ASSOCIATIONS FOR THE RECIPROCAL AND MUTUAL SHARING OF ADVANTAGES AND DISADVANTAGES.

THE WAY TO BE RESILIENT AND SELF-SUSTAINABLE, THE LIVING SYSTEMS ARE RUNNING THROUGH.

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ABSTRACT

To survive the living systems must to eat and not to be eaten. But, soon or late, every one is eaten http://tinyurl.com/surviepbafscet. The law of the strongest is not-at-all the best ! The only way to escape from the struggle is to enter into an Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages (ARMSADA). A lichen which is both an organism and an ecosystem, a cell which is also an ecosystem and an endosyncenosis (ceno: to meet and fuse, syn: into a system, endo: with a new internal structural and functional organisation), both are ARMSADAs. Every ARMSADA merges when the partners do lose simultaneously the capacity to kill the other one(s). In the new Whole, all that is an advantage for a partner is a disadvantage for the other one(s) http://tinyurl.com/pbsustdev. The ôparcenersô are fused together ôfor the best and for the worstö. The benefits are only for their Wholeness which expresses new ôabilitiesö http://tinyurl.com/andesymbiosis. The synthesis of the myelin, in the case of the neurone, emerges from the ôunity through diversityô between a population of Schwann's cells and a giant cellular body. The nitrogen fixation of the legumes' nodes emerges from the fusion of a population of Monera with -and within- an organism. The eukaryotic cell has emerged from the help of a RNA virus from a microbial mat of Monera http://tinyurl.com/pbcellorigin. In their new endophysiotope (endo: internal, tope: space, physio: of functioning), the ôparcenersô are absolutely dependant from each others. But, through the iteration of the process of new ARMSADAs' emerging, the new -more and more complex- ôsystem-of-systemsö is, more and more, independent of its ecoexotope (exo: external, tope: space, eco: of inhabitation) http://tinyurl.com/phylotagmotaphology. The endophysiotope of a i level of organisation is the ecoexotope of previous i-n levels. So the Whole is also less and more than the sum of its parts: because of the semi-autonomy of the parceners, simultaneously abilities of the previous levels are lost and new are gained http://tinyurl.com/anlea05pau. There is never advantages without disadvantages. To survive is to turn disadvantages into advantages and to avoid advantages turning into disadvantages. The systemic disfunctioning of its ARMSADA explains the apoptosis of the cell. That is the result of the death of one endangered internal partner (the monere parts: the population of mitochondria or the nucleus) which results into the death of the endosyncenosis. Cancer also is a breaking of the cell's ARMSADA http://tinyurl.com/pbcancerlisboa. Cells that should have to die, because of external dangers, ôthanksö to the escape of internal dormant viruses do not. Through this metamorphosis -http://tinyurl.com/pbmeta1- their new endophysiotope survives but their previous ecoexotope, the organism, is altered and endangered. Into an ARMSADA each

partner can survive only if the other ones survive first. Man is not an exception http://tinyurl.com/WHYman

Keywords: breaking, ecoexotope, endophysiotope, endosyncenosis, metamorphosis.

INTRODUCTION

A swarm of bees is not a population of individual organisms. The swarm, indeed, is an organism which regulates its internal temperature depending on the external one. Into the Whole (the swarm system), the actors (the bees) are in interaction. Into our organism the red globules, like the other cells into the organism, like the swarm itself, all are functionally defined by their endophysiotope (ENDO: internal, tope: space, physio: of functioning) and their ecoexotope (exo: external, tope: space, ECO: of inhabitation). Both define the system as a whole (Bricage, 2002a) and the interface of exchange between the endophysiotope (ENDO) and the ecoexotope (ECO) -Figure 1-.

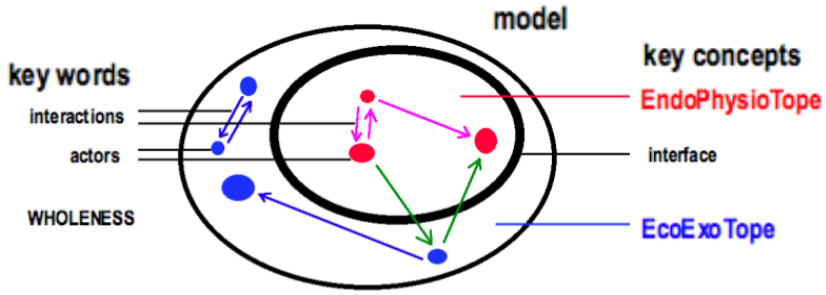

Figure 1. Ecoexotope & endophysiotope

The cell is the adjacent inferior level of organisation of that of the organism. And the ENDO of the organism is the ECO of survival of the cells. The organism, a System-Of-Systems, is integrated into a superior adjacent level of organisation, an ecosystem, that it shares with other organisms. When the ECO is changing, the ENDO must change too, in order to allow the survival of the Whole. Both together, ECO & ENDO are changing or no-changing. That is the integration (Bricage, 2000a). Each level of a living organisation is forever defined with 7 mutually necessary and sufficient functional characteristics, that are in interaction (Bricage, 2002b) -Figure 2-. 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 ECO exhibit a correlated organisation into the space, through the time, and in the action (4). The ECO furnishes to the ENDO a capacity of hosting. Reversely, only can be hosted an ENDO that possesses an appropriate capacity of to be hosted. This is the capacity of integration (5). Soon or late during its life cycle a living system -whatever is its level of organisation- expresses a capacity of movement (6). All the capabilities are necessary for the survival. The survival has only one goal: the reproduction of the corresponding life form (7) -Figure 2-.

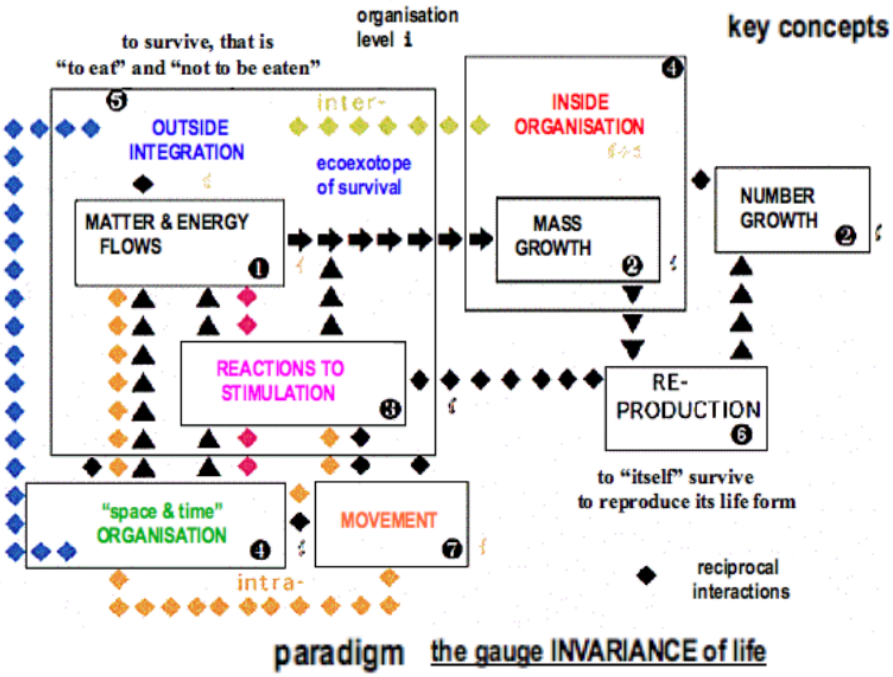

Figure 2. The definition of a level of organisation

To survive that is to eat and not to be eaten. Soon or late, alive or dead, an organism is eaten. It is the prey for a predator. And, into a food chain every animal is a prey for some and a predator for other ones (Bricage, 2000b). There are 4 possibilities in the fate of the relationship between a predator and a prey -Figure 3-.

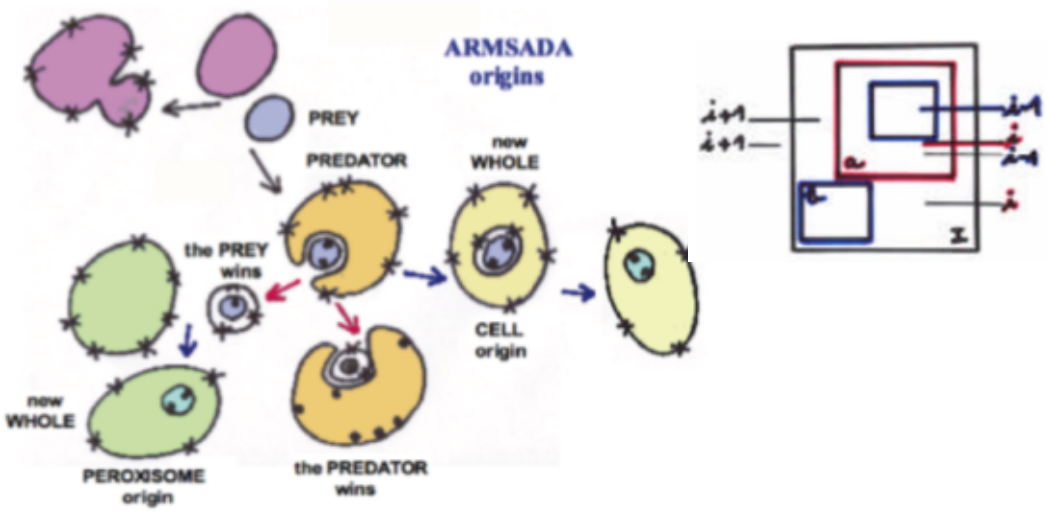

Figure 3. The fate of the predator-prey interaction.

Usually the predator wins and eats the prey (*The strongest is always naturally the fittest.)* Sometimes but rarely, the prey wins and maybe eats the predator (*The biter is bitten !*). Sometimes also, the two lose and die (and they are eaten by an other life's form). *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* 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.

WHAT IS an ARMSADA ?

There are never advantages without disadvantages. And all that is an advantage in a situation may be a disadvantage in an other one. Into the country, the white form of the peppered moth is not-eaten by birds when it lands on the white bark of trees, but the dark melanic form is. Yet, into industrial areas, when the light-coloured form lands on dark trees it is eaten and the dark one is not.

1.a. The nodes of legumes: from parasitism to mutualism.

At the beginning, a population of a Rhizobium species invades the inside of the root -the ENDO- of a legume plant. The bacterial population detect the root, at a distance, through the biochemicals that are released into the soil by the activity of the ENDO of the organism. -The soil is the ECO that is shared by the ENDO of the plant and the ENDO of bacteria.- The individual free living bacteria possess the all 7 capacities which define a level of organisation, indeed here the level of organisation of the Monera. Free, into the ECO, the bacteria are mobile and saprophytic. But invading the plant they metamorphose into a parasitic form that survive into the plant, eating the plant organism. The ENDO of the plant is their new ECO of survival. But, soon or late, the bacterial infection thread joins cells where it is stopped. And at the interface of the not-invaded plasma of the cell, 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 synthesise leghemoglobin, a new molecule that none of the 2 partners is able to make alone, and that emerging capacity directs the interactions between them in a way that the bacteria are now collectively subdued to the plant. 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 synthesise nitrogen sources that the plant cells can use. But, to dispose of the nitrogen sources, the plant cells must, reciprocally, first allow the survival and the nourishment (with sugars) of the bacterial invaders that are now partners...

In order that one may survive, the other one must survive first.

1.b. The lichens: from organisms to ecosystem and towards ARMSADA.

The lichens are ubiquitous widespread organisms that survive in extremely hard ECOs. They are able to colonise ECO where no other life form is able to survive. Why ?

A lichen is a box that is built with the body of a species of an heterotrophic fungus

(Fungi are peculiar organisms that are more and less than a plant and an animal organism, that are both a plant and an animal, and not-a-plant and not-an-animal). In the box is encased a population of photoautotrophic plant cells of an alga species. The two are inseparable. They cannot be cultivated separately. And if one dies so does the other one too. It is an ARMSADA, an association in which all that is an advantage for a partner is a disadvantage for the other one and reciprocally. The fungus offers the alga the mineral nourishment and its ENDO as a home. It is a great advantage for the alga that is then protected against its predators and against the usual variations of the salts and water content of the ECO that will impaired its survival if the alga was free. That is a great disadvantage for the fungus which must consume a part of its matter and energy to allow the survival of the alga. But all that is an advantage must be paid with a disadvantage. Indeed the fungus with its filaments, soon or late, eats the alga cells, like the man species eats his domestic animals or cultivated plants. That is a great disadvantage for the alga and a great advantage for the fungus. All together are eating the matter and energy of the other one. And each one may survive only if the other one does survive first. Sometimes a third partner may enter the association, a nitrogen fixing bacterium.

1.c. The cell endosyncenosis: *The Other One(s) MUST Survive First.*

Body Into a plant cell, like into the lichen, a compartment -the chloroplast- is specialised in the fixation of solar energy, mineral salts, and water, into organic matter. And another one -the mitochondrion- is specialised into the consumption of organic matter. It is a predator-prey like relationship. The mitochondrion eats the sugars that are synthesised by the chloroplast for the entire cell use. But doing so it produces wastes -water and, carbon dioxide- that are the raw materials of the chloroplast's metabolism. Inversely, the chloroplast's metabolism produces oxygen which is the raw material for the mitochondrion to use sugars. A third compartment -the peroxisome- recycles into water the toxic peroxide wastes the mitochondria and chloroplasts are producing together. A cell is made of compartment of Monera origins, the chloroplast, the mitochondrion, the peroxisome, that are juxtaposed to each other and encased into an other one, the hyaloplasm, also of Monera origin. It is an endosyncenosis (ceno: to meet and fuse, syn: into a system, endo: with a new internal structural and functional organisation), a new System-Of-Systems -*E pluribus unum*- that merges step by step through ARMSADA sprouting. All that is an advantage for a partner is a disadvantage for all the other ones, like the partners of the lichen, all are mutually fused *for the best and for the worst*. Each one may survive only if all the other ones must survive first : *Unus pro omnibus, omnes pro uno*. What is the wastes for some is aliments for others, and reciprocally. Both all the products and by-products are shared mutually. It is through their mutual and reciprocal interactions that the parceners survive in a kind of half-autonomy that renders all more independent of the ECO that they would be if free, separately: *In varietate concordia*. All at once they are sharing both the internal dangers of their new ECO -the ENDO of the cell- and the external dangers of their ancient ECO -the ECO of the cell-. 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 ECO which is still the ECO of their new Whole: the cell. Like the Rhizobia are sequestered outside the hyaloplasm of the cell, the internal compartment of the mitochondria or chloroplasts is sequestered. 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. The cell is a resilient system that is sustainable for all the partners because it is sustained by each one.

2. HOW, WHEN and WHY an ARMSADA rises out through merging ?

What are the signals and the constraints that lead individual systems to merge into a collective one ? What sort of collective System-of-Systems is rising out ? And how does it rise ?

2.a. The neurone: less & more than the sum of its parts but not a level of organisation.

A neurone rises out from the merging of a population of cells, the Schwann Cells, with a giant cellular body. The Schwann cells recognise at a distance the thin long axonal part towards which they move -like the Rhizobia recognise the plant root and move towards it-, and around which they fuse. An *E pluribus unum* entity rises out with a new structure -the Schwann sheath- that possesses a new functional property -the salting conducing nervous flux-. That is due to the synthesis of a new molecule: the myelin. Out of the conglomerate, no one cell of the entity is able to synthesise myelin. A neurone is more than the sum of its parts. But a neurone is unable to reproduce its organisation. Each dead neurone will be replaced only if another new population of Schwann cells fuse together with another giant cellular body. A neurone is less than the sum of its parts. Free, the Schwann cells had the capacity of reproduction which they lost when they fused to make a neurone. A neurone has no more the 7 capacities that define a level of organisation.

2.b. THE VIRAL ORIGIN OF THE CELL

Viruses are predators that are able to recognise -at a contact- their preys (bacteria or cells) with whose they fuse. Usually, when invaded, the bacterium or the cell is eaten by the virus to re-produce a new generation of viruses. But sometimes mutant viruses are not able to eat and kill their host. Or else mutant cells are able to not be killed by the invader. Frequently, viruses -like the influenza virus- allow the agglomeration of a lot of cells (or bacteria) in a mass. Such a process may indeed explain the origin of the cell through the merging of Monera of a mat (Bricage, 2005b). Usually, the origin of the eukaryotic cell is explained throughout an endosymbiotic origin from a prokaryotic precursor, with an autogenous scenario of nuclear evolution in which the nucleus emerged in the primitive eukaryotic ancestor (the "pre-karyote") as part of cell compartmentalisation triggered by archaeo-bacterial symbiosis (Mans & al. 2004). But this does not explain simultaneously the origin of the nucleus and that of the reticulum endo-membrane complex as does the viral-triggered fusion scenario (Bricage, 2005c). And indeed, the sequenced genomes of euryarchaeal viruses encode many proteins homologous to bacteriophage core proteins (Prangishvili & al., 2006).

The ancient biodiversity of the Monera was sufficient to allow -from their initial old free individual compartments- the emergence of a new level of organisation. But how did the exaptation process take place ? The cell is a network of Monera, an

endosyncenosis, in which the endoplasmic reticulum, the Golgi apparatus and the centrosome are indivisible. Why ? Because the centrosome is a half-autonomous organelle coming from a virus. Indeed, such viruses always exist (Gibbs & al., 2003) and are implicated in apoptosis. An early constrained endangered actor, when discharged, became a KeyStone Actor (Bricage, 2005b). After the aggregation of Monera compartments with a population of viral particles, 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 peripheral compartments, the merging of which rises out both the hyaloplasm and the reticulum. The mitochondrion and the chloroplast are hostages that were furthermore trapped into the hyaloplasm (Bricage, 2005a). This all explains both the origins of mitochondria and Gram- Bacteria -Figure 3- 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 mutually and reciprocally shared between the actors of the adjacent inferior level of organisation to permit the survival of an adjacent superior level of organisation: their Whole -Table 1-.

Table 1. The requirements for the merging into an ARMSADA.

There are NO advantages WITHOUT dis-advantages.

First advantage :

For THE BEST: emerging of a new capacity of being hosted within ecoexotopes where there was for the endophysiotope, until then, no capacity of hosting.

Second advantage :

To a TALLER WHOLE: a salt of spatial scaling.
To a MORE DURABLE WHOLE: a salt of time scaling.

First disadvantage :

For the WORST: if one of the "parceners" dies, the other one does so too.

Second disadvantage :

LOSS of previous properties: The new Whole is LESS than the sum of its parts.

The setting up of an ARMSADA allows "to survive" and "to re-produce its self" through the creation of a new system with an upper level of organisation.

BUT ONLY IF

First requirement :

Each one's growth is limited by that of each others.

Second requirement :

For ONE to survive, the OTHER ONE must survive first.
The mutual survival is depending on reciprocally shared restrictions.
All the partners MUST simultaneously lose the capacity of killing each others.

During a Conflicting Crisis, the cell was the response for the survival of all the sharers.

2.c. THE LIFE CORAL: a MULTISYNTONIC FRACTAL SYSTEM-of-SYSTEMS.

The cell emerged through the union -*Unus pro omnibus, omnes pro uno*- of endophysiotopes that were into a struggle for their individual survival into the same ecoexotope. After the fusion they are now sharing the same ecoexotope which was an ancient endophysiotope of one of them, and they are each others complementary. After

the way from Monera to the eukaryotic cell, through iterated processes of juxtapositions and encasements, the pattern of life ran then to aerobic animal cells -with mitochondria- or phototrophic plant cells -with chloroplasts-, from cells to multi-cellular organisms -made of juxtaposed and embedded cells-, from algae and fungi to lichen. From a system to a system-of-systems, to a system-of-systems-of-systems, the previous endophysiotopes became new ecoexotopes of survival for new forms of emerging endophysiotopes. The life tree is not a branching dichotomous tree but, as really mentioned by Darwin: a coral, with multisyntonic (ton: oriented forces resulting in, multi: multiple, syn: fusion) and fractal branches -the same law explains the same scaling independent processes- (Bricage, 2009).

3. REGULATION / DIS-REGULATION OF an ARMSADA

The *parceners* into an ARMSADA are merged in a Whole ô*for the best and for the worst*ô. For the ARMSADA to emerge the previous free antagonistic partners had to lose simultaneously the capacity of killing each other. So doing, they became more and more independent of their previous ecoexotope. But if one of the parcener dies the others does so too -Table 1-.

3.a. APOPTOSIS: the DEATH of ONE, the NO-DEATH of ALL.

The invasion of the mitochondrion compartment by a virus alters the interactions within the compartment and between compartments, leading to the apoptosis (the suicide) of the infected cell. Each event that alters the nucleus genome -like the freeing of dormant viruses- also triggers apoptosis. Soon or late a cell -if not a gamete- will die. But, during its life cycle -from its birth to its death, and eventually its reproduction- a cell may be damaged. 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.

3.b. CANCER: the NO-DEATH of ONE, the DEATH of ALL.

Usually when a bacteriophage -an exogenous predator- 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 ô*Unus pro omnibus, omnes pro uno*ö and ô*In varietate concordia*ô -like the death of a virus allowing the no-death of the virus and the bacterium-. 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 ôtemperateô phage- arises, thus the bacterium is killed (a sort of apoptosis, but 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. When a virus enters a cell, usually the cell is eaten (probability 0.999999). But, exceptionally, the no-death of the cell occurs (probability 0.000001). 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 ôtemperate virus-likeô entities). The cancer cell is an injured cell that should have died but did not, and the cancer path was the only way it had to survive (Bricage, 2008). 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. 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. Too much individualism results in the death of the collectivity.

3.c. CURATIVE VACCINES: *impossible but certain*.

Yet, dangers hosted in cells are necessary for the survival (Bricage, 2008). Endogenous viruses are regulators and protectors of life through their control of "the capacity of hosting" of the ecoexotopes and "the capacity of being hosted" of the endophysiotopes. Indeed, the integration of a virus as a "parcener" into a cell is an impossible event (probability maybe of 0.000000000001). But, at the scale of the geological time -namely after billions of years-, soon or late, it becomes certain. Protocols of making curative vaccines -HIV curative vaccine (Bricage, 2005d & e) or cancer curative vaccine- have been proposed using that paradigm (http://archives-ouvertes.fr/hal-00352578/fr).

CONCLUSION

Balancing from individualism to the merging of individualities into collective neo-individualism, the process of ARMSADA rising has allowed the EMERGENCE of new life forms. It is an ôonly one wayô evolution in which ôturning dis-advantages into advantages and avoiding advantages turning into dis-advantagesö allows EXAPTATION of new endophysiotopes that are more and more independent of their previous ecoexotopes (Bricage, 2006). The only way to escape from the dilemma of the predator-prey game where finally the predator always wins and thus loses -It is a game in which that who wins does lose- is for the predator to be also a prey for its prey -like in the lichen or the legume node-. Only will survive the Associations for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages. From the simplicity of the Monera to the complexity of the cell and the hyper-complexity of the lichen, the blueprints of the building of new system-of-systems have preserved the ancient footprints of the previous life forms (Sabbagh & al., 1991). The gauge invariance of life -Figure 2- explains the scaling invariance of processes like the growth: the mathematic law of growth is independent of the organisations levels (Bricage, 2009). With 2 new words -ecoexotope & endophysiotope-, with 3 basic concepts -to survive it is to eat and not to be eaten, soon or late it is impossible not-to-be-eaten & there are no advantages without disadvantages-, with 1 new qualitative paradigm -soon or late a new living system rises from the merging into an ARMSADA-, with 2 evident facts -the gauge invariance of the living systems (their 7 mutually necessary and sufficient capacities) & the modularity and ergodicity (every new living system is built through juxtapositions and encasements of previous ones)- it is possible not only to explain living evolutionary phenomena -like the origin of the cell (http://archives-ouvertes.fr/hal-00130218)- but also to foretell a methodology to

obtain curative vaccines (Bricage, 2005d & e, 2008) -that is effective in the case of HIV (http://www.techno-science.net/?onglet=news&news=7534)-.

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