Living Networks of Networks: The Societal and Environmental Responsibility of Humanness in The Fighting Steps and the Escalade of Violence between Man and the Wild.

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Abstract

To survive that is first "to eat and not to be eaten", but "soon or late every living being is eaten". With that single law, through a systemic and cybernetic approach, we can explain the origins of the current crises of survival for the life on Earth due to the mankind escalade of violence against the Wild.

Man is the enemy of the other non-domestic and "non-useful" species of the Wild. Education must focus on developing the human's capacity to be a keystone species for a "natural sustainable and nature sustained" economic, social, and ecological development. Because, like every predator, Man is an endangered species!

key words: antibiotic resistance, Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages (ARMSADA) http://www.armsada.eu, ecoexotope, emergent viral disease, percolation.

Introduction: *More and more.., but until when?*

The International Standard Organization stated in October 2010 "ISO26000" on "Social Responsibility" advising human societies and organizations to behave in interdependency with an holistic approach. Man species is growing up each day! But to grow that is "to eat and not to be eaten" (Bricage, 2000a). What does that mean about the Earth management? Man shares it with other inhabitant species (Bricage, 2004a)!

Higher is the number of people on Earth, higher is the quantity of food needed.

So Humanness is invading, eating or destroying more and more wild ecosystems (Bricage, 2010b). To allow the survival and growth of more and more domestic vegetables and animals as food stuff -but only for himself- Man is using more and more artificial chemicals (Bricage, 1975) and more and more violent practices against the Earth as a Whole (Bricage, 2000b).

1. Our global ecoexotope of survival -the Earth- is limited.

Each living system -an atom, a cell or a forest- is a system of systems (figure 1). Its global biodiversity results from a steady state of interactions between all of its local embedded and juxtaposed systems. It is "the sum" of various local energetic chains integrated into a Whole, an endosyncenosis. The spaces (volumes and interfaces), the times (delays or durations) and the possible interactions are limited (Bricage, 2001, 2010a). Each living system has a capacity to be hosted by a peculiar hosting ecosystem. Man species is sharing with all the other living species a common ecoexotope -the Earth- whose capacity of hosting is limited.

Biodiversity is the amount of the different species who are sharing the same place at the same time. Since billions of years, the growing populations of different species, soon or late, are competing for the same water, minerals or organic food. The Man's food chains' economy and the Wild's one obey to the same laws. Man and his associated species are in conflict with all the others Man's non-associated species in the Wild. Man versus Wild: who will win? Maybe the both will lose?

Only one human species is surviving today. All the other ones are dead.

2. To survive that is always, first, *"to eat and not to be eaten"*.

In the Wild and Human parts of the Earth, animals are eating animals or plants.

2a. No survival outside a food chain!

Each ecoexotope is structured with food chains networks in which all plant and animal endophysiotopes have a place. That is a great advantage to have a place, your life form can exist! But there are no advantages without disadvantages: ***"soon or late every living being is eaten"***, Man is not an exception! Biodiversity results from the network of interactions between all the local interacting species (figure 2). ***Each living species is integrated into an ecoexotope in which it is more adapted to that network of interactions than other species are.*** Continuously, Humanness is more and more invading the Earth spaces where she is eating all she can. That is a great advantage to be an omnivorous species! But, to survive, the Wild species also must eat and not be eaten. All that is an advantage for the Man is a disadvantage for the Wild.

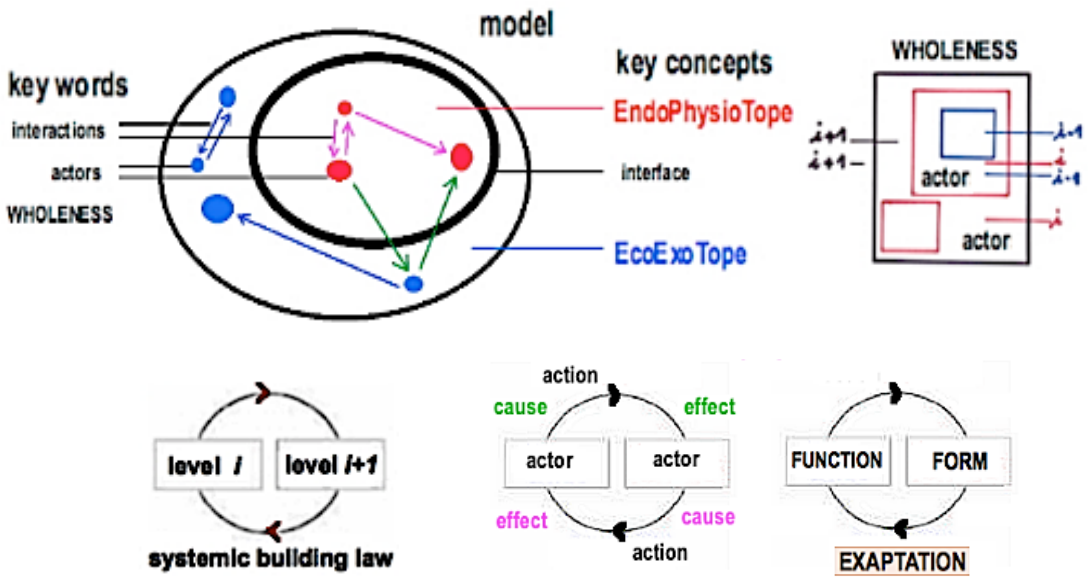
2b. No food chain without a keystone species.

Different food chains, even not in the same space or the same time, can be stressed by a same factor that alters the survival of only one step. At the bottom are always organic producers, like green plants. At the top are organic eaters. Animals are always consumers. The organic producers destruction always results in the chain destroy: they are keystone species, their disappearance results in that of the whole chain.

Overexploited populations can collapse. No population increases without limit.

In a Whole the change of the number of actors or of the network of interactions is the result of a percolation process. This percolation process of emergence of a new network is a metamorphosis with 3 simultaneous processes: -ancient actors disappear during the interactive process of integration of new actors, -new actors, that were not there before, are integrated into "the coming network", -ancient actors are conserved but "transformed" in their action, in their place, or in their time of action. Integration is depending on the age and stage of the actors, the interactions and the Whole.

Figure 1.



<u>Figure 1. A system: a network of interactions between actors but first a wholeness</u>!
A system is made of 3 types of entities: -**actors**, -a set of **interactions** between and within actors, -the Wholeness. It is a collection of elements interconnected in such a way that if we act on one we act on all. Due to the juxtaposition and embedment of the actors and the transdimensional recursive network of their operational relations, a system is *a system of systems* in which the **endophysiotope** (endo: internal, tope: space-time, physio: of functioning) of a ***i*** level of organisation is the **ecoexotope** (exo: external, tope: space-time, eco: of inhabitation) of adjacent ***i-1*** levels. Due to the retroactions between actors -and levels of organisation- on each others and the recursive nature of their interactive transformations and changes:

"*interaction is construction and construction is interaction*."

("<u>systemic constructal law</u>": Bricage, 2000a, 2000c, 2004a, -afscet creative commons-, http://www.afscet.asso.fr/SURVIVRE.pdf , http://www.afscet.asso.fr/JdVie1.pdf)

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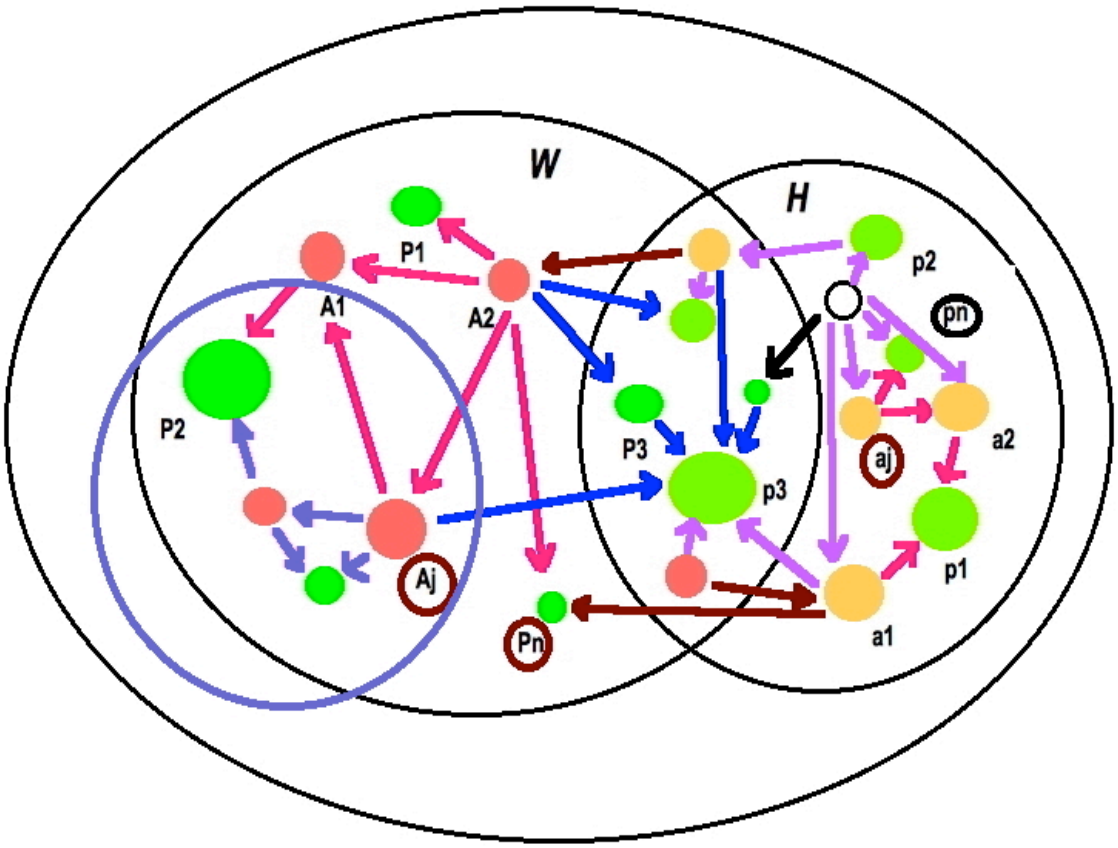
Figure 2.



<u>Figure 2. Each system of systems is a co-network of interactions between actors</u>.
W wild species' <u>ecoexotope</u> (actors: **A** animals, **P** plants, biodiversity of animals **Aj** and plants **Pn**), **H** domesticated Man's species <u>ecoexotope</u> (actors: **a** animals, **p** plants, biodiversity of animals **aj** and plants **pn**). The survival of each part -**W** and **H**- of the Whole is the result of their agoantagonistic interactions. Arrows indicate the way of the eating process (from the eater to the eaten) in each food chain. The value of the local biodiversity is the result of a steady state due to a percolation process: **p1, p3, P2** are respectively keystone species of the **H** part, the **W** part and their interactive part (where Wild and Humanness are co-existing). All food chains are juxtaposed and embedded into circular networks of matter and energy flows ("*Qualitative Animated Semiological Holistic*" model, diagram n° 12b -ues, creative commons-, Bricage 2011c). That collection of collections of co-active elements is interlinked in such a way that if we act on one we act on all!

Connectedness in a network often shows a threshold behaviour. When there are few connections there are isolated islands of connections and the largest connected group is a small fraction of the total members in the network. However, at some point, the addition of just a few more connections can cause a substantial fraction of the network to be connected (Riordan & Warnke, 2011).

2c. Man species is a keystone species for Man's domesticated species.

Man is more and more destroying or domesticating all the Wild species he can, to make food, or to make energy to have more food. He is in competition with wild animal species to eat wild plants or animals and with all wild species to grow the domesticated plants and animals he is eating. ***The survival of an actor into a chain depends both on that of the adjacent superior and inferior actors of the chain: "Interaction is construction and construction is interaction."*** Man is a keystone species for the survival of all the domesticated species he is eating alone!

3. *"All that does not kill a species makes it stronger."*

First inhabitants of the Earth, more diverse than any other life's form, the Monera are sharing a common ecoexotope of survival: the endophysiotopes of all the living species. Through waters they can move everywhere, without barrier! Man is using chemicals to kill those livings that can eat his plants, animals and himself.

3a. More and more drug resistant species.

The use of biotoxic chemicals is a great advantage. But the use of antibiotics has always unexpected side effects outside the Man's biome: -species of the Wild's biome may be favoured and turned as invaders, -species of the Man's biome may be freed of predators that were regulating their growth, -new consumers of food chains may arise because of a new availability of food, -new bacteria species may invade Man's plants or animals and Man, -to survive bacteria species become resistant to toxic chemicals, -soon or late, the resistance is transferred between species of the Wild's biome and from it to species of the Man's one. This increases the death of domesticated species.

Soon or late, the advantage of the chemical is turning into a disadvantage.

Everywhere the malaria vectors mosquitos species are more and more resistant to insecticides. There are now bacteria that are resistant to all the available antibiotics. They survive better in the hospitals where there is a lot of antibiotics and they can invade us. New antibiotics' resistant invaders from the Wild can infect all the Man's biome species. Each new pesticide, herbicide, fungicide, insecticide can not kill all the living beings but, soon or late, it does select rare resistant ones.

And all that does not kill a living being makes him stronger.

3b. More and more diverse viruses.

With air and water flows, viruses can move everywhere. They are hosted and protected into the livings they inhabit and are moved with their moves. Viruses are eating all living forms, cells or bacteria. In marine ecoexotopes, like coral reef, viruses are 10 times more abundant than bacteria (that are 10 times more abundant than cells). Their genomes are smaller and genes are continuously and easily transferred among each other and the bacteria (or the cells) they infect. Viruses account for 94% of the nucleic acid-containing entities in the marine ecoexotopes (Gitig, 2010).

The entire gamut of functional genes is present into the virome. Viruses globally influence all the metabolic processes by storing genes that can get shared among their common ecoexotope of hosts. Their biodiversity is the result of the global changing of the plant, animal and bacterial biodiversity. Flows of viruses burst from Wild species to domesticated animals and to Men at the end (Bricage, 2011a). When Men disturb the ecosystems -in sea water by overfishing, or in land soil by treating with high nitrates flows- they affect the microbial communities of bacteria, cells and viruses. Useful bacteria or viruses may become less abundant. Pathogens can become more virulent. That has a great effect on the whole biosphere health. But microbes metabolic processes are so diverse and stable that their communities maintain their diversity and stability. Viruses kill bacteria (or cells) on a strain level. But each killed strain gets replaced by a similar one (de Waal, 2012). So the Wholeness -at the bacterial and viral levels- globally stays the same as the strains turn over. The microbial community of genes is not affected globally, but huge flows of deaths are running into the adjacent superior levels of cells and metacells organisms.

And finally that is the local molecular interactions (Lee & al. 2010), between proteins and nucleic acids, between proteins and metabolites, at the adjacent inferior level of survival (Bricage, 2009), that govern the survival of the whole superior level of the biosphere (systemic building law: figure 1). The Earth -airs, waters, soils and organisms-, is the property of the microbial communities!

With the industrial food producing, flu's epidemics are more and more frequent and influenza viruses are more and more diverse in their hosts requirements. Bacteria and viruses compete to eat living forms of the same food chain. Men's use of chemicals like herbicides may result in the death of wild plant species that were usually the ecoexotope of survival of viruses (the same with bacteria). This results either in the death of viruses or bacteria or in their invasion of other food chains. Man's endophysiotope is more and more an ecoexotope of survival for endangered bacteria and viruses. Viruses are eating bacteria, plants, animals and Men. Due to chemicals abuse by Man's industrial management of the economy of nature, viruses and bacteria flow from their endangered wild species to the domesticated species and to Man at the end! ***"Man is an endangered species!"***

Destroying a Wild plant population results in an ecoexotope change of their eaters, with a new load of disadvantages for domesticated keystone plant species. After the extinction of keystone plant species, a new network of food chains will arise through a percolation process. The last invaded hosts at the end of the chains are the domesticated species and Men (like in flus' epidemics). Viruses are invading from the Wild and create new emergent Man diseases. The selection of antibiotics' resistant bacteria species has created a new ecoexotope for ancient and new viruses that, following their genomic integration, give to their bacterial hosts new invading virulent properties (like in cholera and pestis pathogenicity). A keystone species, that was previously free of bacterial aggressors, may be endangered. ***Man is not an exception!***

A great pressure may result on any selective species that were previously free of bacterial eaters or invaders. Competition between bacteria may result in an increasing growth of a few bacterial species that were not pathogen initially and became so.

When scientists discover a new species that results from its hyperproliferation or the disappearance of its predators, changing the survival network of its ecoexotope.

3c. Man is an endangered species.

Man is a prey! Our cells embed mitochondria that are descents of bacteria that were eaten by bacteriophages. The use of herbicides to destroy wild plants results in the destruction of ecoexotopes of viruses and bacteria. If a species of viruses or bacteria does not become modified and improved in its integration into a new ecoexotope, it will be exterminated. So it does and flows into other hosting species! Changes in the percolation networking of predators and preys result in the emergence of new food chains and the disappearance of previous ones. This leads to a decrease in biodiversity.

Man is not an exception but an hosting ecoexotope like another one.

Maintaining and extending biodiversity is a key-process to struggle against aggressions (figure 3a). A world without bees will be a world without fruits and seeds of a lot of plants. Soon or late the vacant places of the biomes will be occupied by ancient or new adapted species: all the available places in a food chain are occupied! Whatever was the intensity of the extinction of species in the past, more and more diversification of the livings has occurred with new invaders of ancient and new ecoexotopes, new avoiders of new chemicals, or new evaders of Man's polluted ecoexotopes. Soon or late, new food chains take place. New patterns of hosts allow the expansion of ancient and new viruses or bacteria. Viruses are more susceptible to invade -and more aggressively- Man's biome species because they are genetically less diverse than Wild's species are. Soon or late, through a percolation process, Man will be a host!

When previous limitations are broken, full growth is the rule, as it is in cancer diseases, unless new limits stop it. The growth of antibiotics resistant bacteria allows the growth of new populations of bacteriophages. Mixing together into the same bacterial species, viral genomes can create new recombinant viruses. These new virulent viruses can, from host to host, invade Man's species. New antibiotics' resistant bacterial strains can do so too. Bacteriophages transporting the genes of resistance or virulence from a bacterial host to another one, new virulent bacteria lines will appear, like those of the cholera (Vibrio) or the pestis (Yersinia): an ancient virus integrated into the genome of their non-pathogenous ancestors. Many bacteria carry various mobile genetic elements contributing to their diversity and adaptability. Usually plasmids are very stable because the viability of plasmid-free bacteria is reduced. So, it is very difficult to make plasmids free except in endangered situations (Hale & al., 2010).

4. Environmental responsibility: only ARMSADAs will survive!

We must know all the actors and their interactions to make a prediction about the fate of a Wholeness.

4a. A minimal requisite variety is necessary for the survival of a Wholeness.

Even if we know the existence of equilibria between predators and preys into a lot of food chains, even if we know **qualitatively all the actors** and **quantitatively all their interactions**, in an ecosystem like a forest, when we kill a present species or introduce a new species, we do not know what the result will be (Bricage, 1991).

Figure 3.

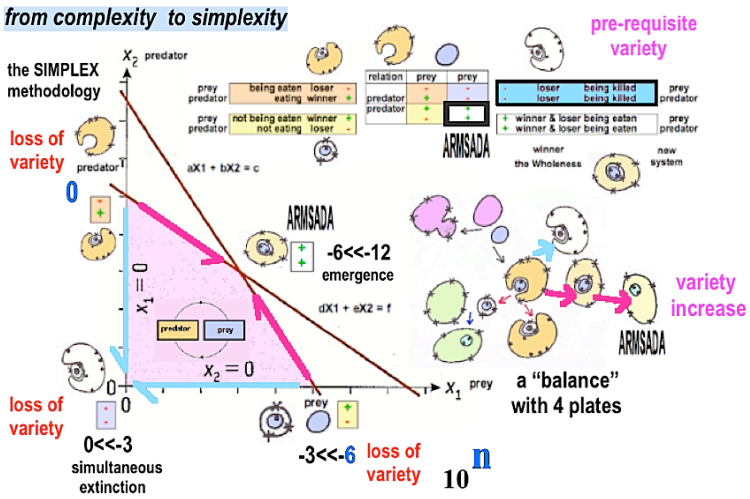


Figure 3a. **X1** prey (forest, bacteria, Man, chicken), **X2** predator (caterpillars, bacteriophages, viruses, Man), **10^{n}** probability of the result at the end of each struggle: **n= 0**, (near 100%) usually the predator wins! But it loses too! No more prey equals no more predator!, **-3<<-6** (less than 0.1%) exceptionally the prey wins!, **0<<-3** sometimes the two are reciprocally killed, **-6<<-12** (less than 1 per million, maybe 1 per billion): **ARMSADA emergence**, "impossible, but certain" at the time scale of evolution!

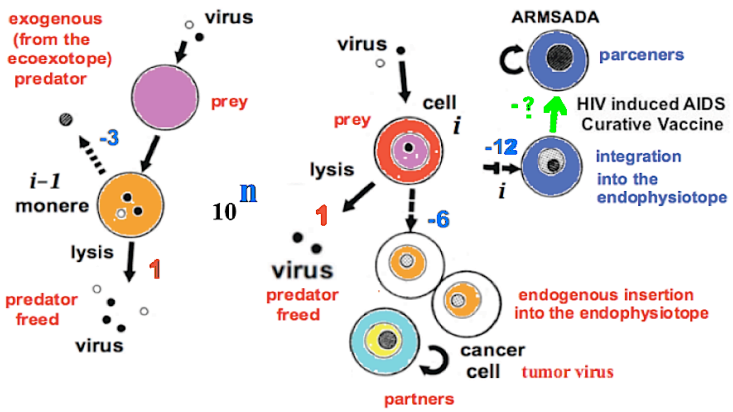


Figure 3b. Probability of the resulting organization at the end of each "struggle": soon or late, even the most rare event will arrive! **1** usually near 100% (0.999999999999), **10^{n}**: maybe frequently **n= -3** (0.001), rarely **-6** (0.000001) or extremely rarely **-12** (0.000000000001) but certain" at the time scale of evolution! (Bricage, 2008)

<u>Figure 3. The fate of the predator/prey "interactive play":</u> no survival outside an ARMSADA co-making, whatever the levels of organization that are involved in.
(Bricage, 2006, -afscet creative commons-, http://www.afscet.asso.fr/pbAnde06txt.pdf http://tinyurl.com/pbAnde06figures)

The loss of trees in the Amazon forest created hospitable breeding grounds for malaria-carrying mosquitoes: from 1997 to 2000, a 4.2% rise in deforestation resulted in a 48% increase in malaria cases! The Amazon Anopheles species proliferate in forest clearings, and fields, where the rate of mosquito bites is 278 times higher than in the middle of the forest! The CO2 fixation mean is usually less than 0.4 billions tons a year in The Amazon forest. But, in 2005 and 2010, because of a big lack of dry-season rainfalls, the forest has released respectively more than 1.6 billions and 2.2 billions tons of CO2 than fixed (Lewis & al. 2011). At least 10 years of usual fixation, of the previous healthy forest, without any future stress, are necessary to compensate! "Human made" "domesticated" forests -like pines one- with only 1 species, are like a corn field, and are less able to resist to ecological damages than natural wild forests! The climatic and biotic stresses are enhancing the human stresses **and reciprocally**.

Humanness is **now engaged in a positive feedback of loss** of biodiversity like the ones that, in the geological past, were at the origin of huge species extinctions.

4b. ARMSADAs are the guarantors of the biodiversity conservation and increase.

There is **only one fate** in the predator/prey dilemma (figure 3)**:** ***no survival outside an ARMSADA co-making, whatever the levels of organisation that are involved in!*** Usually the predator wins. But it is ***a game where the one who wins loses too***. A predator must have preys to eat. To survive that is to eat! Either the predator or the prey may win. They can also lose together. In all cases the biodiversity is reduced!

The obligate mutualism between leafcutter ants and their fungi functions like the lichen one (Bricage, 2000a). It originated 12 million years ago in the tropics. It is today extended into South and North America temperate regions. The leafcutter *Atta texana* sustains fungiculture during winter temperatures that would harm the cold-sensitive *Attamyces* cultivars of tropical leafcutter ants. Cold-tolerance of *Attamyces* cultivars increases with winter harshness along a south-to-north temperature gradient across the range of *A. texana*, with selection for cold-tolerant *Attamyces* variants. The *texana* populations are able to sustain fungiculture throughout winter because of their cold-**adapted** fungi and because of seasonal vertical garden **adapted**-relocation (maintaining fungi deep in the ground in winter to protect them from cold, then moving gardens to warmer, shallow depths in spring). The origin of leafcutter fungiculture was **an evolutionary breakthrough** that revolutionized the food chains of tropical fungus-growing ants. The original adaptations of this symbiosis to tropical temperatures and their dependence on cold-sensitive fungal symbionts **constrained** its expansion into temperate habitats (Mueller & al., 2011). Evolution of cold-tolerant fungi within the symbiosis **relaxed** constraints on winter fungiculture at the northern frontier of the leafcutter ants distribution, thereby enhancing **the ecoexotope's hosting capacity** of the obligate host–microbe symbiosis. The whole Ants' Society is an organism!

Only the emergence of an ARMSADA -at **the origin of a new blueprint** of life's forms (figure 3)- can increase the biodiversity and allow the resilience of Life. The domestication of a fungus species by an algal species (within the lichens), that of a fungus species by an ant species (with the leafcutter fungiculture), that of a population of a corn species by a human population are **the same evolutionary breakthrough**.

4c. *"The viral behaviour of Man species".* At what time scale?

The emergence of an ARMSADA, in which all that is an advantage for a partner is a disadvantage for all the other ones, is very rare. But soon or late, with the time, it comes. It is an *"**association for the best and for the worst**"*. It emerges when all the partners are losing together the capacity to kill the other ones:

"***For the One to survive all the other Ones must survive first!"*** (Bricage, 2000c)

The emergence of an ARMSADA ***"Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages"*** between **a human population and a peculiar species of a plant or an animal** from the Wild is at the origin of the so diverse modern civilizations. Man is "**a trademark" from the Earth's biome**. His species is the property of the Earth but the Earth is not his property! In Amazonia, Humanness is a ravager eating the wild forest, creating lysis plagues of loss of diversity. In Kansas, with fields of corn, sorghum or wheat, Man is a keystone specialist for the survival of domesticated plants. But with no Wild rest! Man's conquest of the interaction zone between the Wild and Human parts (figure 2) gives the least diversity. In the Libya desert, through irrigation with fossil water, Man could be a keystone generalist for all species, with the propagation of more life, more biodiversity and more to eat! But at what cost? Man uses his technology to be a keystone species, ***"for the best and for the worst"!*** Man behaviour is that of a virus. Viruses that are at the origin of cancers are destroying their ecoexotope (killing their organism of survival) and then, soon or late, they disappear. But viruses are at the origin of an ARMSADA through their integration into a new ecoexotope of survival (the endophysiotope of a bacterium or a cell) they are "eternalised", because of a jump in the scale of their space-time (Bricage, 2005a, 2005b). What sort of virus is Humanness?

To survive that is ***"to eat and not to be eaten"***.

"There are never advantages without disadvantages."

All the living systems emerged from an ARMSADA (figure 3).

Viruses may be regulators of the Life temporary steady states, through their control of **the "capacity of hosting"** of ecoexotopes and **the "capacity to be hosted"** of their endophysiotopes.

4d. Contingency: food chains are chains of transfer and accumulation of dangers.

There are 2,500 serotypes of Salmonella. Salmonella are adapted to the digestive tract of all animals. Their invasion results from the eating of crude or insufficient baked food. Into the intestinal flora, there is a struggle between our domesticated bacteria and the pathogenic Salmonella. Antibiotics did not only killed the pathogenic bacteria but also the domesticated ones and resulted in the proliferation of antibiotics resistant bacteria, like the agent of botulism Clostridium difficile. The resistance is transferred form a bacterium species to another in less than 1 year!

Algal blooms cause worldwide economic and ecological damages. The harmful alga *Aureococcus anophagefferens* outcompeted phytoplankton in waters with elevated levels of dissolved organic matter and turbidity. The algal genome contains genes that facilitate dominance during blooms, with more genes involved in light harvesting, organic carbon and nitrogen use, and encoding selenium- and metal-requiring enzymes, and a larger genome, compared with those of competing phytoplankton species.

Genes for the synthesis of microbial deterrents permitted the proliferation, with reduced mortality losses during blooms. The **anthropogenic activities** resulting in elevated levels of turbidity, organic matter and metals **opened a new ecoexotope** -within coastal ecosystems' ecoexotopes- that ideally suited the unique genetic capacity of *A. anophagefferens* and facilitated its harmful proliferation (Gobler & al. 2011).

There are never advantages without disadvantages!

Man uses his technology for the best and for the worst!

Whatever the pollutants -radiations, chemicals (heavy metals, hormones) or bioproducts (toxins, bacteria, viruses)- and the way (absorption by water, air or food), Man is always the final acceptor! Not only pathogenic bacteria, their toxins, poisons or viruses, but also radioelements are flowing through food chains and are stored at the end of the chain into the final eater. Man's **abuse** of chemicals like herbicides may result not only in the death of wild plant species, and domesticated ones, but also in the introduction in the matter flow of unusual aminoacids into proteins (Neerathilingam & Markley, 2010). Bacteria are particularly able to mutate to use them, but complex organisms can not! Bacteria are also particularly able **to avoid that advantages turn to disadvantages** and they **easily transform disadvantages into advantages** (Woods & al, 2011). The "mutator" phenomenon allows clones of asexually reproducing bacteria to evolve at different rates, enabling bacteria to escape antibiotics selection pressure. After several hundred generations, clones of Escherichia coli that had initially showed low competitive fitness outcompeted initially more successful clones. ***The apparent losers turned into winners***, not by increasing mutation rate and running off with the innovations, but because their competitors acquired mutations that, ***while conferring superior fitness in the short term, in the longer term hindered their "evolvability.***"

Locally, the “diversity conservation” is not only linked to the education of people. It must be a way of life! Globally, only international organizations are able to durably preserve a collective common living heritage (Bran, 2011). This is an investment that has a cost but it can save money! There is no need to talk about climatic or technologic **catastrophes, “of the usual nowadays life“**! They just **accelerate the process** of extinction of our species due to its too high degradation of its ecoexotope. There is no need to argue about the rediscovering of the Life's laws of the Living Systems (Haines, 2011). **Only 1 law is needed: “to survive that is to eat and not to be eaten“.** Every year, 4 millions of men die of hunger and 40 millions are eaten by infectious organisms!

A system cannot be understood through a local analysis, but through a global synthesis, looking at it as a wholeness within its ecoexotope. In the case of the Living Systems Man deals with messes of interrelated de-controlled dangers with huge unintended systemic actions and reactions. There is no need to talk about control processes! **Finally, soon or late, there is only 1 process: “percolation“**.

We must help the natural goods sources to save themselves -to face dangers- by taking part both in their global conservation and local recycling. Locally, in its territory, everybody is an actor. Are the today crises, like the deforestation, the waters and soils pollutions or the large-scale accidents, either the consequences of a too proud science or the consequences of a non-consideration of an inaccessible science to people, a non-consideration of a future outside its own generation?

Trophic cascades can occur when the consumption of one species impacts the abundance and distribution of species at lower trophic levels. Such cascading effects have been documented across all the ecosystems, and often the top consumers -such as predators or large herbivores- have been lost due to Man activities over the last several thousand years (Estes & al., 2011).

5. Societal EcoResponsibility: only will survive the Associations for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages.

One-sixth of the human world population, **more than 1 billion people, does not have access to fresh healthy water, to drink or to cook.** The Earth is limited!

5a. **Variety/diversity is a living, reproducible and recycled, money-making capital.**

To "eat" food or money you must each day have a local "part of a pie", your food or money capital. But you can not eat the pie and have the pie! The size of the global pie is limited (K), so when the number of eaters (Q) increases, the size of the individual part (q) decreases, qQ=K (Bricage, 2011b). Living systems **can not create virtual** organic matter and **their flow** of synthesis **is limited**. So they will recycle. To allow more and more eaters to survive, the food of the ones must be the waste-products of others! So must do economical organisations! Goods may be recycled to have more goods. But goods can not be created from nothing. Just virtual money can be! Increasing food, goods or technology allows to increase the creation of actors and groupwares to resist to higher stress. They must not be virtual but real! A society which is making quantity, "more and more growth" and growth only, is addicting and destructive. On the contrary, a society which is making quality (diversity of products) is producing novelties and owns a capital of adaptive skills to face dangers (Bricage, 2011c).

Living systems do that through **the juxtaposition and embedments** of metabolic chains, at the molecular level, and of food chains, at the ecosystems level. Ecology is the economy of the limitations of Nature: **there are no gains without costs, there are never advantages without disadvantages.** And the living systems gains are different when we jump from an emerging level of organisation to another one, compared to the kind of gains actors can obtain when they move within the organisational state of a level (Bricage, 2009). Economy must learn and practice in the same way Ecology does.

5b. ***Never freedom without duties!***

We can evaluate the advantages and disadvantages de **la "soumission de l'homme à la nature" (**Serres, 1990). We know the consequences of poisoning Nature. To survive that is first to eat! Soon or late, all the poisons end into our plates, and concentrate into our bodies. The progress of knowledge and techniques brings both advantages and disadvantages! Our "childish species" must acquire an holistic attitude: Humanness must pass a societal and environmental exam through the design of a symbiotic deal of reciprocity with the whole Nature.

In economy and ecology, ***the alleloramic attitude*** consists in constantly making sure that a correspondence is established between the micro- and macro-scales.

They are looking and reflecting each other!

It is necessary to go out of the religion of the market by bringing conceptual, ethical and psychological limits on the merchandising of the world (Benkirane, 2009):

- **the consciousness of limitations and the measure of the limits impose temperance**,
- we need to develop the behaviour to prevent and forecast. **To be cautious** means ordering the purposes and means, **weighing and distributing reciprocally and mutually** the advantages and disadvantages!
- The justice is first equity: "a place for each one and each one at its place", "each one the owed according to its needs and role".
- The strength of Humanness is in the necessary courage for the implementation of this program, with the perseverance, the endurance and the enthusiasm that are necessary to have an influence on herself.

The unanticipated impacts of trophic cascades on processes -as diverse as diseases dynamics, carbon sequestration, species invasion and biogeochemical cycling- emphasize the urgent need for interdisciplinary systemic and cybernetic researches to forecast the effects of trophic and economic downgrading on process, function, and resilience in global systems and Man's societies.

5c. Education: the key factor of humanness integration into the Earth ecoexotope.

Education must not be uniform (linked to a dominant society!) and with only one language (English!) (Gal & Vial 1983). Because **diversity is the key** to globally ensure an effective conservation of all our natural, cultural, educational and historical heritages! Diversity allows the society **to be resilient!** To make new ARMSADAs you need **a sufficient minimal pre-requisite variety first! But within limits!**

The resiliency capacity is **operating at the Limits**, it resides through regulations **within limits and between limitations** (Bricage, 2010b).

Control theory provides a mathematical basis for engineering the dynamic behaviour of a system by using feedbacks. The system's design, like in the glycolytic one (to survive that is first to eat!), is constrained by trade-offs between making the system efficient and robust while minimizing output errors. Both engineering and evolution are **constrained by trade-offs between efficiency and robustness,** with oscillations as an inevitable side effect. This hard trade-off "law" is universal. It depends minimally on the details of the system and generalizes to the robust efficiency of any auto-catalytic and auto-poietic network, with **only one law: "to survive that is to eat and not to be eaten"** and with **only one process: "percolation"** through **a network of networks**. Our interactions with others (people or species) influence many of our decisions. In order to survive, we must define the economical and ecological networks of networks to which we belong and characterize our interventions that can change these networks, to change our behaviour (de Waal, 2012).

"Who we really are: guests of nature for a short time."

Henry D. Thoreau (The Wilderness)

Conclusion

Locally, the respect of human rights is necessary everywhere. But this is less important than the respect of environmental rights at a global scale. For the One (humankind) to survive, the other Ones -the domesticated species and the wild ones- must survive first! That must be taken into account in the Earth management.

Fair ecological and societal practices, with the respect of the truth about both products quality and processes transparency are requirements for the producers and the customers. The involvement in the development of communities needs first an holistic sensibility of the real common local place of Man in the global "economy" of Nature. There are always humans behind decisions and actions. Politics must pay attention to develop human capacities as a key leverage for a "sustainable and sustained" economic, societal and ecological development. Balancing agricultural production economics and biodiversity, ***Societal and Environmental Responsibility*** goes far wider than the business world, it includes all the managers and decision makers from all the ways of our life (environment, sustainability, poverty alleviation, agriculture, health systems, education). To seed the future we need to provide an "education towards an holistic behaviour" everywhere (Bricage, 2001a, 2010b): an education network of networks to bridge the gap between scientists, teachers and everybody. With a lot of other species, Man is a local actor of a global living organism into which **he is hosted**. He is also a keystone organism for the global survival of a lot of local actors **he is hosting**.

Agricultural systems that takes into account the functioning of Wild systems (Alard & al. 2002), avoiding struggle, are more effective in their durability **through duality and participation**. Modelling the functioning of agrosystems is first an interdisciplinary holistic way of local management of the present global biodiversity at the light of its past history (Moity-Maïzi & al., 2001). We can not predict what may arise and when, we only know why it could but not what it could be. Maybe life flows undergo **a sudden transition from adaptation to exaptation** and ARMSADA emerging when "the ratio" of "the hosting capacity of the ecoexotope" and "the capacity to be hosted of the endophysiotope" undergoes a critical value.

The academic system -based on research and technological assessments- won in terms of applications and money-making but failed in terms of ethical value and education. Knowledge and technology succeeded but only for some people, not for all. Education has failed and humankind is losing in its integration into the Earth organism. That is not the Earth which is endangered but Men! What we need is not to make better researchers and money-makers (through take-make-waste processes!) but teachers so as every people in the World can know how our organism -the Earth- is functioning: that ***"there are never advantages without disadvantages", ***that ***"everyone is both a winner and a loser"***, depending on the space-time "of functioning" he is in. We do need a new mode of thinking and new applicators in systems science: **teachers for everybody, at every level and everywhere**, to claim what Earth and solar systems are -in an upwards scaling view-, and what Earth and cell systems are -in a downwards scaling view-.

To tell why and how ***"a system is always more and less than the sum of its parts"***, why and how every system is an ARMSADA, and that we are only a tiny part of our limited native world. ***"Like every species, our species must pass the integration exam that every species has to pass to survive!" And nowadays we fail.*** It is vain to persuade people that progress can cure all our sanitary or societal troubles. Success is only in prevention! But prevention imposes a constant effort. And experience shows that, soon or late, the carelessness takes it! (de Benito & al., 2012).

The slightest effort is easier!

With the Neolithic revolution Humanness modified its behaviour with regard to the Wild: through domestication (cultivation and breeding) the survival and reproduction of selected plants and animals was favoured. The Neolithic was also a societal and symbolic revolution: with the creation of a long-lasting housing and communities, new relations between individuals emerged. This joint metamorphosis of Man and the Wild simultaneously resulted for the Man in advantages (greater food sources) and disadvantages (new diseases, inter-human disparities, pollutions) (Guilaine, 2012). The Wild was perceived locally as an ally. Nature is now utilized globally as a slave! Man must now make a revolution **the other way back**, becoming again an ally of Nature, being globally a key species at her service, if he wants to survive (Bricage, 2011c).

References

Alard V. & al. 2002. *A la recherche d'une agriculture durable*. INRA Editions, Paris, France, 346 p.
Benkirane R. 2009. Sortir de la religion du marché. *La Recherche* **426** : 96.
Bran M. 2011. Une immense aire protégée naît le long du Danube. *Le Monde* **15-16 mai 2011** : p. 4.
Bricage P. 1975. Quelques aspects d'une maladie endémique : la lèpre. *Bull. A.A.S.N.S. Dakar, Sénégal,* **51** : 5-12.
Bricage P. 1991. Évaluation des interactions entre les densité et diversité des chenilles de Lépidoptères et les diversité et degré de défoliation des feuillus d'un bois. Mesure de la polyphagie et prédiction des pullulations potentielles. *Acta Entomologica Vasconae* **2** : 5-21.
Bricage P. 2000a. La survie des organismes vivants. In *Prendre soin de l'homme,* AFSCET-MCX, Fac. Médecine Saints Pères, Paris, France, 33 p. http://www.afscet.asso.fr/SURVIVRE.pdf [4 février 2000].
Bricage P. 2000b. La nature de la violence dans la nature. In *La Violence,* Colloque AFSCET Andé, France, 7 p. http://www.afscet.asso.fr/pbviolW98.pdf [18 mars 2000].
Bricage P. 2000c. Systèmes biologiques: le "jeu" de la croissance et de la survie. Quelles règles? Quelles décisions? Quels bilans? In *La décision systémique: du biologique au social*, Atelier AFSCET, I.I.A.P., Paris, France, 6 p. http://www.afscet.asso.fr/JdVie1.pdf [25 novembre 2000].
Bricage P. 2001a. A new evolutionary paradigm: ARMSADA In *The creation of a sustainable society depends on Innovative Systems Thinking. International Conference "Unity through Diversity",* Vienna, 1p.
Bricage P. 2001b. La vie est un flux, ergodique, fractal et contingent, vers des macro-états organisés de micro-états, à la suite de brisures de symétrie. In *Systémique & Biologie*, AFSCET, I.I.A.P., Paris, France, 11 p. http://www.afscet.asso.fr/ergodiqW.pdf [1 december 2001].
Bricage P. 2004a. La gouvernance du vivant : les acteurs et les systèmes. In *La gouvernance,* Colloque AFSCET Andé, France, 26 p. http://www.afscet.asso.fr/pbAnde04GV.pdf [5 June 2004].
Bricage P. 2004b. Entre local et global, la gouvernance associative. In *La gouvernance*. Colloque AFSCET Andé, France, 14 p. http://www.afscet.asso.fr/pbAnde04GA.pdf [6 juin 2004]
Bricage P. 2005a. The Cell originated through Successive Outbreaks of Networking and Homing into ARMSADA between the Partners, with a Benefit only for their Wholeness. *Res. Systemica* **5** : 11 p. http://www.afscet.asso.fr/resSystemica/Paris05/bricage3.pdf [20 September 2005].
Bricage P. 2005b. The Metamorphoses of the Living Systems: ARMSADA. *Res. Systemica* 5 : 10 p. http://www.afscet.asso.fr/resSystemica/Paris05/bricage.pdf [21 September 2005].
Bricage P. 2006. Pouvoir de prédiction des représentations systémiques en Sciences de la Vie. In *Les représentations au crible de l'approche systémique.* Colloque AFSCET Andé, France, texte 39 p., figures 21 p. http://www.afscet.asso.fr/pbAnde06txt.pdf http://tinyurl.com/pbAnde06figures [13 mai 2006].
Bricage P. 2008. Cancer is a breaking of the cell's ARMSADA through an aggression that results in a lack of non-autonomy. Res. Systemica 6 : 33 p. http://tinyurl.com/pb-cancer [19 décembre 2008].
Bricage P. 2009. L'évolution créatrice: métamorphoses et phylotagmotaphologie du vivant. In *Lire l'évolution.* Teilhard, Paris, France, 109 p. http://tinyurl.com/phylotagmotaphologie [13 novembre 2009].

Bricage P. 2010a. ARMSADA, The way to be resilient and self-sustainable the living systems are running through. In *Governance for a Resilient Planet.* ISSS 54th International Congress,Waterloo, Canada, 12 p. http://journals.isss.org/index.php/proceedings54th/article/view/1491 [19 July 2010].
Bricage P. 2010b. Thinking and Teaching Systemics: Bio-Systemics in Higher Education. In *The International Academy for Systems and Cybernetics Sciences.* Gu JF, Xu JP (eds). Chengdu Sichuan University, PR China; 1-14. http://www.armsada.eu/files/pbricageChengdu2010txt.pdf [25 October 2010].
Bricage P. 2011a. Balancing between individualism & collectivism, between union & breaking: for the one to survive, all the other ones must survive first. In *Crises et réponses systémiques*, *Acta Europeana Systemica* **1** : 18 p. http://www.armsada.eu/files/pbARMSADA.pdf [21 October 2011].
Bricage P. 2011b. Les associations à avantages et inconvénients réciproques et partagés : "acteurs clés-de-voûte" de l'évolution créatrice du vivant "vivant". In *Systems Evolution*, Acta Europeana Systemica **1** : 19 p. http://www.armsada.eu/files/pbEvolution.pdf [21 October 2011].
Bricage P. 2011c. The Social and Environmental Responsibility of Mankind. In *Social Responsibility*, Acta Europeana Systemica **1** : 25 p. http://www.armsada.eu/files/pbManSERqash.pdf [21 October 2011].
Bricage P. & al. 1989. Évaluation des cortèges des Lépidoptères défoliateurs d'un bois de feuillus (bois de Pau). *Ikartzaleak* **13** : 5-26.
de Benito E., Sancho R. & Sahuquillo M.R. 2012. Salud sexual y reproductiva. *El Pais* **12652** : 32-33.
de Waal F. 2012. La naissance de l'économie. *Pour La Science Dossier* **76**: 36-42.
Estes J.A. & al. 2011. Trophic Downgrading of Planet Earth. *Science* **6040** : 301-306.
Gal R. & Vial J. 1983. *Histoire de l'éducation*. Que sais-je ? Presses Universitaires de France, Paris, **310** : 128 p.
Gitig D. 2010. Marine Metagenomics. Phages and Viruses. *BioTechniques* **48(5)** : 361-365.
Gobler et al. 2011. Niche of harmful alga Aureococcus anophagefferens revealed through ecogenomics. *PNAS* **108** : 4352-4357.
Guilaine J. 2012. Au Néolithique, en devenant sédentaire, agriculteur et éleveur, l'homme n'a-t-il retiré que des bénéfices de son nouveau mode de vie ? *Pour la Science* **76** : 112-113.
Haines S.G. 2011. Life's Laws Rediscovered: The 12 Natural Laws of Living Systems. *General Systems Bull*. **40** : 16-18.
Hale L. & al. 2010. An efficient stress-free strategy to displace stable bacterial plasmids. *BioTechniques* **48(3)** : 223-228.
Lee DY & al. 2010. Mass spectrometry-based metabolomics, analysis of metabolite-protein interactions, and imaging. *BioTechniques* **49**(2) : 557-565.
Lewis SL & al. 2011. The 2010 Amazon Drought. *Science* **331** : 554.
Moity-Maïzi P. & al. 2001. *Systèmes agroalimentaires localisés.* INRA Editions, Paris, France, 216 p.
Mueller UG & al. 2011. Frontier mutualism: coevolutionary patterns at the northern range limit of the leaf-cutter ant–fungus symbiosis. *Proc Biol Sci*. **278(1721)** : 3050-3059.
Neerathilingam M. & J.L. Markley. 2010. Auto-induction medium containing glyphosate for high level incorporation of unusual aromatic amino acids into proteins. *BioTechniques* **49(3)** : 659-661.
Riordan O, Warnke L. 2011. Explosive Percolation Is Continuous. *Science* **6040** : 322-324.
Serres M. 1990. *Le contrat naturel*. François Bourin, Paris, France. p. 67.
Woods R. J. & al. 2011. Second-Order Selection for Evolvability in a Large Escherichia coli Population. *Science* **6023** : 1433-1436.