Systèmes vivants : agoantagonisme inter- et intra- niveaux "de ARMSADA en ARMSADA..."

Local versus global & individual versus whole competition between & within living systems ARMSADA emergence and breaking

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Abstract— **Whatever its level of organization, any alive system, to survive (*'eating and not being eaten'*) and live on, has *'to be lucky' for 'to be at the right place at the right time'*. Formed by embedments and juxtapositions of pre-existing systems in a new endophysiotope (ENDO), it is a part of a food chain: it eats and is eaten. Soon or late it is impossible not to be eaten. Man is not an exception**. **The modularity of alive systems allows both a partial location and a global recycling of matter and energy. The pleiotropy of the structures and functions, allowing *'to make of a stone several knocks'*, is a mechanism of exaptation of a new Whole. The agoantagonistic relations balance, within any ecoexotope (EXO), ends soon or late with the disappearance of predators and a reduction of biodiversity. The merging into Associations for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages (ARMSADA) allows the emergence of a new biodiversity**.

Key words: **agoantagonism, "Associations for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages" (ARMSADA http://armsada.eu), competition, ecoexotope, endophysiotope, exaptation, food chain, metamorphosis.**

Résumé— "Le malheur des uns fait le bonheur des autres". Quel que soit son niveau d'organisation, tout système vivant, pour survivre (*"manger et ne pas être mangé"*) et se survivre, doit *"avoir de la chance"* pour *"être au bon endroit au bon moment"*. Formé par emboîtements et juxtapositions de systèmes pré-existants en un nouveau Tout , il appartient à une chaîne alimentaire : il mange et il est mangé. *"Tôt ou tard il est impossible de ne pas être mangé"*. L'homme n'est pas une exception. **La modularité des systèmes vivants permet à la fois une délocalisation partielle est un recyclage global de la matière et de l'énergie.** La pléiotropie des structures et des fonctions de l'endophysiotope (ENDO) permet de *"faire d'une pierre plusieurs coups"*, c'est un mécanisme d'exaptation. L'équilibre indéfiniment remis en question des relations agoantagonistes, au sein de tout écoexotope (EXO), aboutit tôt ou tard à la disparition des prédateurs (ou ravageurs), donc à une réduction de la biodiversité. La mise en place d'*associations à avantages et inconvénients réciproques et partagés (*Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages ARMSADA) permet l'émergence d'une nouvelle biodiversité. La violence est présente partout dans la nature, au sein de tout niveau d'organisation et entre niveaux, mais tôt ou tard elle doit être dépassée. Toute ARMSADA émerge d'une rupture dans l'escalade de la violence entre acteurs antagonistes. Cette rupture de l'escalade des violences n'est pas une escalade des dons : ***il n'y a jamais d'avantages sans inconvénients.*** **Dans l'association tout ce qui est un avantage pour l'un des partenaires est un inconvénient pour les autres et réciproquement : pour que l'un survive il faut d'abord que l'autre survive.** Seules survivent les ARMSADAs ! Au cours de l'évolution du vivant tout nouveau plan d'organisation émerge de la mise en place d'une ARMSADA, par juxtaposition et emboîtements de niveaux d'organisation pré-existants. Cela permet un contrôle des dangers internes -de l'ENDO- et externes -de l'EXO-, en rendant plus dépendants les partenaires ("***in varietate concordia***") mais plus indépendant leur TOUT ("***un pour tous tous pour un***"). Au niveau cellulaire, la rupture de l'association entraîne l'apoptose, si UN seul ne survit pas, le TOUT disparaît ("***e pluribus unum***"). Le cancer est une libération des dangers contenus qui entraîne la mort du niveau supérieur adjacent, l'organisme méta-cellulaire. L'intégration, sélective, de dangers externes à contenir, et la libération de dangers internes contenus, ont "sculpté" les génomes des systèmes vivants. Ces phénomènes permettent de comprendre les altérations pathologiques et peuvent être mis à profit pour réaliser des vaccinations curatives du SIDA et du cancer.

Mots clés : agoantagonisme, "Associations for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages" (ARMSADA http://armsada.eu), cancer, chaîne alimentaire, classification périodique du vivant, compétition, écoexotope (EXO), endophysiotope (ENDO), exaptation, limites, limitations, loi systémique constructale, phylotagmotaphologie, stabilité inter-locale et compétition stratégique globale, virus.

Introduction

Tout système comporte 3 entités indissociables qu'il faut considérer ensemble dans leur structure fonctionnelle : un tout, des acteurs, des interactions (des liens entre ces acteurs et avec le tout, ce qui est plus complexe qu'une circularité !). On ne peut pas se centrer sur l'une de ces entités en ignorant les autres. Il faut toujours les considérer ensemble : **approche holistique** (**figures 1 & 5**). La réciprocité implique un accompagnement et une évaluation mutuelles.[1] Mais, il peut y avoir mutualisme sans qu'il y ai réciprocité.[2] Sans parler de la symbiose qui est toujours considérée comme une association à bénéfices réciproques (gagnant/gagnant), ce qu'elle n'est pas !

South penguins have no reason for walking fast. On the frozen soil of the south pole there are no predators to eat them. But there are no preys too and nothing to eat for them and it is very cold. There are never advantages without disadvantages ! They are surviving very difficultly in that **ecoexotope with an extremely low hosting capacity** (figure 1). To survive they need **an endophysiotope with an extremely high capacity to be hosted** (figure 1). But they can lay their eggs there and their offspring can grow if they will have enough matter to eat. Fortunately, the sea water is an **ecoexotope with a high hosting capacity !** There are a lot of preys to eat for them. But there are predators too. There are never advantages without disadvantages ! So penguins have always at least 2 reasons for swimming very fast : ***"to eat" and "not to be eaten".*** To survive they need "to be lucky !" : "to be at the right place at the right time and not to be at the wrong place at the wrong time". But ***"sooner or later it is impossible not to be eaten."*** Like they are eating fishes, penguins are eaten by killer whales. They are belonging to **a same food chain**. To survive that is ***"to avoid advantages turn to disadvantages and to transform disadvantages into advantages"*** [2, 7, 8, 9][3]. Every living system (a cell, a forest) is a wholeness, made of actors with their interdependent links (figures 1, 2). The stability and resiliency of the system, while facing to changes of its internal medium (its endophysiotope ENDO, from Greek: *endo* internal, *tope* space-time, *physio* of functioning) and its external surrounding (its ecoexotope EXO, from Greek: *exo* external, *tope* space- time, *eco* of inhabitation), is depending on the number of actors and the percolation process of their interactions (figures 3, 5). What sort of governance does allow the sustainability? The growth and development of a vertebrate embryo (the ***i+1*** organization level) involve tightly regulated cellular (***i*** level of organization) processes with molecular (***i-2*** level) instructions informing the proliferating embryonic cells about their identity and behavior (figures 6, 7). The opposite gradients of two **agoantagonistic** [39] proteins are sufficient to induce the molecular and cellular mechanisms required to organize the embryo morphogenesis [49]. But, depending on its variants and interactions, the same molecule may have different roles [48]. To survive that is to use the simplest way to control both the maintenance, the modulation and the changes (like in the metamorphosis of an organism) of a structure and function [22, 23, 24][4].

All living blueprints do emerge from merging previous systems into an ARMSADA

A lichen species is an association between an algal species and a fungal one [7]. The organization level of the lichen organism is higher than the organization levels of each of the organisms of its partners [30]. The lichen species elaborate molecules that no other fungal or algal species can produce.

A. Building an ARMSADA as a response to the limited hosting capacity of the ecoexotope (EXO).

The survival of the lichen's organism is based on a steady state of sharing of advantages and disadvantages between the 2 partners. As lodging host, the fungus pays a double cost: the cost of the accommodation of the alga, the cost of a growth limited by the growth of the alga. In order that the fungal part survives it is necessary that the algal part survives first [9, 10, 15].

1 https://fr.wikipedia.org/wiki/Coaching_pédagogique http://www.afscet.asso.fr/PBtlseMCX33.pdf
2 http://fr.wikipedia.org/wiki/Mutualisme https://fr.wikipedia.org/wiki/Mutualisme_(biologie) http://en.wiktionary.org/wiki/mutualisme
3 Les manchots n'ont aucune raison de marcher vite mais au moins 2 raisons de nager très vite.
Survivre c'est "manger" et "ne pas être mangé". Tôt ou tard il est impossible de ne pas être mangé.
No tienen ninguna razón para marchar rápidamente pero por lo menos 2 razones para nadar muy rápidamente :
"comer" y " no ser comido ". Tarde o temprano es imposible no ser comido.
4 ***"Faire d'une pierre (au moins) 2 coups."***

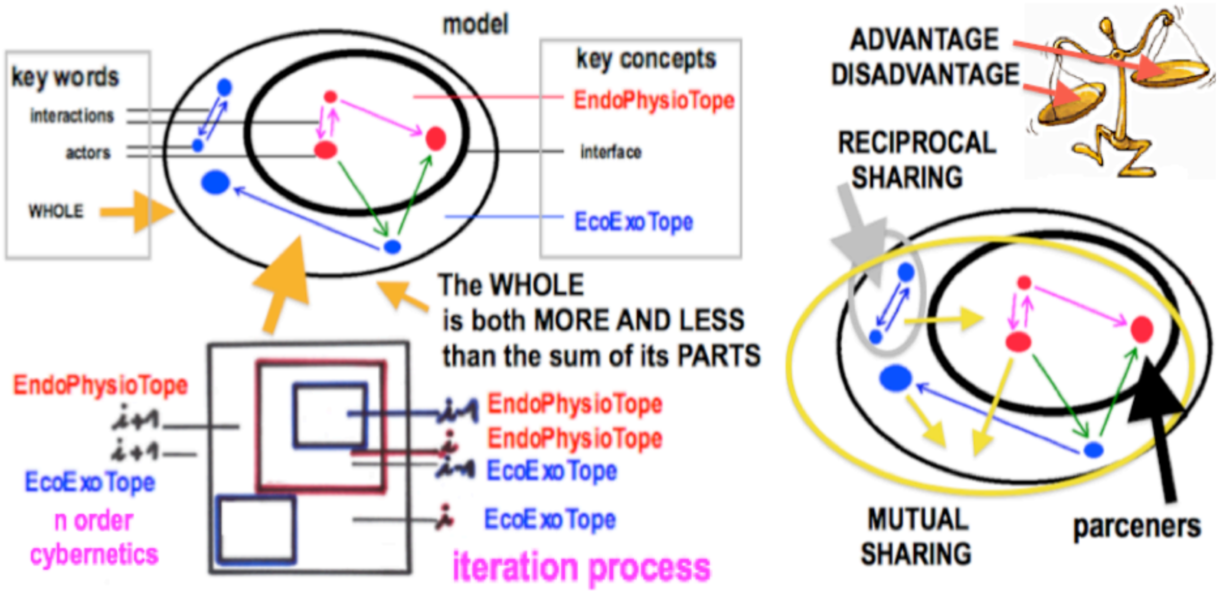


Figure 1. **How a living system is structured as a system of systems ?**

(On the left) System of systems : juxtaposition and embedment [Bricage 2001a, d, 2010a, b, 2014a http://www.wccs14.org/, 2014b]
The **model** and the **keywords** : Every system is made of 3 kinds of entities, actors, interactions and the whole. Every living system, whatever its level of organization, is integrated into an ecoexotope of survival which gives the system's endophysiotope an hosting capacity. During the life evolution process, new endophysiotopes of living systems are emerging through an iteration process of embedment and juxtaposition of pre-existing systems (figures 5, 7). So the endophysiotope of a ***i*** level of organization is the ecoexotope of survival of a ***i-1*** one. And the whole, as a wholeness, is always more and less than the sum of its parts. The juxtapositions and embedments of the parts into their Whole are known but the functioning of the Whole is not predictable from the functioning of the parts [Bricage 1986, 1991, 2000a, 2001d]. The modularity of the actors and interactions is the source of exaptations [Bricage 2001a, 2002b].

(On the right) ARMSADA **A**ssociations for the **R**eciprocal and **M**utual **S**haring of **A**dvantages and **D**is**A**dvantages [Bricage 2014b]
From individual to collective actions (associations) and conversely from organizations actions (lobbying) and societies (lawing) to individual actions: from ago-antagonism to symbiosis, http://emcsr.net/book-of-abstracts/] ***There are never advantages without disadvantages.*** To survive that is ***"to avoid advantages turn to disadvantages and to transform disadvantages into advantages"*** through the reciprocal sharing of advantages and disadvantages -at the local level all that is and advantage for a partner is a disadvantage for another one- and their mutual sharing -at the global level between the partners and their whole, for the benefit only for the whole-. For the survival of a partner, and the whole, each other partners must survive first. Actors are **parceners** [Bricage 1991, 2000a, 2003, 2005a].

To survive, the algal partner, the lodged host, also pays a double cost: the cost of the surviving of its population of cells, through the non-survival of a part of it, which is eaten by the fungal filaments, the cost of a growth limited by the growth of the fungus. The lichen organism is an ecosystem that contain a food chain [7, 8, 16, 21]. The growth of each partner is **limited** by the growth of the other one. In order that one may survive, ***the other one must survive first***. The fungus has to limit its growth demands with respect to the alga. Reciprocally the hosted alga may develop itself only **into the limit of the carrying capacity** of the hosting fungus. ***The mutual survival is depending on reciprocal limitations***. But, the surviving is possible and the acquisition of new capacities is possible, even in conditions of global growth close to zero. And, if the one dies, the other dies too. The 2 totally interdependent partners form **a wholeness**. Together they survive in ecoexotopes where there is no capacity of hosting for each partner separately. ***The symbiosis is a partnership of mutual sharing of profits and injuries***. It emerges due to the fact that the two partners are not simply added but are combined and interpenetrated to form **"an association for the mutual and reciprocal sharing of advantages and of disadvantages"**. They metamorphose themselves simultaneously in a new, unique, different, whole organism. Their autonomy is built on their interdependence. [9, 10, 28, 33]

B. Building an ARMSADA as a response of a constraint on the development of the endophysiotope (ENDO).

Free-swimming larvae of benthic marine animal populations recognize cues from surface-bound bacteria to settle and metamorphose. A bacterium (*Pseudoalteromonas luteoviolacea*) is producing arrays of bacteriophage tail-like structures that trigger metamorphosis of a tubeworm (*Hydroides elegans*). This novel form of virus-bacterium-animal interaction [47], that explains how marine biofilms can trigger ecosystems development, is **another type of ARMSADA**. ARMSADAs are everywhere [44] !

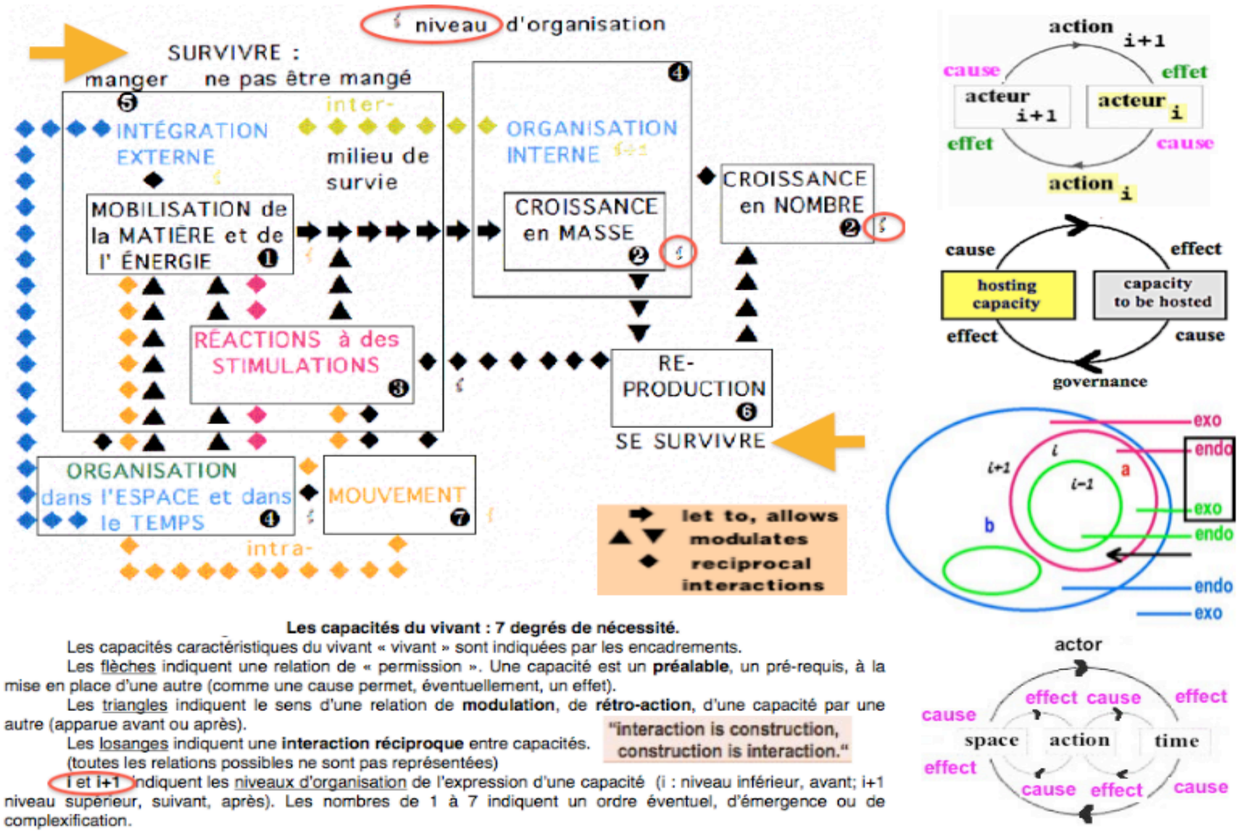


Figure 2. **"How living systems are functioning ?"**

(On the left) The gauge invariance of Life [Bricage 1991, 2000a] : the 7 capacities of a level of organization.

Each organization level of a living system-of-systems is defined with 7 mutually necessary and sufficient functional characteristics, that are in interaction (Bricage 2002b). The capacity of moving matter and energy flows (1) is the first requirement before the capacity of mass growth (2). The matter and energy flows and the growth are controlled through the capacity to respond to stimulation (3). All of that is possible because the ENDO and the EXO exhibit a correlated organization into the space, through the time, and in the action (4). The EXO furnishes the ENDO a capacity of hosting. Reversely, only can be hosted an ENDO that possesses an appropriate capacity to be hosted. This is the process of integration (5). Soon or late during its life cycle a living system -whatever its level of organization- expresses a capacity of movement (7). All these capabilities are interdependent and mutually necessary and sufficient for the survival.

The survival has only one goal : the reproduction of the corresponding life form (6) [Bricage 1991, 2002a].

(On the right, from top to down) The systemic constructal law: "interaction is construction, construction is interaction."

Causality is circular. "Each living system-of-systems is integrated into an ecoexotope within which it is more adapted to the interactions network than other systems-of-systems are." [Bricage 1976, 1982]. Climate changes, ecoexotopes changes, communities changes, endophysiotopes changes are overlapping and in a loop. The changes of the hosting capacity, in quality or in quantity, particularly due to recycling, are controlling the growth and constrained changes in the functional, spatial and temporal organization of the capacity to be hosted [Bricage 1982, 1986]. That itself feedback is controlling the growth and the development: ***"(hosting capacity)x(capacity to be hosted)=k"*** [Bricage 2011b, c]. Step by step, by cycling through amplifying loops, "a threshold of growth is a requisite for development, a threshold of development is a requisite for growth". The appearance of an ARMSADA depends on the ecological, economical and genetical history of every actor, on its place into the system, on the global context of interaction and on its local fate.

In the case of neurons, a new property, the synthesis of the myelin, is emerging from the ***"unity through diversity"*** between a population of Schwann's cells and a giant cellular body. But a neuron, whatever its complexity [50] is not a level of organization (figure 7).[5] From the simplicity of the Monera to the complexity of the cell and the hyper-complexity of the lichen, the blueprint of each new system-of-systems (figures 1, 6, 7) has preserved the ancient footprints of the previous life forms.

5 Tout système comporte 3 entités indissociables qu'il faut considérer ensemble dans leur structure fonctionnelle : un tout (**a Whole**), des acteurs, des interactions (des liens entre ces acteurs et avec le tout, **a wholeness**, ce qui est plus complexe qu'une circularité !). On ne peut pas se centrer sur l'une de ces entités en ignorant les autres; il faut toujours les considérer ensemble, globalement (**approche holistique**) [Bricage 1982, 1986, 2001d, 2004, 2005a, 2006].

C. Building an ARMSADA to increase the capacity to be hosted of the endophysiotope.

A lichen which is both an organism and **an ecosystem** [2, 7, 28], a cell which is also an ecosystem and **an endosyncenosis** [20, 21][6], both are ARMSADAs [30, 31]. The eukaryotic cell has emerged from the help of a RNA virus [20, 22] from a microbial mat of Monera. The nitrogen fixing legumes emerged also from the fusion of a population of Monera with -and within- an organism [25, 31]. *"Any living system is indissociable from an environment of survival its **ecoxotope**. Permanently it must re-build its organization and re-create its autonomy; it is unceasingly dependent on an ecoexotope in which it continuously has to regenerate itself **its self**, its **endophysiotope**. In that ecoexotope it is sharing with other life forms it takes matter, energy and information, integrated within a food chain. Before being able to survive itself in its progeny, it must first stay alive and survive, by extending its existence beyond the unbearable events which can result in its disappearance."* (The survival of the living organisms and the adaptation of human systems to change and aggression. Pierre Bricage. La nature de la violence dans la Nature, 2000) [9]

The emergence of an ARMSADA : a global response to local crises

Parasites are manipulating the behavior of their hosts to enhance their transmission and they need to ensure a sufficient survival of their vectors. *Plasmodium falciparum* infection increases *Anopheles gambia* attraction to nectar sources and sugar uptake. The eating behavior of *Plasmodium*-infected *Anopheles* is modified in a manner governed by the vectors' fight for survival and the parasite's need to advance its transmission [46] : ***"To survive that is first to eat and not to be eaten."*** Into a food chain every animal is a prey for another one and a predator for other ones [7, 9]. Like in the prisoners' dilemma game [8, 10, 39] there are 4 possibilities in the fate of the relationship between a predator and a prey (figure 4).

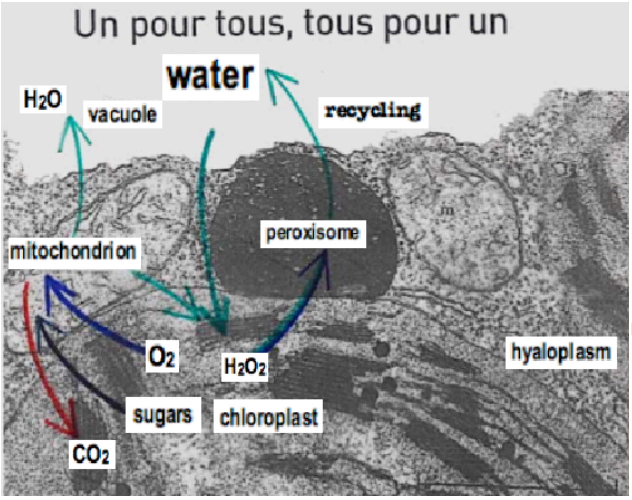
D. The nodes of legumes: from parasitism to mutualism. ***From invasion to co-integration.***

At the beginning, a population of a *Rhizobium* species from the EXO invades the inside of the root -the ENDO- of a legume plant. The bacterial population detects the root, at a distance, through the biochemicals that are released into the soil by the activity of the plant organism ENDO. The soil is the common EXO that is shared by the ENDO of the plant and the ENDO of bacteria. Each individual free living bacterium (***i−1*** level of organization of the Monera : figure 7) owns the 7 capacities which are defining a level of organization (figure 2). Free, into the EXO, the bacteria are mobile and saprophytic. But invading the plant (***i+1*** level) they metamorphose into a parasitic form that survive into the plant, eating the plant organism. The plant ENDO is their new EXO of survival. But, soon or late, the bacterial infection thread joins cells (***i*** level) where it is stopped. And at the interface of the never-invaded hyaloplasm, a membrane sequesters the bacteria population, into the organism, but outside of the cell. Thus an other metamorphosis takes place. Mutually, the plant cell and its outside-hosted bacterial population are able to synthesize leghemoglobin, a new molecule that none of the 2 partners is able to make alone. That emerging capacity directs the interactions between them in a way that the bacteria are now collectively subdued to the plant [25]. Mutually the plant cells and the bacteria population are able to survive together because the two metamorphose together in a new entity, a node, in which the bacterial part is able to fix atmospheric nitrogen (that the free bacteria did not) to synthesize nitrogen sources that the plant cells can use. But, to dispose of these sources, the plant cells must, reciprocally, first allow the survival and the nourishment (with sugars) of the bacterial ***invaders that are now partners***... [28, 33]

E. The cell ecosystem : ***from food chains to an endosyncenosis****.*

Into a green plant cell, <u>global</u> ***i*** organization level (figures 3, 7), the chloroplast is the local compartment that is specialized for the fixation of solar energy, carbon dioxide and water, into organic matter. Another local compartment, the mitochondrion is specialized into the production of energy from the consumption of organic matter. It is a local predator-prey like relationship. The mitochondrion eats the sugars that are synthesized by the chloroplast for the global cell use. But doing so it produces wastes, water and carbon dioxide, that are the raw materials for the chloroplast's metabolism. Inversely, the chloroplast's metabolism produces oxygen which is the raw material for the mitochondrion to use sugars. The peroxisome, another juxtaposed compartment, recycles into water the toxic peroxide wastes the mitochondria and chloroplasts are producing together. A cell is made of local compartments of Monera origins [19, 20], the chloroplast, the mitochondrion, the peroxisome (***i-1*** local organization level), that are juxtaposed to each other and encased into an other one, the hyaloplasm, also of Monera origin [20, 21, 22]. It is an endosyncenosis (ceno: to meet and fuse, syn: into a system, endo: with a new internal structural and functional organization), a global new System-Of-Systems "E PLURIBUS UNUM" that has emerged step by step through ARMSADA "sprouting". All that is an advantage for a <u>local</u> partner is a disadvantage for all the other ones.

6 **ceno**: to meet and fuse, **syn**: into a new system, **endo**: with a new internal structural and functional organization



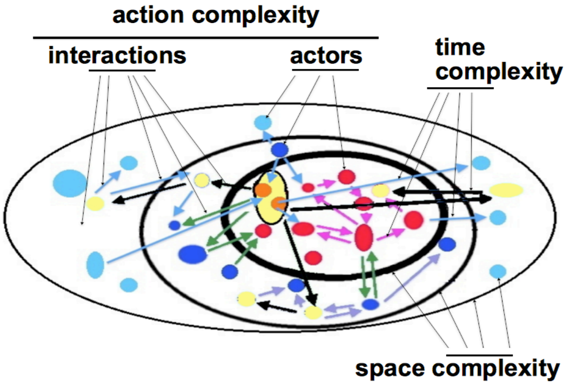


Figure 3. The plant cell, an example of how is structured and functioning an ARMSADA ?

A symbiosis is not an association for mutual benefits but ***a "unity through diversity" partnership for mutual and reciprocal sharing of profits (advantages) and injuries (disadvantages), whatever the level of organization.***

The cell is a new mode of integration, a new endophysiotope into a new ecoexotope [Bricage 2006].

3a (left side). The modularity of the system allows both a partial location and a global recycling of matter and energy.

The pleiotropy, of the structures and functions, allows ***"to make of a stone several knocks"***, which is the basis of the exaptation processes. The survival of the whole is ensured by local recycling processes of wastes from a compartment that are foods for other ones and a global sharing of the external dangers of the compartments that are internal dangers for the whole. The endophysiotope of the whole, the cell (***i*** level), is the ecoexotope of survival of the endophysiotopes of its compartments, the organelles (***i-1*** level). The cell is a part of a leaf tissue which is a part, an organ, of a metacellular organism, an herb or a tree (***i+1*** level). The organism can survive a while without leaves but the death of the organism leads to the death of all leaves. The death of the mitochondria leads to the death of the cell.

3b (right side). System complexity : how to define and measure it ? [Bricage 2011c, 2014c]

To define the complexity of a system, we must first identified and characterized, qualitatively and quantitatively, all its parts, by deconstructing it (reductionism). Then through reconstructing the whole from the parts (holism) we cannot explain new properties (emergence) only by ancient previous ones. A complex system is always more and less than the sum of its parts. Emergence is always a metamorphosis percolation process : new structures and properties appears, ancient ones disappeared, ancient ones remains but changed. Then we can define 3 parameters for measuring the complexity of the system : the Action complexity which is given both by the numbers of each kind of actors (one colored "point" for each kind), and all numbers will give the total actors number (we can also define actors quantitatively by the surface of the point), and the numbers of each kind of interactions (one colored arrow for each kind) which all will give the total interactions number (we can also define interactions quantitatively by the thickness of the arrow), the Time complexity which is given by the duration of all the interactions that take place during a period (a time cycle of survival) [Bricage 2013], the Spatial complexity which is given by the absolute and relative surface limits (interfaces) of the ecoexotope (EXO) and endophysiotope (ENDO) [Bricage 2003].

All are mutually fused together in a whole "for the best and for the worst". Each one may survive only if all the others must survive first : "UNUS PRO OMNIBUS OMNES PRO UNO". What are wastes for some are aliments for others, and reciprocally. Both all the products and by-products are shared mutually. It is through their mutual (global) and reciprocal (local) interactions that the parceners survive in a kind of half-autonomy that renders all more independent of the EXO that they would be if free, separately: "IN VARIETATE CONCORDIA" [30]. All at once they are sharing both the internal dangers of their new EXO -the cell ENDO- and the external dangers of their ancient EXO -the cell EXO- [33, 37][7].

7 L'évaluation qualitative de la complexité est première. *"Tout système complexe est à la fois plus et moins que la somme de ses parties, il faut d'abord mettre en oeuvre une approche réductionniste, du Tout aux parties, puis une approche holistique, des parties au Tout. La connaissance du système est celles du Tout et des parties à la fois.*" Comparer 2 systèmes revient à comparer 2 algorithmes [Chabert 2003]. L'évaluation quantitative se fait en déterminant les types d'opérations (**complexité d'action**) et le nombre d'opérations (**complexité temporelle**) qu'ils requièrent, et la place nécessaire pour garder en mémoire les informations (**complexité spatiale**). Cet espace-temps-action dépend de l'état initial du système. On définit une "complexité au pire", la plus encombrante en espace-temps-actions, qui "délimite" le système.

« La structure d'une chose n'est nullement une chose que nous puissions "inventer". Nous pouvons seulement la mettre à jour patiemment, ..., la "découvrir" ... nullement pour "façonner" ou "bâtir" des "structures". Celles-ci ne nous ont nullement attendus ... pour être !... Pour exprimer, le plus fidèlement que nous le pouvons, cette structure ..., nous essayons ... à constamment "inventer" le langage apte à exprimer de plus en plus finement la structure ... et à "construire" à l'aide de ce langage, au fur et à mesure, les "théories" qui sont censées rendre compte de ce qui a été appréhendé et vu. » [Alexandre Grothendieck, Récoltes et semailles. 78 p., mai 1985]

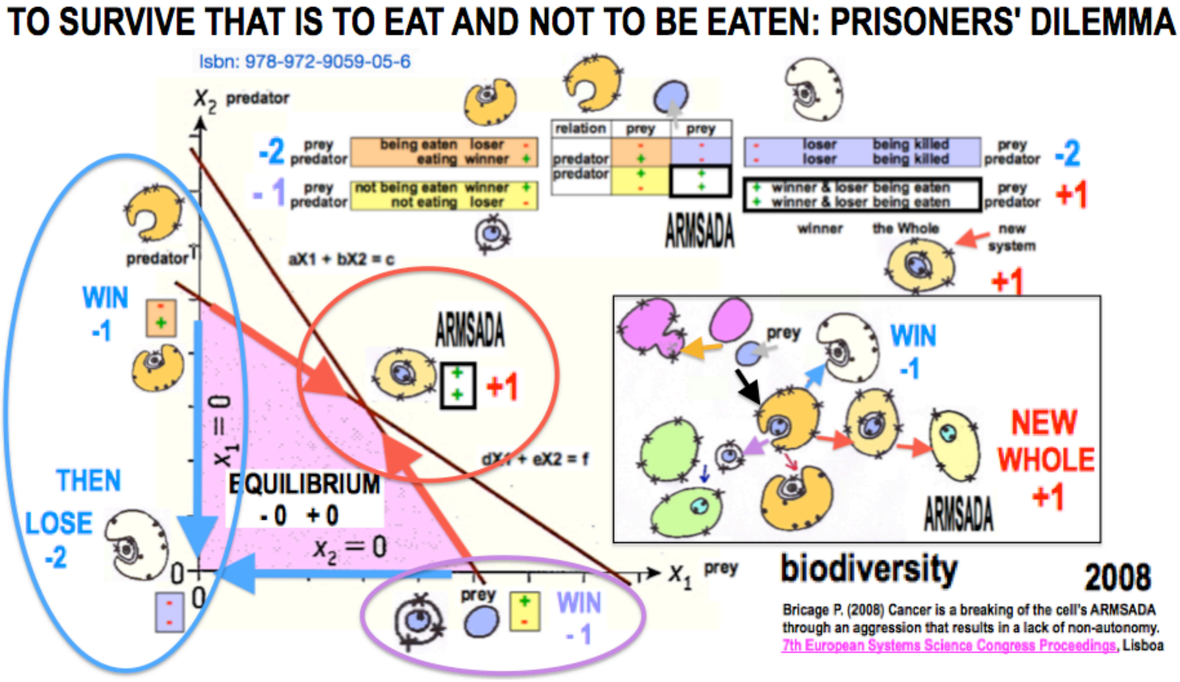


Figure 4. **ARMSADA emergence : Why ?, When ?, How ?, What for ?**

(Graph on the left) Usually the predator wins and eats the prey (*The strongest is the fittest...)* but not too much ! Because if there is no more prey, nothing else to eat for the predator, it will disappear too ! (It is *a "who wins is a loser" game*, a "lose-lose" situation !) And the biodiversity will be reduced **-2**. Sometimes but rarely, the prey wins and maybe eats the predator (*The biter is bitten !*) so the biodiversity is reduced **-1**. Sometimes also, the two lose and die (and they are eaten, dead of alive, by an other life's form) and the biodiversity is reduced too **-2**. *Exceptionally* (in term of probability), *but certain* (that will always arrive, soon or late, at the scale of the geological timing), *the two win and lose simultaneously (it is not a "win-win" situation !)* and a new Whole emerges [Bricage 2000c]: an Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages (ARMSADA). That is the way the living systems, to be resilient and sustainable, do run trough [Bricage 2010a]. That is the only way for increasing biodiversity **+1** [Bricage 2011a].

(Table on the top & Schema on the right) The agoantagonistic relations balance, within any ecoexotope, ends soon or late with the predators' disappearance and a reduction of biodiversity. **The merging into an Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages allows the emergence of a new biodiversity.** "**It is a rare wind that blows everyone some good but not without some ill.**" An ARMSADA emerges when the partners lose simultaneously the capacity to kill the other ones!

« **Le tout est à la fois plus et moins que la somme de ses parties.** » « Ni la compétition, ni la violence, ne sont marginales dans la nature, elles sont des processus nécessaires, et contingents, agoantagonistes, mais qui doivent être dépassés tôt ou tard. Ni la mise en place d'une ARMSADA, ni son maintien structural et fonctionnel, ne sont des processus coopératifs, mais plutôt ago-antagonistes. » [Bricage 2014c] « Ce sont des processus "au-delà" (**au-delà de l'espace, au-delà du temps**), c'est-à-dire "émergents", qui "concilient" violence, compétition, coopération, ago-antagonisme, tout en **respectant des lois d'échelle**. » [Bricage 2009a, b, 2014a]

Being more and more dependent for their collective sharing of dangers of the cell's ENDO -through inter-recycling-, they become more and more independent of their ancient EXO which is still the EXO of their new Whole: the cell (figure 3). Like the Rhizobia are sequestered outside the hyaloplasm of the cell, the internal compartment of the mitochondria or chloroplasts are sequestered too. This does explain the presence of 2 limiting membrane interfaces between the ENDO of mitochondria or chloroplasts and the ENDO -the hyaloplasm- of the cell [19, 20]. The cell (***i*** level) is a resilient system that is sustainable for all the partners (***i-1*** level) because it is sustained by each one. This is the only successful state (figure 7) of the iterated prisoners' dilemma game [39].[8]

8 Tout système vivant est un **écosystème d'écosystèmes**. Quel que soit le niveau d'organisation, il est défini par 2 espace-temps d'interactions et en inter-actions indissociables : **endophysiotope et écoexotope** (figures 1, 3, 6). Toute approche systémique est fonctionnelle ! L'écoexotope (tope espace-temps, exo externe, éco d'habitation), habité, fournit une capacité d'accueil à l'endophysiotope (tope espace-temps, endo interne, physio de fonctionnement), habitant, si et seulement si celui-ci possède une **capacité d'être accueilli** en adéquation avec cette **capacité d'accueil** (figure 6) [Bricage 2000a, b, 2002a, b]. Le niveau d'organisation atomique possède les mêmes caractéristiques d'invariance fonctionnelle que les niveaux cellulaire ou métacellulaire, mais dans un espace-temps de survie qui n'est pas le nôtre (en température, pression, durée), celui des systèmes stellaires. ***"Ce n'est pas parce qu'on ne voit pas quelque chose que cela n'existe pas.", "Ce n'est pas parce qu'on voit quelque chose que c'est un niveau d'organisation." : "Un caillou n'est pas vivant, mais il y a de la vie dans un caillou."***[Bricage 2009a]

F. From system to system-of-systems emergence : ***from ARMSADA to ARMSADA.***

The ancient biodiversity of the Monera (their initial variety as free individual one-membraned compartments, ***i-1*** level) was sufficient to allow the emergence of a new level of organization (the cell, ***i*** level). But how did that exaptation process (figures 4, 5, 6, 7) take place? The cell is a network of Monera, an endosyncenosis, in which the Golgi apparatus, the endoplasmic reticulum and the centrosome are indivisible. Why? Because the centrosome is a half-autonomous organelle coming from a virus. Such viruses always exist [43] and are involved in apoptosis (figure 5). An early constrained endangered actor, when discharged, became a KeyStone Actor [20, 26, 27, 37, 38]. After the global aggregation of Monera compartments, through the help of a local population of viral particles [20, 21], a single one constraining feature explains all the exaptation process, the appearance of a gradient flow of exchanges -a side-by-side effect- between the central compartment which becomes the nucleus and the other around compartments, the merging of which rises out both globally the hyaloplasm and the reticulum. The mitochondrion and the chloroplast are hostages, prisoners, that were furthermore trapped into the hyaloplasm [19]. This all explains both the origins of mitochondria, Gram- Bacteria and the three types of membranes of the chloroplast. Their survival, through their reciprocal and mutual sharing of advantages and disadvantages, explains why mitochondria and chloroplasts are working in constrained reverse ways. Costs and profits are locally reciprocally shared, between the actors of the adjacent inferior level of organization, and globally mutually shared to permit the survival of the adjacent superior level of organization (figure 7): their Whole. **During a Conflicting Crisis** into an ecosystem of food chains, the cell was **the response for the survival of all the antagonistic sharers** (figures 3, 4, 5). For an ARMSADA to emerge the partners must lose simultaneously the capacity to kill the other one(s) [18, 28, 29]. In the new Whole (figures 1, 3) all that is an advantage for a partner is a disadvantage for the other one(s) [7]. The “parceners“ are fused together “for the best and for the worst” [7, 8, 9]. The benefits are only for their Wholeness which expresses new “abilities” [10, 15]. The ARMSADA **inter-**merging process (figure 6), making from different species a new one, by embedment and juxtaposition (figures 1, 2, 4, 7), is an **intra**-emerging synchronizing one [36], a percolation **extra**-emerging process with threshold and delay [20, 22], maybe like the timing mechanism that is involved in **intra-**organism differentiation at the cell level [51]. **Time** is very important but, soon or late, only small structural changes [41 in **space** may be sufficient to trigger the **reciprocal interactions** that allow the emergence of an ARMSADA [16, 18, 20][9].

The gauge invariance of living systems

A neuron is a complex system [50] because it is both more and less than the sum of its parts[10] [8] but itself it is unable to reproduce its self. Each dead neuron will be replaced only if a new population of Schwann cells will fuse with another giant cellular body. A neuron is less than the sum of its parts. Free, the Schwann cells had the capacity of reproduction which they lost when they make a neuron. A neuron has no more the 7 capacities that define a level of organization. It is made of systems of the ***i*** level (cells) and it is an inhabitant of a ***i+1*** level system-of-systems (the metacellular organism) but it is not a level of organization (figure 7) [8]. The life gauge invariance explains the scaling invariance of growth processes, the Law of which is independent of the organizations levels [7, 8, 9, 16, 34].

The periodic classification chart of living systems-of-systems

The cell (***i*** level) is the adjacent inferior level of organization of the meta-cell organism (***i+1*** level). And the ENDO of the organism is the EXO of survival, the inhabitation, of the cells, integrated inhabitants (figure 1). Every life form, whatever its level of organization, as a System-Of-Systems (figure 7), is integrated into a superior adjacent level of organization, as a local partner of a global eco-system, that it shares with other organisms (figure 6) [28, 29].

ARMSADA's breaking

Soon or late, if not a gamete, a cell will die (figure 5). But, during its life cycle, from its birth to its death and eventually its reproduction, a cell may be damaged, leading to cancer cells [15, 16, 26, 27]. Cancer cells are cells that should have to die but did not.

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9 Quel que soit le niveau d'organisation [Bricage 2001a, b, c, d, 2009a, b], la mise en place d'une ARMSADA donne au nouveau système à la fois plus de robustesse et de fragilité, plus de résilience et d'immobilisme, le rendant à la fois de plus en plus indépendant de son écoexotope de survie, de plus en plus dépendant de son endophysiotope [Bricage 1986] et ***de plus en plus dépendant de leurs interactions***.

10 ***« Le tout est à la fois plus et moins que la somme de ses parties. »*** *« Ni la compétition, ni la violence, ne sont marginales dans la nature, elles sont* ***des processus nécessaires, et contingents, agoantagonistes****, mais* ***qui doivent être dépassés tôt ou tard.*** *Ni la mise en place d'une ARMSADA, ni son maintien structural et fonctionnel, ne sont des processus coopératifs, mais plutôt ago-antagonistes. »* [Bricage 2014c] *« Ce sont des processus "au-delà"* ***(au-delà de l'espace, au-delà du temps)****, c'est-à-dire "émergents", qui "concilient" violence, compétition, coopération, ago-antagonisme, tout en* ***respectant des lois d'échelle****. »* [Bricage 2009a, b, 2014a]

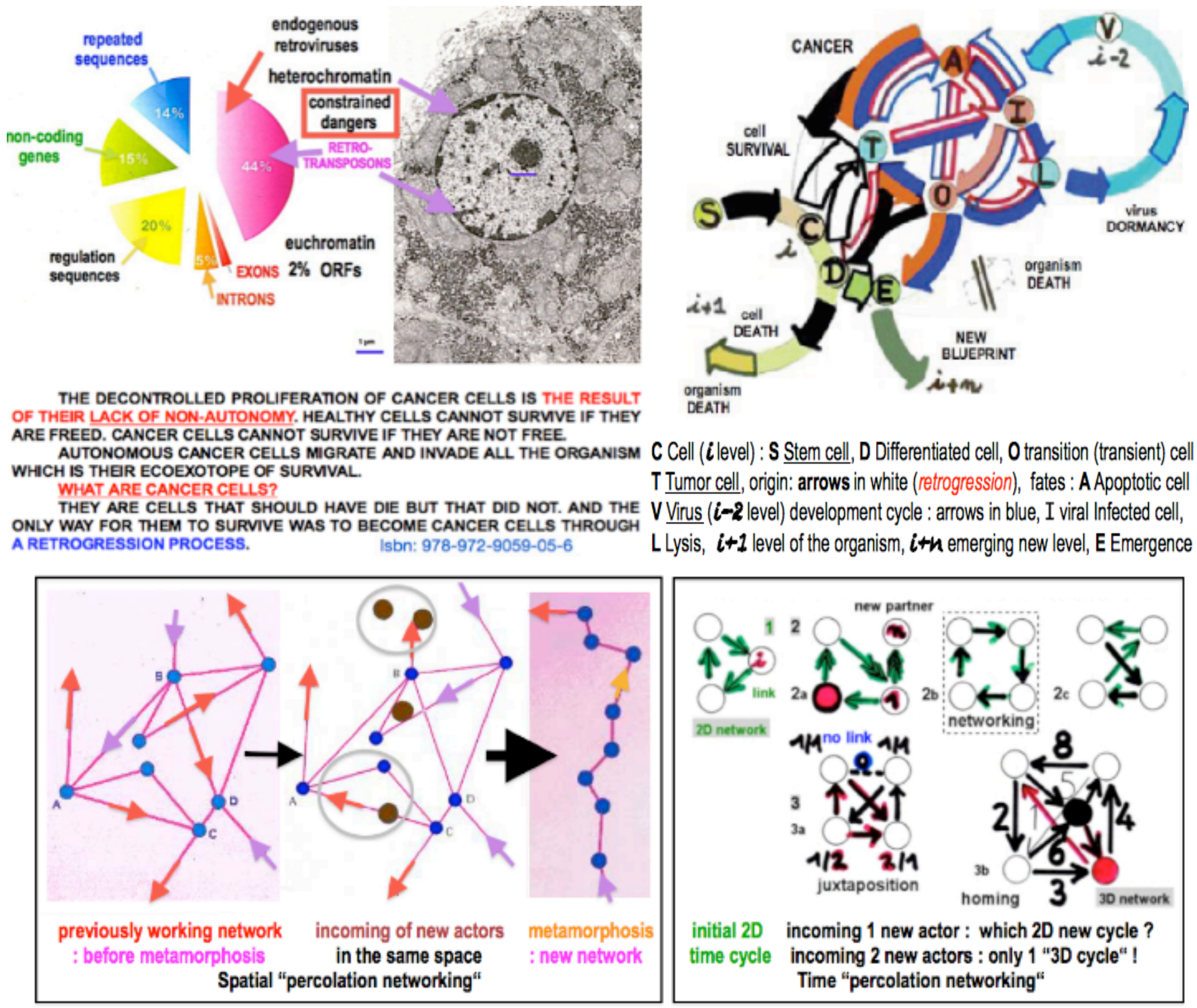

Figure 5. The percolation process leading to emergence of a new system of cooperating interactions is a spatial and temporal, structural and functional, metamorphosis within a periodic cycling equal sharing network.

The encasement and juxtaposition of the genic constrained dangers (as viruses) is a part of the nucleus role (top left). Constraining dangers, either from the ecoexotope or endophysiotope, either into the nucleus or the hyaloplasm of the cell, obeys the same process, whatever the organization level "ontogeny is recapitulating phylogeny" (top right) [Bricage 2002a, b]. After a time of antagonism TT (predator-prey relationship or competition for the same food), the birth of a new system results from the simultaneous losses by the 2 actors of their capacities to kill the other one. That allows to enter a cooperative process CC and to merge into a new whole for homing the new partners through changing the spatial and temporal dimensions of the previous system [Bricage 2005b, c, 2014a, b, c]. There are always 3 simultaneous processes in a metamorphosis: -lysis of ancient structures with the disappearance of previous actors during the interactive process of integration of at least 1 new actor, -creation of new functional structures, new actors that were not there before, are integrated into "the coming network", -ancient actors are conserved but"transformed" in their action, or in their place, or in their time of action. Integration is depending both an age and on stage of the actors, the interactions and the Whole. Connectedness in a network often shows a threshold behavior. When there are few connections, there are isolated islands of connections, and the largest connected group is a small fraction of total members in the network. However, at some point, the addition of a just a few more connections can cause a substantial fraction of the network to be connected (down left). Rebuilding of a one way cycling functional time calendar (down right). A rhythm emerges with **a 1 way cyclic network** (a both Eulerian and Hamiltonian cycle), only when the partners are sharing the time flow, **one after one at a time: "*A space for each one and each one in its space*" & "*A time for each one and each one in its time*"**. When a new partner (2a) enters the association, the same equal repartition of the time (1) use must be restored, with 1 choice of 2 possibilities (2b, 2c) in a "2D network". When another actor enters the time pathway there is only one way of cycling for an equal time sharing (3b) and in a 3D network [Bricage 2005b, c, f, 2013], ***a new dimension is emerging from the merging constraints***.

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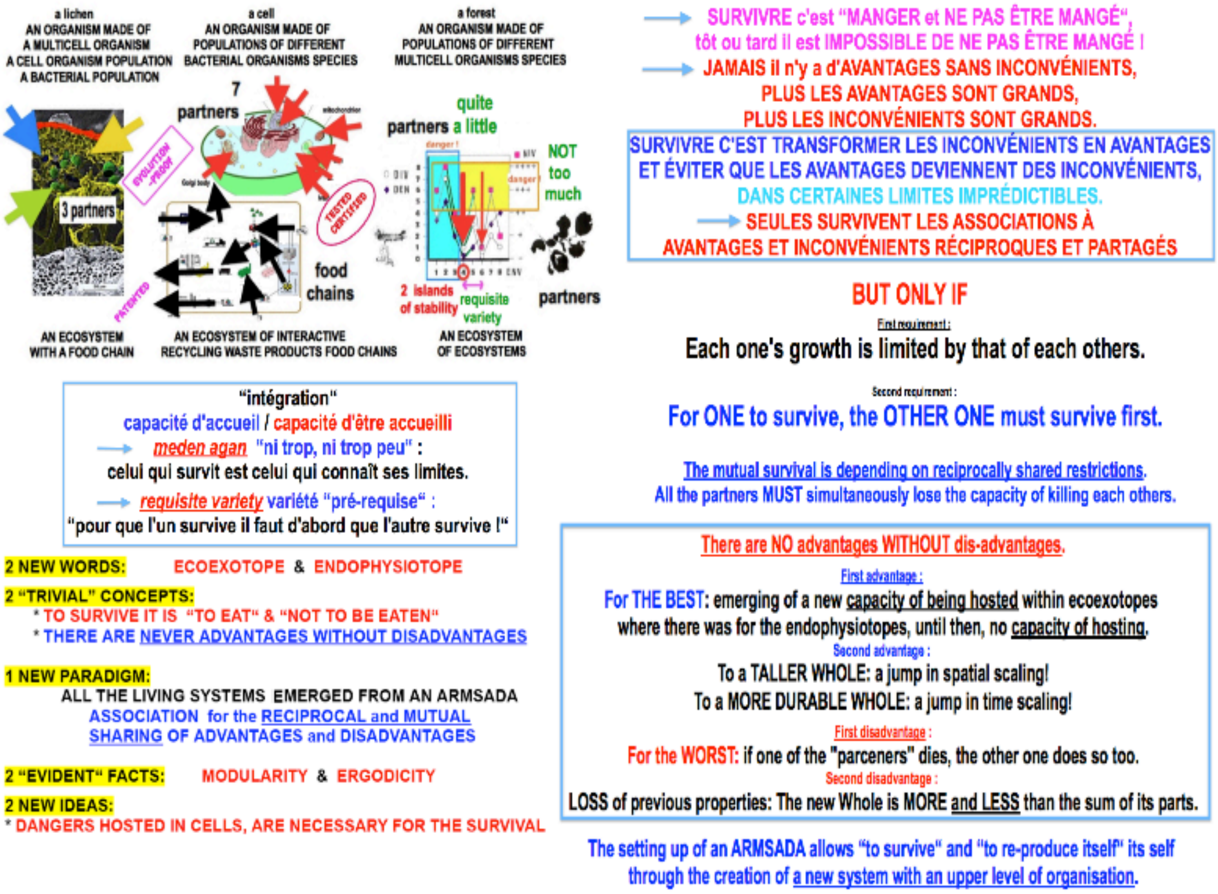

Figure 6. **No survival outside an ARMSADA** (**http://armsada.eu**)
Every ARMSADA emerges when all partners simultaneously lose the ability to kill the others. In the new Whole everything which is an advantage for a partner is a disadvantage for the others (**http://tinyurl.com/pbsustdev**). They are merged together ***"for the best and for the worst"***. ***"The benefits are only for their Wholeness"*** which get new "abilities" (**http://tinyurl.com/andesymbiosis**) -like the cell, which, with the help of a virus, emerged from a mat of Monera (**http://tinyurl.com/pbcellorigin**). In their new endophysiotope the ***"Parceners"*** are all interdependent. Through the iteration of the process of ARMSADAs' emerging, each new more-and-more complex "system-of-systems" is more-and-more independent of its ecoexotope (**http://tinyurl.com/phylotagmotaphology**). The endophysiotope of a *i* level of organization is the ecoexotope of previous *i-n* levels. Due to the parceners half-autonomy, abilities of the previous levels are lost while simultaneously new ones are gained: ***"The Whole is both less and more than the sum of its parts"*** (**http://tinyurl.com/anlea05pau**) [Bricage 2005a, b]

G. ***Ago-Antagonism between the adjacent levels of organization.*** *How to contain violence ?*

The local invading of the mitochondrion compartment (***i-1*** level) by a virus alters the cell global network of interactions, within the compartment and between the other cell compartments, leading to the apoptosis (the suicide) of the infected cell (***i*** level). Each event that alters the nucleus genome -like the freeing of dormant viruses- also triggers apoptosis [22, 38]. The systemic dys-functioning of its ARMSADA organization explains the apoptosis of the cell [26, 32]. The result of the death of only one endangered internal partner (one of the moneral parts: the population of mitochondria or the nucleus) results into the death of the whole endosyncenosis.

For the one to survive the other ones must survive first [5, 6].

The no-survival of the altered damaged cells allows the survival of the organism in which well-being sister cells or daughter cells are protected through the death of the altered ones. The death of one sub-system (***i-n-1*** level) leads to the death of the system (***i-n*** level) and the survival of the system-of-systems (***i-n+1*** level) it is belonging. That is an advantage for a system is a disadvantage for its adjacent levels of organization, and reciprocally. To survive that is to turn disadvantages into advantages and to avoid advantages turn into disadvantages ! [3, 4, 5, 34, 37]

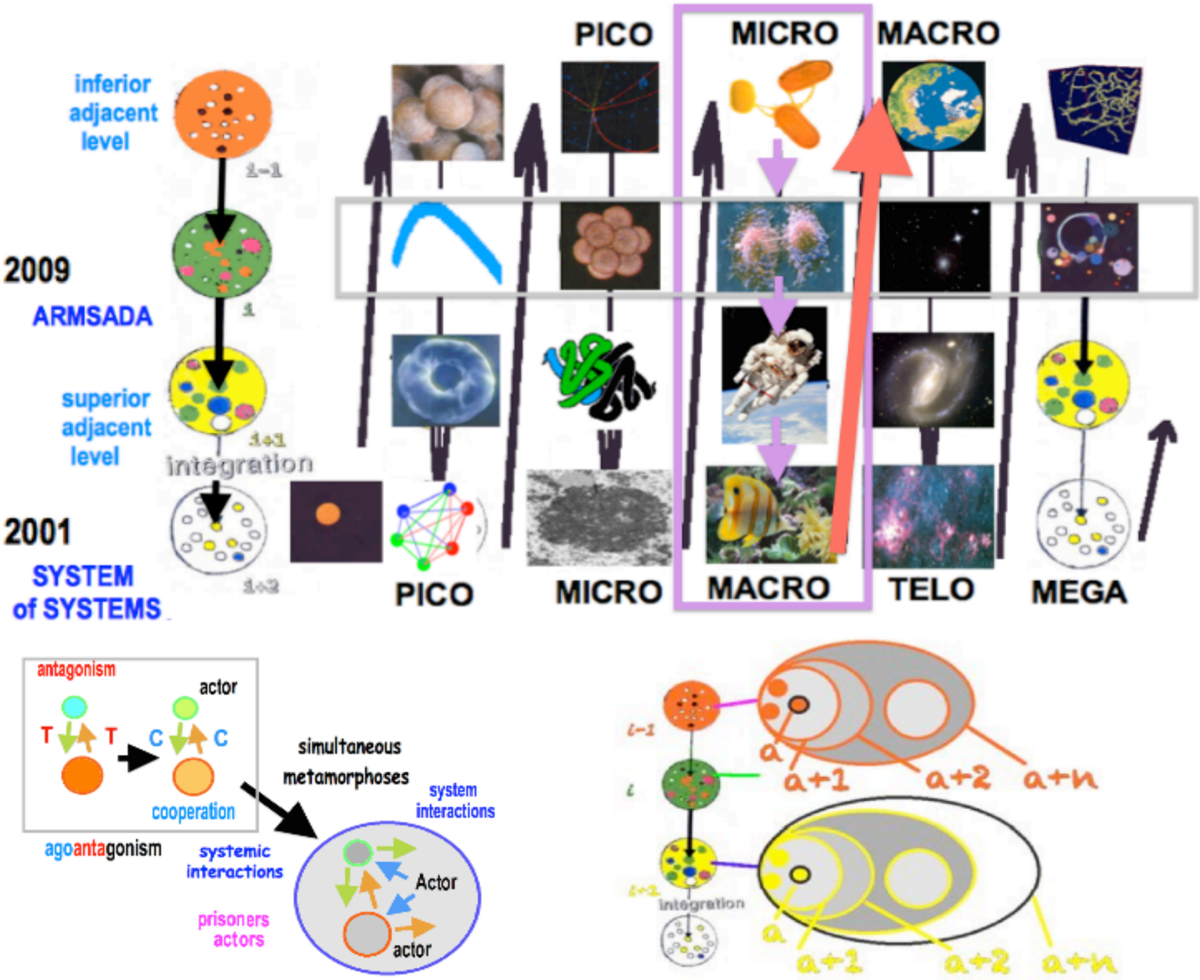

Figure 7. **The classification periodic chart of the living systems organization levels.**
(top) The chart: Living steps levels of organization ***... i-1, i, i+1, i+2 ...***
Example (mauve frame) "from MICROscopic scale to MACROscopic scale" : jumping from the level of Monera species (***i-1***) to the level of Cells species (***i***), from the level of Cells species to that of MetaCell Organisms (***i+1***) species (like Man species), from "Organisms" species to "ecosystems" species (***i+2***) and so on (towards adjacent superior SYSTEMS-OF-SYSTEMS) … [Bricage 2009a, b]
(down left) The process of jumping through ARMSADA emergence [Bricage 2014a, b, c].
The systemic interactions (antagonism/cooperation) between actors, through their simultaneous metamorphosis lead to a new system-of-systems
(down right) Societal organizational states of encasing within a level of organization: **a, a+1,... , a+n**.
Each species of a level of organization, ***i-1***, ***i*** or ***i+1*** ..., can produce GROUPWARES ***a+1*** of individuals ***a*** and "groupwares of groupwares" ***a+2*** and so on... ***a+n*** (adaptation), but they are not living steps levels. They are convergent forms of responses of the endophysiotopes to similar constraints of the ecoexotopes and ***n*** is depending of both the level of organization and the strength of the constraints. New living systems emerge only from groupwares of different species ***a, b, c, d,...*** whatever their, different or not, level of organizations [Bricage 2010a, b, 2011a].

*H. **Cancer**: the no-death of one, but the death of all. **No survival outside an ARMSADA.***

When a bacteriophage invades a bacterium, the bacterium dies and a progeny of viruses is released from the eaten prey (probability 0.999). But sometimes (probability 0.001), the infected bacterium is not lysed and a dynamic equilibrium is lasting a very long time -at the time scale of the bacterium life cycle- during which the hosted virus and the hosting bacterium survive and reproduce all together :"unus pro omnibus omnes pro uno" and "in varietate concordia" [19, 26, 31, 37]. But if an alteration of their common ecoexotope of survival (outside the bacterium) or of the endophysiotope of the bacterium -its inside, which is the ecoexotope of survival of the "temperate" phage- arises, thus the bacterium is killed (a sort of apoptosis named lysogeny !) and a viral progeny is freed.

The no-death of the virus triggers the death of the bacterium. The same is true for cells. It is now proved that viruses are involved in cancer emergence [26, 27]. When a virus enters a cell, usually the cell is eaten (probability 0.999999), but exceptionally (probability 0.000001), the no-death of the cell occurs. For the cell, to become cancerous is the only way not-to-die! The cancerous state can be triggered both with external invasion of viruses or with internal evader viruses (because the genome of the cell is inhabited by endogenous "temperate virus-like" entities) (figure 5) or by other dangers. The cancer cell (***i*** level) is an injured cell that should have died but did not, and the cancer path was the only way it had to survive. The no-death of the cancer cells lineage, soon or late, leads to the death of all the other no-cancerous cells, with the death of the organism (***i+1*** level). Cancer is a breaking of the cell's ARMSADA through an aggression that results in a lack of non-autonomy of cells through the de-controlled freeing of an ancient integrated virus [26, 27, 37]. Too much exogenous dangers or de-constrained internal dangers result in the death of the whole. Cancer also is a breaking of the cell's ARMSADA. Cells that should have to die, because of external dangers, "thanks" to the escape of internal controlled dangers do not [37, 38, 39]. Through this metamorphosis, their new cell ENDO will survive but their previous EXO, the ENDO of the organism, is altered and endangered. And soon or late the organism and its cancer parasite part will both die. There are never advantages without disadvantages. Into an ARMSADA each partner can survive only if the other ones survive first. To survive that is to turn disadvantages into advantages and to avoid advantages turn into disadvantages [9, 10]. Man is not an exception [17, 18, 31, 32, 33, 34].[11]

DISCUSSION - CONCLUSION

To survive all living systems must ***to eat and not to be eaten*** [2, 6, 7, 8]. But, ***soon or late, every one is eaten*** (http://tinyurl.com/surviepbafscet). Violence is necessary but the law of the strongest is not the best [9, 10] ! To partly escape from the prisoners' dilemma of the predator-prey game, *in which* ***"who wins loses***", the predator must, as the prey, enter into an **A**ssociation for the **R**eciprocal and **M**utual **S**haring of **A**dvantages and **D**is**A**dvantages (ARMSADA) -like a lichen or a cell, which both are an organism and an ecosystem-. **This is the only way to escape, but only for a while, from the struggle** for life. In their new endophysiotope (endo: internal, tope: space, physio: of functioning), the "parceners" are absolutely dependent from each others. But, through the iteration of the process of new ARMSADAs' emerging, the new -more and more complex- "system-of-systems" is, more and more, independent of its ecoexotope (exo: external, tope: space, eco: of inhabitation). The endophysiotope of a ***i*** level of organization is the ecoexotope of previous ***i-n*** levels (figures 1, 7). Because of the semi-autonomy of the parceners [15], abilities of the previous levels are lost and simultaneously new are gained. So the Whole is always less and more than the sum of its parts. ***There are never advantages without disadvantages !*** Each ecoexotope is structured with food chains (figures 3, 4) in which all plant and animal endophysiotopes have their places. "Man is not an exception" [3, 18, 29, 32]. There is no survival outside of a food chain: to have a place is a great advantage, your life form can exist ! But "there are never advantages without disadvantages", "soon or late every living being is eaten".The local biodiversity is the result of the global network of interactions between all the interactive species (figures 4, 6). The ecological, economical, educational or societal artifacts of the Man endangered species must be built according to the way of ARMSADA: ***"nobody must be a permanent winner"***, ***"everybody alternatively is a winner and a loser"***, ***"transparency is necessary to allow the mutual and reciprocal sharing of advantages and disadvantages"*** [31, 32, 39]. Growth must not impair the durable survivals of the organisms that are sharing the same ecoexotope.

For having destroyed a lot of ARMSADAs only for his own benefit, and at a short term, Man is an endangered species. And his domesticated plant and animal species are endangered too. Through his for-himself-only increase of the ***hosting capacity*** of the ecoexotope, he increases the violence between all the species that were sharing it with him [9, 34]. He should rather have to increase his ***capacity to be hosted***, his ***"capacity to be a guest"***.

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11 With the domestication of living species [Bricage 2003], Man species has evolved (exaptation) in a new state of integration in the earth biosphere. The ***"unity through diversity"*** pico-, micro-, macro-, telo-, mega- modeling (Systems of systems convergent hierarchical sub-levels) gives new insights into ***the social dynamics involved in the ontology of each life form*** (figure 7). In a set of individuals of a population, everyone participates in every other individual's existence and actions, the totality is present implicitly in every individual, and every individual makes a mark on the totality (holism). The concept of wholeness makes it impossible for primary laws to be summarized in a simple set of statements, since every aspect of reality enfolds all other aspects of it in the implicate order. In contrast, the explicate order, which current laws of all natural sciences are based upon, refers to the apparent reality of things.

Anthroposystèmes et écosystèmes : **"ACTEURS clé-de-voûte"**. Les anthropo-systèmes, écosystèmes artificiels dont l'homme est le seul acteur clé-de-voûte, sont très productifs en matière et en énergie, mais au seul bénéfice de l'homme. Les agro-systèmes sont moins robustes, moins durables que les écosystèmes naturels. Les écosystèmes sauvages, d'une plus grande diversité (forêt naturelle), sont plus résilients mais leurs temps de latence sont très longs, ils ne résistent donc pas aux actions humaines à temps de latence très courts. La disparition d'une espèce clé-de-voûte entraîne la mort de tout (si c'est la seule espèce clé-de-voûte) ou partie de l'écosystème (ou des écosystèmes) dont elle est partie.

This an exam that to survive each living system-of-systems has to pass continuously. If it fails only one time it will be eliminated. Natural selection is that ![12] Symbiosis is not a "win-win" association [25]. It is an association for reciprocal and mutual sharing of profits and losses, not for mutual benefits. Together the partners are surviving in conditions in which no one is able to survive alone. But the mutual survival depends on reciprocal limitations. ARMSADA is ***"a unity through diversity"*** that had been allowing the survival of all living systems (figure 6) for billions of years. Each partner survived only because all the other ones survived first. The growth of each one is limited by the growth of all the others [10]. The survival is possible without growth. Growing is only a way to acquire new capabilities, to jump to new steps of organization (figure 7) [18, 25], but ***only if at the right time, at the right place*** [1], only if ***with the right partners***, ***within and for the right partnership*** [39].

New ecosystems, whatever their level of organization (cell, lichen, forest, reef) emerged by the ways of both competition and cooperation, both between and within actors (figures 1, 7)[13], for responses to face up to dangers both from the ecoexotope and endophysiotope and in response to predator or ravager pressures (figures 4, 5) [45, 46]. "To survive that is to eat and not to be eaten !" To face the ecoexotopes changes, endophysiotopes had been interconnected together into new wholes. That increased the capability of their new ecoexotope to host their new endophysiotope which had a better ***"capacity to be a guest"***, and to face to a variety of ecoexotopes with a less "hosting capacity".

We are just discovering that mutually beneficial associations between individuals of different species have enabled major ecological innovations and underlie some of the major transitions in evolution.[14] Yet, surprisingly little is known about how mutualistic symbioses evolved and persist [44] !

"The development of a Wholeness is sustainable only if sustained by all the parceners".

"The development of an endophysiotope is durable only if sustainable for the ecoexotope."

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12 ***« Du point de vue d'un biologiste "extra-terrestre", l'homme n'est qu'une forme de vie (une espèce) parmi des espèces terrestres, de jour en jour de moins en moins nombreuses dans les anthroposystèmes. Seule la mise en place d'une ARMSADA entre l'espèce humaine et les autres espèces avec lesquelles elle partage la même biosphère permettra leur survie commune. C'est là la responsabilité sociétale et environnementale de l'espèce humaine, en tant qu'acteur "clé-de-voûte". C'est "un examen de passage" que chaque forme de vie passe au cours de l'évolution et auquel elle échoue (définitivement !) ou réussit, provisoirement... »*** [Bricage 2011c]

13 Tout système vivant est caractérisable par sa modularité : Quel que soit son niveau d'organisation, il émerge par EMBOÎTEMENTS ET JUXTAPOSITIONS de systèmes pré-existants, il est caractérisable par son ERGODICITÉ (approche cybernétique) [Bricage 2001d]. Tout système est à la fois ouvert et fermé. Ses propriétés dépendent de son fonctionnement aux interfaces, de sa transfrontaliérité : il est toujours à la fois plus et moins que la somme de ses parties (approches systémique et cybernétique).

14 The association with the cell ancestor and the domesticated endosymbiotic photosynthetic bacteria, ancestors of today's chloroplasts for carbon fixation, greatly increased the habitat of these photosynthetic bacteria from the sea to terrestrial ecosystems.

Despite being unrelated, free-living algae and fungi can help one another [Hom & Murray, 2014]. The green alga *Chlamydomonas reinhardtii* in CO_2-restricted environments and the yeast *Saccharomyces cerevisiae* were forced to depend on one another. The CO_2 production is provided by the yeast as it consumes glucose and is needed by the alga. Conversely ammonia can be made from nitrite by the alga and then used by the yeast. This dependence was seen under a broad range of environmental conditions and ensures phylogenetically broad range of mutualisms.

The colonization of land by plants required an additional symbiotic association, with fungal root symbionts for fitting nutrient uptake.

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