buddhism, like Kuruna, (compassion) or the ethical component, are missing.
10. Let me use this picture to ask another very important question for the modern theory of complexity. The question is: where in this picture is life localized? And the answer is very interesting: Life cannot be localized in one single point, in one single compound, in one single reaction. Life is a global property, due to the mutual interactions of all components. The life of the bacterium is the whole network of reactions, is the entire system

• Cellular life (life in general) is a global, distributed quality. Is not due to any particular "centre", any particular compound or any particular reaction.

LA VITA E' UNA QUALITA' GLOBALE,  
DISTRIBUITA.  
NON E' DOVUTA AD UN PARTICOLARE  
CENTRO  
AD UN PARTICOLARE COMPOSTO, AD  
UNA PARTICOLARE REAZIONE

The notion of a global property without a centre of localization is a quite general concept. It applies of course not to the bacterium alone, but to any living organism. Where is the life of an elephant localized? And also, looking at the bee hive, or at the termite nest, or to the swarm movement of migrating birds, we are always witnessing an organized, "intelligent" ensemble, without any point of localization, without any director, master, or dictator. The whole ensemble,

with all its interactions and corresponding emergent properties, in its globality, has to be considered the unity. A collective unity. And something more trivial: where is New York localized? Of course, NY is all NY.

The same is true, in cognitive science, for subtler concepts like the “self”. Where is the self of Mr. Luisi localized? There is not a point of my body, where this localization can be seen or experimented.

**the problems of our modern time**  
Pollution  
Global warming  
Insane consumption of energy  
De-forestation, loss of biodiversity  
The immense richness of multinationals  
The extreme poverty of s many people  
Emigration, the wars, destabilization of democracy....

cannot be considered as isolated one from the other;  
they form a complex system of mutual con-causes. And  
possible solutions must be sought within a systems  
thinking  
from Capra-Luisi, 2014

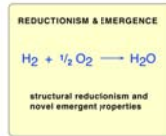
11. Changing scale, one good example of systems thinking is in the present problems of our world: the irrational energy consumption is the origin of pollution, which is the cause of global warming, which in turn conditions climate, biodiversity, deforestation, the state of our oceans; and this production of energy is in the hands of multinationals, which became richer and richer at the expenses of a multitude of poor people, most of them destined to become migrants with consequences for the stability of democracy and peace....all in this case is a negative loop of conditioning causes mutually dependent. We will come back to this point in the last part of my presentation.

### 1.2. THE EMERGENT PROPERTIES

12. About this notion of systems thinking, we can then say that is not a novelty, actually the old Vedanta tradition –as well as Buddhism- is based on that-everything depends on everything else, there is nothing that has a value in isolation. However, to say simply so, it would give no justice to modern science, as this principle of systems thinking has been enriched by a series of epistemic concepts which are quite new and original, and actually, as we will see, not so much present in Buddhism or Vedanta thought. The most important is the idea of **emergence, or emergent properties**, something which is directly related to the concept of organized system. It concerns however the properties of the system, and the important bottom line is the following: that when the parts assemble to form an organized system, new properties may and will emerge-new in the sense that they are not present in the single parts. Emergence, emergentism, is a philosophical idea that was developed originally by British philosophers already one hundred years ago, -the so-called British emergentism- and the authors of that time used to give as the simplest example the formation of water from hydrogen and oxygen. The properties of water, as a transparent, non inflammable liquid which seeds at zero degree, etc....are not present neither in hydrogen nor in oxygen, are emergent properties.

**Emergence:**  
 the formation of a higher complexity level brings about **NOVEL properties** that are not present in the basic components

...the whole is more than the sum of the parts  
 ...holism



**The British emergentism:**

J.S. Mill, System of logic, 1843,1872 (8.th edit.)  
 A. Bain, Logic, Book II and III, 1870  
 S. Alexander, Time and Deity, 1920  
 C.L. Morgan, Emergent Evolution, 1923  
 C.D. Broad, The Mind and its Place, 1925

**And modern literature, for example:**

R.W. Sperry, Philosophy of Science, 1986  
 W.C. Wimsatt, 1972; 1976  
 J. Klee, 1984  
 B.P. McLaughlin, 1992  
 J.H. Hollnd, 1998  
 T. O'connor, 1994

**EMERGENCE**

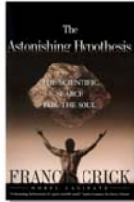
**In chemistry:** from atoms to molecules, from molecules to macromolecular complexes, DNA duplex, haemoglobin cooperativity, muscle movements  
**in biology:** from cells to tissues, from tissues to organs, from organs to organisms etc...  
**in physics:** superconductivity, voltaic electricity, non-linear dynamics, cybernetics  
**In geometry:** surface and space from single lines  
**In common life:** linguistics, music  
**In social systems,** family from individuals, nations from tribes, common markets from single nations

13. To us, this sounds now trivial: of course, each time we form a product in chemistry from the elements- be hydrocarbons from hydrogen and carbon, be a sugar from carbon, hydrogen and oxygen, be ammoniac from nitrogen and hydrogen... of course we have each time new properties. Things become however much less trivial when we consider that also life can be considered an emergent property, as the single components- be proteins or sugars or lipids or nucleic acids, -per se are not life. Or when we consider the progression in complexity going from cell to tissues, from tissue to organs, from organs to organisms, and from individuals to families, families to tribes, etc.... At each step of increased complexity, new properties are to be detected, which are not present in the lower level of complexity. And this concept has been used in language, in music, in geometry, in cosmology, and has been discussed in the literature in a large series of books and meetings.

And it is not a simple thing. And this for two main reasons. The first is, that –as it is commonly accepted by all researchers in the field- the emergent properties cannot be predicted, or explained, on the basis of the properties of the constituent parts. In other words, science accepts the arising of novel properties, due to the increase of complexity, as a granted a posteriori bonus. The question, whether this is an ontological tenet, or whether this ignorance is simply due to our technical or computing incapability, is still debated. But all agree that the properties of water cannot be derived from the properties of hydrogen and oxygen, and that the properties of haemoglobin cannot be derived from the properties of the single amino acids.

On the question of predictability:  
 (bottom to top...)  
 „strong emergence“  
 ... the...relation between an emergent property  
 of a whole and the properties of its parts  
 is...one of non-explanatoriness...“  
 Schroeder, 1998

“weak emergence“  
 ...it is rather so, that the explanation is often  
 technically difficult to give, not computational  
 power, no skill  
 For example A. Bejan, 1997



We also learn a most important example of **Emergence**.

Life as an emergent property: not present in any of the components, arising only when the components interact with each other

which is an expression of **self-organization**

14. The second important point is this: that emergence is the magic box by which science explains the qualia. Thus, to jump directly to something difficult, mind is seen as an emergent property from the body (better body/environment) and even consciousness is seen, by many scientists, neurobiologists and cognitive scientists, as an emergent property of the brain which has reached a critical degree of complexity. You see here the frontispiece of Francis Crick’s book, where he, under the astonishing hypothesis, means that consciousness, for him, is an emergent property of the brain.

This is in connection with the point I made at the beginning, that science has eliminated transcendence and God, but needed something to introduce qualia and spiritual values. For science, all this is immanent, coming from within, from the biological organism itself. It is a difficult point. There is no doubt that Volta pile electricity is an emergent property coming out from an alternate stock of Cupper and zinc disks, with a conductive solution in between. This is quite acceptable, even though you may not understand why, you can repeat the experiment and see that it is so. Quite different is the case of consciousness, or even of life as emergent properties. Because this becomes an assumption, and here the word “emergence” appears to acquire the meaning of a word solution to something we do not understand.

15. Another point about emergence, of quite different nature. I would like to emphasize that this notion of emergence is **not in good consonance** with the tenets of Buddhism nor with Vedanta thinking. The notion that some new property originates from matter, and in particular life, mind and consciousness, is actually alien to this traditional oriental thinking. And this is at the same time a question: isn’t so, that to see life as an emergent property from a molecular interaction is not at all a Buddhist way of thinking? Even less of Vedanta...So, the notion of emergence, at a certain level, may represent a point of disagreement or at least of discussion.

## 2: WHICH KIND OF SELF-ORGANIZATION PRODUCES LIFE?

16. With all this in mind, we can now look at these systems which surround our reality with a different sight. Indeed, we are away from the reductionist view, in which is, or was, important



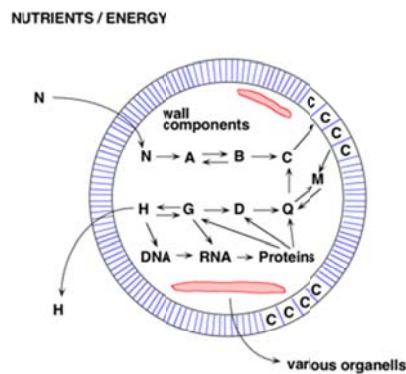
to look at the single components in order to have a key for understanding reality. But here we can ask a new, important question:

what is then the difference between an organized mechanical system, and a living system? Finally, also an automobile, or a clock, or a robot, are systems formed by interdependent parts, where the mutual interaction among the parts is very important for the functioning and the properties of the whole.

This question brings us directly to the theory of autopoiesis of Maturana and Varela, which in my opinion is still the best view for understanding the question “what is life?” both from the biological and philosophical point of view.

x

•What is then the difference with a machine, as a complex system of parts interacting with each other?....



#### SCHEME OF THE PRESENTATION

- PART ONE: SYSTEM THINKING, EMERGENT PROPERTIES, NON-LOCALIZATION
- PART TWO: AUTOPOIESIS AND COGNITION OF VARELA AND MATURANA
- CONCLUDING IN A MONASTERY

### 2.1.: AUTOPOIESIS

17. Let me say at the start that the theory of autopoiesis is not something theoretical, with the concept of life coming out from an abstract thinking. On the contrary, phenomenology is at the basis of it, meaning by that, that we observe life as it is, and from this observation we derive information and knowledge. Let us take again the cartoon of the cell, because we want to start from the simplest possible unit of life-for example a unicellular organism. You see the membrane which outlines the internal world from the environment, a spatial discrimination which is the first basis of life. You see then that some chemical can cross the boundary, the

nutrients N, and some compounds are expelled. And inside the cell there are many chemical transformations, thousands of them every second in each of our billions of body cells. You remember the complexity we have seen before (show slide). But then you experience here a first paradox about cellular life. The paradox is the following: that a liver cell, despite all these transformations, remains a liver cell; an amoeba remains an amoeba, and actually this is so for each cell you may consider. There is what we call self-maintenance at least for all the period of homeostasis, the normal life cycle of a cell, or of an organism. Each cell remains itself during its normal life span, despite the fact that sugars are burned inside, proteins are being hydrolysed, lipids are being synthesized, dozens of different families of nucleic acids are being made and other are being destroyed. How is this paradox of the self-maintenance possible? In fact, as shown here in the slide, this is the main job of the cell: to maintain itself.

THE CELL MAIN ACTIVITY IS  
 TO MAINTAIN ITS OWN IDENTITY  
 (SELF-MAINTENANCE)  
 DESPITE THE ENORMOUS NUMBER  
 OF TRANSFORMATIONS  
 AND THE CELL DOES SO  
 THANKS TO A PROCESS OF  
 RE-GENERATION FROM WITHIN

self-maintenance from within,  
 due to a dynamic network of  
 interactions,  
 which are defined and  
 constructed  
 by the system itself"

18. And the answer is simple, and profound at the same time. The cell is always the same, because the cell regenerates from the inside all compounds which are being consumed up.

This of course at the expenses of the nutrient and energy that comes from the outside. The cell is a factory which re-makes itself from within, so as to remain the same. (see slide). This provides a definition of life, and actually such a definition, is a universal truth, in the sense that there is no living organism on our earth, which does not comply to this. And you see also some citations of Maturana and Varela, from their famous book, "The tree of Knowledge", where it becomes clear that what the cell does, is actually the remaking of itself. Do not confuse this re-making from within with self-reproduction, by which there is a multiplication of the cells. This is altogether a different phenomenon. Here we are talking about re-generation from within, namely internal renovation.

LIVING SYSTEMS TRANSFORM MATTER  
 INSIDE THEMSELVES  
 IN SUCH A WAY THAT THE PRODUCT IS THEIR  
 OWN ORGANIZATION  
 Maturana and Varela

The cellular definition of life:

A system spatially defined by a  
 boundary of its own making  
 and that is self-sustaining  
 by re-generating all system's components  
 from the inside

*Whenever you encounter a network  
 whose operations eventually  
 produce itself as a result, you are facing an  
 autopoietic system. It produces itself. The system  
 is open to the input of matter but closed with  
 regard to the dynamics  
 of the relations that generate it."*

MATURANA 2004

And what is true for a cell, is true for every macroscopic organism. I lose most of my haemoglobin every few days, but this is fabricated again from within my body. I shave every morning, but the bird comes out again –from within. And the apple tree loses its apples and leaves in winter, but it will make all again in spring and summer-from within.

19. Notice that all this is strictly chemical. Maturana and Varela insist on this concept, that life is molecular, and they even talk about living machine. I mention this, because Francisco' life has been profoundly influenced by Buddhism and by HH, and the fact that for him, Francisco, life is simply mechanical may appear surprising.

20. A complete discussion and treatment of autopoiesis would be very long, and I must stop here for time limits. First, let me say that with autopoiesis we have answered to our initial question: what is the difference between an organised artificial system, and a living one? But autopoiesis, in addition to tackling the question "what is life?" has deep implications also for epistemology at large. Unfortunately, we do not have the time for that, but let me add a couple of concepts concerning the interaction with the environment.

The first thing to say, is that every living organism, in order to live, must be opened to the flux of energy and nutrients from the environment. In the language of science, we say that the living is a **thermodynamically open** system- open to the flux of nutrient and energy, although in a very selected way.

**Important in autopoiesis:**  
Relationship between structure and self-organization  
**Self-organization** is the invariant property, the relationship between the processes that produce the components  
The **structure** may be contingent, and may vary depending on evolution and other perturbations  
**Note: the two things are inseparable, there cannot be the one without the other in a living system**

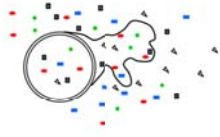
21. At the same time, Maturana and Varela insist on the fact, that each living organism is characterised by the so-called **operational closure**. It is in fact, a very important point, both for the theory of autopoiesis, and for philosophy of science in general. What does that mean?

It means that the "being an ant" is contained in the autopoietic internal organization of the organism and does not need any information from the outside. Likewise, the elephant does not need any information from the external world to be an elephant- all is in his internal circuits. This operational closure does not mean that there are not external stimuli-but they act as triggers, without modifying the invariant system's organization. Thus, if I kick a dog, the dog will react out of his dog-ness; an elephant out of its elephant-ness. Of course, each organism interacts with the environment, in force of what we have said before. But this interaction is specific, is due to the particular organization structure of the individual- a specificity which is mostly due to the long story of evolution. Thus, a fish has a series of developed perception tools which permit the life in the ocean; the bat, the butterfly, the earth worm, have each quite different sensorial systems and consequently quite different interactions with the environment.

## 2.2.: COGNITION

Maturana and Varela speak, in this case, of **cognition**- a quite broad and complex notion. They say that each organism is a cognitive organism, even bacteria, in the sense that each

organism is provided with a sensorial system capable of recognizing, and interacting favourably, with its own specific environment.



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



22. And about the bacteria being alive and having no mind, is an important issue between science and Buddhism. let me say something about a personal experience. A couple of years ago I was teaching in a Buddhist monastery in Bhutan, and actually it was a nunnery, a monastery of nuns. You can see here, just to rest from my harder science expressions, some nice picture of that region of the world, and here you see also my students, the nuns. I was teaching them science, very intensively for two weeks, not to convince them about science, but to tall them simply what modern science was about. I even shown to them the birth of a child, starting from the decondition of the mother egg cell by the spermatozoa, then the embryo,the foetus, till the coming out of the baby-with crying and clapping of hands for happiness. This was a teaching of four hours a day for two weeks.





And we had several controversies between science and Buddhism, and here for example is their answer to my statement, that bacteria are alive, but have no mind:



YOU SAY BACTERIA ARE LIVING, BUT HAVE NO MIND. NONSENSE!!!



and another controversy was of course about reincarnation, see here:

At the meeting, also came some Lama and Rimpoche of Bhutan, and the whole things developed into a dialogue between Buddhism and science, with questions of this kind:



...IF THERE IS NO SELF, WHO IS RE-INCARNATING?

but the most important point was that about live without consciousness. It is an important point and certainly the Vedanta people would be on the side of my nuns and contrary to the science view. We can come back to this point later on.

### 2.3. LIFE FROM WITHIN

23. But let me go back to the question of cognition. And actually this cognition brings about a particular interaction with the environment, which takes generally the form of creation of a particular world. See here the examples of the spider, of the termites, and also of humankind. It is not an exaggeration to say that the **organism creates his own world**, thanks to its own specificity of the internal, autopoietic organization. The general mechanism of autopoiesis is invariant, always the same, but the internal structure is different from organism to organism—clearly the spider is constructed internally in a quite different way than the fish, but they all

work with the invariant mechanism of autopoiesis, the principle of re-generation of the self-maintenance from within-be a fish or a bat.

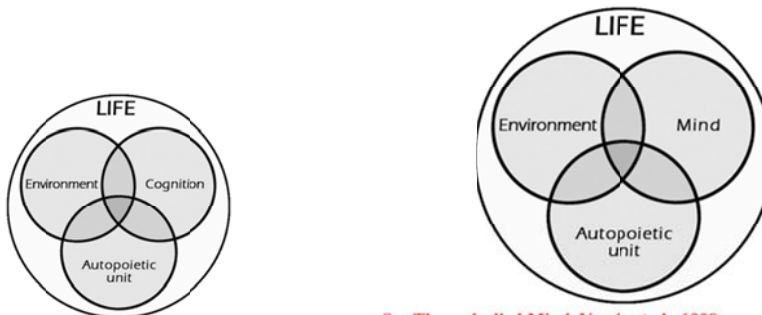
But this means that there are as many world as many organisms; here comes the notion of many **multiple worlds in parallel**, a notion well known and accepted in Buddhism. From the epistemic point of view, this means the disappearance of the concept of objectivity, something outside there which is equal for everybody. This is so also at the level of humankind. If I look at a rose, me, as a western Italian who knows about romanticism, Romeo and Juliet, etc. Then the rose has a certain value. For a Tibetan who has never seen a rose in his life, the very looking at a rose evoke a quite different world.

It is clear then that this view from within corresponds to a very particular epistemic position as far as the seeing of the world is concerned. Varela calls this “**enaction**”, as Francisco like to invent new words, I like to call it co-emergence between the organism and the world, at any rate, objectivity disappears, and scientists who accept this view often have the impression to stay on shaky ground. Where is then the solid tissue of science objectivity?

24. And there is another conceptual consequence of this view from within. Given what we have called internal closure, the observer, the scientist, is not able to penetrate inside the world of the organism he is watching. Let me explain with a simple example this point. The biologist looks at the amoeba and says: “The amoeba swims and goes up in a sugar gradient so as to get nutrients”. This seems to be a very safe statement. But it is not really correct, or better, it should be specified that this is only the subjective experience of the observer. The amoeba, from its internal closure, does not know anything about gradients, sugars, nutrients-she has no intentionality, no mind, no consciousness. But the amoeba is a cognitive being, and its cognition means, that it does what its internal, autopoietic organization is made for. In particular, the surface of its membrane is such, that a difference of concentration between two close points determines a mechanical contraction, a propulsion, but it would be an epistemic mistake to say that the amoeba moves in order to do something that our mind defines intelligent or purposeful.

### 3: THE GLOBAL IMPLICATIONS OF SYSTEMS THINKING

25. Let me go now to the last part of my presentation. Having said that cognition is essential to life, as Maturana and Varela state, then a more systemic view of life should be seen in terms of this trilogy: the autopoietic, organic structure, environment, and cognition, whereby these three entities complement and integrate themselves. At the level of man, cognition corresponds to the 5 senses, plus mind, our capability of thinking and imagining.

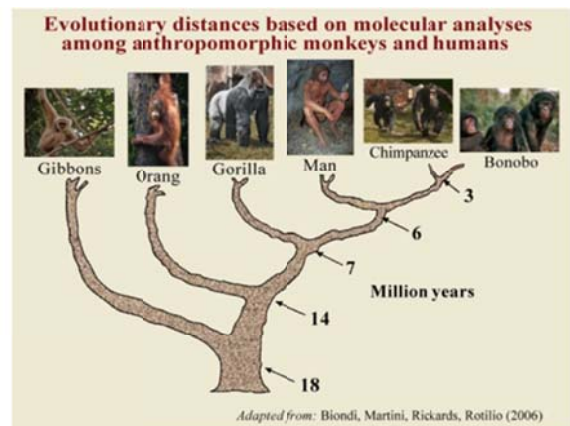


See *The embodied Mind*, Varela et al., 1998



The arising of Man was not obligatory: is a product of contingency, and if he would have not being born, Nature would certainly have not missed him.

According to the common secular view, consciousness, spirituality, the very idea of God...are products of evolution, are mind self-generated values



#### FROM 1950 TILL TODAY

- WE HAVE DESTROYED ONE HALF OF THE EARTH FORESTS
- INSERTED IN THE ATMOSPHERE LARGE QUANTITIES OF CO<sub>2</sub>, METHANE AND OTHER
- WITH A GLOBAL INCREASE OF TEMPERATURE OF 0.5° C; WHICH CAN GO UP TO 2 DEGREE
- WE CREATED A LARGE OZONE HOLE
- 65% OF LAND, ONCE GOOD FOR CULTIVATION, IS NO LONGER AVAILABLE TO FARMERS
- AND ONLY 12% OF EARTH SURFACE IS LEFT FOR THE CONSERVATION OF NON HUMAN SPECIES
- WE HAVE A LOSS OF BIODIVERSITY ABOUT THOUSAND TIME HIGHER THAN NORMAL
- WE CONTINUE TO PRODUCE NUCLEAR WASTE
- ALMOST ONE THIRD OF THE WORLD POPULATION LIVES WITH LESS THAN A DOLLAR/DAY

HUMAN CONSCIOUSNESS:  
THE APEX OF EVOLUTION  
(???)

26. And then there is even a higher degree, that of consciousness, the knowing that we know. This is indeed a very complex business, particularly if we consider the subjective, experiential side of consciousness. However, let us remain in the more common meaning of this term, that of awareness and ethical responsibility. This is in a way the Christian meaning of consciousness, the discrimination capability between evil and good. We can even add that man, of all the creatures of this planet, is the one endowed with the highest form of consciousness, for somebody man is the crowning of creation, and consciousness- the capability of discriminating the good from the evil-is the crowning of mankind. But then, if it is so, why is the man the only animal who destroys his own habitat, his own planet? See for example what we have done from 1950 (slide)
27. Capra and I devote the last 200 pages of our book to these problems of the world today, indicating, as many other concerned authors do, that the main root of our problem is the obsession of producing more and always more.

THE OBSESSION OF POLITICIANS AND ECONOMISTS FOR UNLIMITED ECONOMIC GROWTH MUST BE SEEN AS ONE OF THE ROOT CAUSES, IF NOT THE ROOT CAUSE, OF OUR MULTIFACED GLOBAL CRISIS. ...THE GOAL OF VIRTUALLY ALL NATIONAL ECONOMIES IS TO ACHIEVE UNLIMITED GROWTH, EVEN THOUGH THE ABSURDITY OF SUCH AN ENTERPRISE ON A FINITE PLANET SHOULD BE OBVIOUS TO ALL

Capra and Luisi p.366

From this comes the absurd energy consumption, mostly based on fossils, carbon and petrol, with the corresponding production of CO<sub>2</sub> and methane, together with other pollutants, which cause the increase of temperature, which cause the existence of the multinational and the misery of entire populations.

In this we are sharing the concern of pope Francesco (slide) and the concern of several economists, who do not see a bright future for our world.

*« Laudato si', mi' Signore, per sora nostra madre Terra, la quale ne sustenta et governa, et produce diversi fructi con coloriti flori et herba ».* (S. FRANCESCO)

Questa sorella protesta per il male che le provochiamo, a causa dell'uso irresponsabile e dell'abuso dei beni che Dio ha posto in lei. Siamo cresciuti pensando che eravamo suoi proprietari e dominatori, autorizzati a saccheggiarla.

PAPA FRANCESCO, ENCICLICA 2015

And in fact the perspectives do not look terribly promising, despite the recent upraise of global consciousness in favour of the global warming and corresponding thermic devastations. See my next few slides on that.

We still go on with the ideology of "more and more", and the problems are when this more and more comes at the costs of poorer people, as Francesco again mentioned:

Quando l'essere umano pone sé stesso al centro, finisce per dare priorità assoluta ai suoi interessi contingenti,..... tutto diventa irrilevante se non serve ai propri interessi immediati.

PAPA FRANCESCO, LAUDATO SI, 2015

When Man pose himself at the center, he tends to give absolute priority to his own cortingent interests, .... all the rest becomes irrelevant unless it serves his own immediate interests



However, we also present in the book the view of several economists, who see the possibility of salvation, based on a different actions and ideas. There are many people working in the right direction, and in the book we summarize these idea giving also addresses of most of the non government organizations which are working in these directions.

Will we succeed? Difficult to say, but the direction is again an improvement of our being human, an improvement of our consciousness, as indicated by another spiritual man, Albert Einstein:

**A human being is a part of a whole, called by us "universe", a part limited in time and space. He experiences himself, his thoughts and feelings as something separated from the rest... a kind of optical delusion of his consciousness. This delusion is a kind of prison for us...Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty."**

**Albert Einstein**

#### **POEM OF THE NUNS, THE LAST DAY**

**YOU HAVE TRAVELED FROM FAR, ALL THE WAY FROM  
ROME**

**TO TEACH US ABOUT THE BIG BANG, EVOLUTION AND  
CHROMOSOME**

**THROUGHOUT OUR WINDOWS NEW LIGHT HAS COME  
BRINGING NEW QUESTIONS, LIKE WHO IS DOLLY'S MUM?**

**YOU EVEN TOLD US WE EVOLVED FROM BACTERIA**

**REDUCING OUR EGO AND BRINGING MUCH HYSTERIA**

**YOU EVEN AROUSED THE CURIOSITY OF OUR RIMPOCHE  
OF YOUR THEORIES, HE WAS LEFT WONDERING OF WHAT  
TO SAY**

**AND THEN THERE IS THE QUESTION OF LIFE AND MIND**

**AND IF CONSCIOUSNESS EXISTS BEYOND MANKIND**

**AND AS THESE DEBATES WILL CONTINUE INTO THE NIGHT**

**WE WISH YOU TO RETURN AND CONTINUE THE FIGHT!**

28. We can resume this discussion here, as it is indeed one main problem between Buddhism and science. But I like to close by showing you the poem that the nuns wrote to me when I left, which, in its sweetness, also coils some of the basic contrasting questions between science and Buddhism.

#### **ADDITIONS**

Looking in particular at life sciences, we can say that there is still a large emphasis on molecular science, meaning by that the the notion of molecular organization is central: think for example to

all genetics, based on the notion of genes-which are large, specific sequentially ordered macromolecules; and the entire field of molecular biology, pharmacology, medicine chemistry, and the applicative side of synthetic biology, agricultural chemistry, petrol and industrial chemistry---all centred on the chemical notion of molecule and its organization in larger assemblies.

Let us consider now how all this compares with old induistic thinking. The Vedic hymns describe this 'seed' or singularity as the source of all creation, and clearly the most important feature of Vedic cosmology is that it begins with fullness and unity and proceeds from there to establish an integral web of causation. Science, on the other hand, begins with chaos and disorder and tries to reconstruct a prior principle of order. The Universe, says Aurobindo, is not a random field of infinite possibility. It is rather a purposeful, meaningful and measurable unfolding of a predetermined plan. [Materialism \(Cārvāka/Lokāyata\)](#), [idealism \(Sankara's Advaita\)](#), and [interactive substance dualism \(Sāṃkhya\)](#) cannot explain this without making category mistake. I cannot find anything that cannot be explained in the eDAM (*Dvi-Pakṣa Advaita*) framework.

From the article sent by mauro)

As Abhinavagupta tells us,

“As the adage goes, ‘Everything has the nature of everything else.’ Even those things which are by nature mere object, insentient, if they abandon that form as object, they become capable of participating in the forms of subjective awareness and of address, the first and second persons. For example, “listen O Mountains” and “of mountain peaks, I am Mount Meru” ([2], p. 212).[\[14\]](#)

Abhinavagupta postulates a fundamental transmutability of the physical and the phenomenal. He suggests that phenomenal experience is a matter of a modal shift.



To this extent, that which is “conscious” contains both perceiver and object and doesn’t have this distinction made between itself and the other, the object perceived. Yet that which is conscious gives rise to both of these, limited subject and object. And even while consciousness exists in that way, as undifferentiated, at the same time out of its own nature, that is out of its own form, which shines as only pure consciousness alone; it gives birth to things that, like blue, etc. are said to be insentient, things that lack consciousness. So it does not abandon its own form as pure consciousness alone shining ([6], p. 292).[\[22\]](#)

That is, the object as well the subject perceiving the object both derive from consciousness.

To conclude then, it is probably fair to acknowledge that Abhinavagupta’s conception of the mind-body split derives initially from a position that favors the phenomenological pole, the “subject” formulation of consciousness and matter. This

perspective is one he inherits from the wider landscape of Indian philosophy, which, unlike our contemporary Western models of materialism, tended historically to minimize a materialist position, even as the legacy of Sāṃkhya, like Descartes legacy, initially proposed a mind-body dualism. However, Abhinavagupta adds a great deal to possible ways of thinking about the mind-body split. His monist position of a spectrum of a subject-object continuum offers a way of incorporating an idea of what Chalmers calls the phenomenological, and what Abhinavagupta points to as the subjective, while managing to avoid an essentialist dualism between the phenomenological on the one hand and the psychological, the neurons firing in that mass of matter called the brain.

18.

Actually, let me recall an episode with Francisco: in my lab at the Federal Institute of Technology in Zurich, the famous ETHZ, we developed what is known as **chemical autopoiesis**, in which the autopoietic units were simple micelles, tiny soap bubbles, which were making themselves from within the bubble. And when we wrote a paper together, Francisco wanted to put in the very title, that we were proposing a living system-that our micelles were living. When I refused to do so, he smilingly accused me to be a romantic, and to keep to a definition of minimal life which were too spiritual. This surprised me. But you see here the example of a scientist, Francisco, who makes a clear division between his profound spirituality- and the interpretation of life as a biological phenomenon



18. My personal position as scientist is somewhat critical about some of the aspects of this notion of emergence. Let me briefly explain why and how.

When a stack of different metal disks give rise to electricity as a novel property, this is of course to be accepted, as you can always repeat the experiment, and you see that the emergent property indeed comes out from this operation of putting the disk of the two metals in top of each other. Likewise, I see well that, when you make a family starting from single individuals, new properties-the properties of the family- emerge, which were not present in the single individuals. In can see that daily. And when single lines combine to make a tetrahedron, I see that by this operation new properties-surfaces and space- are created-

and this can also be repeated easily. Quite different is the case of mind and/or consciousness. I do not have any way of putting neurons together and show that by this operation, the thinking emerges. Thus, to talk about emergence at this level, or at the level of consciousness, is an abstraction-an assumption. It is not the same as in the case of electricity. And I could say almost the same in regard to the definition of life as an emergent property-as nobody has done the experiment of taking the separate elements, put them together, and see that life emerges in this way. In conclusion, I, as scientist, am critical about the application of the word “emergence” to all cases in which this is an assumption without any experimental direct demonstration.