

Regina and Rogerio: fragments of a fifteen year conversation

As I started the study and translation of Keleman's books, in 1990, I felt immediately the need to understanding the evolutionary roots of his formative and unique conception of the body.

Rogerio Sawaya was already at the time a very experienced medical doctor, an obstetrician, introducer of the Leboyer Birth Method in Brazil, son of a great Brazilian biologist, somebody that was very intimate, since home, with life and its processes and, later, with the heavy scientific readings that for me, by myself, would be inaccessible.

As we first met, by a happy coincidence, he was looking for a deeper meaning to his interest in the study the body, beyond the inevitable medical biases. The breadth and depth of Stanley's views about life to which I introduced him, astonished him. This has been the beginning of a real and productive exchange and cooperation that keeps alive and in movement.

These fragments presented here come from video recordings of Rogerio's talks in my Emotional Anatomy Seminars.

They have been collected by Beto Teixeira in his notes and transcriptions from video recordings of the group in which he is the reporter and photographer, then edited by Rogerio and myself. Beto is a dancer, a body therapist, a very dedicated student, co-worker and researcher of my Kelemanian transmission. **Regina Favre**

Regina: Reading, understanding and bringing to our lives Emotional Anatomy, we deeply build up a feeling of being part of a bigger process, of not being an isolated individual, something "in itself". This study also allows us to feel, as well, that we share a universal pulse, since the Big-Bang around 15 million years ago, that is here. The inputs brought by Rogerio in our study will contribute, gradually, to enhance and enlarge our possibilities of self-recognition as evolutionary anatomies and, consequently, will deepen our self-management.

Rogerio: During the process of pre-vital selection in this planet, life finally appeared. And as it comes up, life made "circumscriptions in the environment" so particularizing an inner environment, individualized little oceans. Life creates, then, the cell membrane. In every cell that appeared since then, over 3 billion years ago – be it a very primitive cell as a bacterium, be it a modern one, like the cells that constitutes our body – it is always a membrane that guarantees its individuality.

By the presence of this membrane, the cell protected itself since the beginning from the competition of other molecules in the environment. This cell has in its center the nucleic acids – RNA and DNA – that, until some years ago, were understood only as molecules that contain the heredity code. Today, there is a wider comprehension: nuclei acids express the hereditary characteristics codifying the synthesis of structural proteins, essential for the cell formation.

In the more primitive cells – prokaryocytes - it existed no nucleus as it does in modern ones. Their RNA and DNA remained free floating and diluted in the cytoplasm, becoming then vulnerable to the action of competitor molecules in the neighborhood. The modern eukaryote cell (*eu* = proper, *karion* = nucleus) invents a nucleus with a double membrane in order to ensure this safety even more - the central cellular station - where lives the hereditary code that gives the basis of its functional shaping and where from life replicates itself and continues.

Another thing that life created since the beginning of the cells are the ribosomes, hundreds of thousands of little cell organs, micro-industries that manufacture the proteins of the body. It is in the ribosomes that gland cells produce, for instance, pancreas insulin and thyroid thyroxin. In the same way, they produce, in the

immunological system, the antibodies, a sort of proteins that protect the organism against invaders.

This is a very basic and simple vision of the cell.

The cell membrane is made of a double layer of special fat molecules with one extremity directed to the interior and the other one to the outside of the cell. This membrane is highly selective: it is not any substance that is able to come in or go out through it. There are protein micro-channels that cross the membrane and reach the cell interior and select what enter or what does not enter in its internal environment. These channels open or shut in according to the vital needs of the cell.

Throughout the initial period of evolution, life through unlimited trials and with its high morphogenetic power – already began to produce unicellular beings, sketches of complete systems that went further until our complex macro level. It already existed a mouth to capture nutritional particles of the surrounds, a prototype of digestive tube, cilia that beat in a synchronized way to promote the displacement in the environment. A sketch of neuro-motor micro-system, therefore, already appeared in this time.

Life, in this way, in its formative impulse, tried, diversified and came to a limit with unicellular structures. To continue to explore the ecosystem, life connected sisters-cells with sisters-cells, making colonies. Colonies became more complex and learned to divide work with the intention of getting in a better way the reserves of the environment. All these events were always guided by Darwinian natural selection, in which more fitted shapes are more capable and succeed.

Regina: I want to speak about the concept of **fitness** that, I believe, has had a wrong interpretation being identified only as the law of the strongest. More fitness is not only to win the competition for place and food. Fitness is also and mostly **to have more ability to make connections with environments** be them big or small. In this view, we can think that, at this moment of evolution, the unicellular forms that survived were exactly the ones with more connectivity and ability to gather themselves into colonies.

Rogério: Fitness has to be understood, also, as one of the fundamental characteristics for the continuity and spread of life: to be more complex, to have a growing biological complexity, not only in its shape but also in its strategies for adaptation to the environment. And it is obvious that a group of cells that unite and make a work division have a higher degree of complexity favorable to the construction of a society in adaptation.

Regina: In English the verb “to fit” means to be at the right measure, as a foot fits in a shoe and vice versa. It is the mutual fitness, the connectivity of shapes, the one that fits in. And, since the beginning of the living impulse, I believe, there is the problem of fitting or not fitting. The situation of cooperation, of the gathering of forces to produce something in and with the environment.

Rogério: It is always the interaction. In any ecological niche, interaction is fundamental and needed to form and keep the organization and complexification of any colony or society.

Regina: We can see this in the case of the carbon molecule self-selected in nature to produce the chemistry of organic compounds exactly by its highly connective capacity. The idea of something that connects in cooperation is very interesting. Connecting in cooperation or disconnecting in competition, this is the other side of the same coin. The separation and the union, to compete or to cooperate, but always in relation to feed more, to produce more life and, therefore, to achieve energy for the cell vital processes to go ahead, building more powerfully the living networks.

Rogério: More life, more capacity of form, with more potential to succeed, feed and reproduce. In this process, it appears a clear advantage: life gained condition to explore areas of the ecological niches inaccessible for it until then.

Regina: The investment of life is going ahead, in other words, to select forms with capacity of self-sustaining and being able to react in relation to the forces of entropy. That means selecting forms that resist to the disorganizing forces in the environments.

Rogério: Life continues in making experiments and creating differentiations in these organisms, favoring its own supportive forces of their difference against the homogenizing tendencies of the environments. Life is self-formative as facing life struggles, maintaining itself in a dynamic equilibrium. In doing so it guarantees the singularity of its form in the environment that continuously try to absorb the living being to the primordial chaos of entropy.

Regina: There are two ideas in there. First, to maintain this capacity of self-construction from oneself and from the lived experiences, feeding an internal process. Second, the idea of an operational closure, as Francisco Varela says similarly to Keleman, in which the membrane protects its entirely individual internal functioning where certain autopoietic or self-constructive processes take place. There is permeability, there are passages, but everything very well regulated to guarantee that this functioning happens and maintains itself as itself in a dynamic equilibrium.

We can find this idea of maximum precision in this voyage inside the micro that you are bringing to us. At first, we can see the dimension of the force that triggers itself in the universe with the Big-Bang event – we can feel that is the same power that has been differentiated in each organism in an evolutionary process of the biosphere. From this point, we can see that life has a fantastic potential to express and create gradually what fits, more connectivity and more ability to cooperate in the forming of realities. The other point is that how this precise organization is there in the smallest details, always selected, always succeeding in the selective process towards shapes that are more functional. This comprehension we can extend to the self, to the environments, to the interaction between the bodies and people. It is wonderful to begin the understanding of Keleman from this point of view. I think, this is a pre-condition for us to take better advantage from this book, Emotional Anatomy, from the contemplative as well as from the operational point of view.

Along the readings we will see the “increase of excitement that requires more form”: forms that organize themselves to be able to give support to more interactions and inner operations, to go one step further in terms of organizing the excitement, to be able to expand and make more connections.

In terms of biosphere and ecosystems, simpler forms compose themselves with more complex ones. Not everything needs to be complex. Bacteria, for instance, have been simple forms for a very long time, functioning and cooperating with the system. There are other forms, however, that followed a line of complexification, with a very high range of actions and connections. In this path, the simpler forms are interacting in different levels, all the time, with the more complex ones.

Rogério: That's it! I agree with you. Bacteria exist over 3 billion years (fossiles are found in Africa and Australia), they are very simple and primitive forms of life that are able to replicate rapidly - some species duplicate in population in only 20 minutes and have a very successful sort of organization. A real accomplishment! We could think, perhaps, that life did not need to surpass the prokaryocyte level to occupy, completely, the varied ecosystems of the biosphere. However, life was sort of forced to differentiate itself in much more complex ways.

This explains the creation of eukaryocytes, its association to construct the macro body of multi-cellular plants and animals, whose last step was the surprising development of our unique neo-cortex, which differentiated *Homo sapiens* from the rest.

The models of simpler structures, highly well succeeded, stay as themselves until today. Hemoglobin is a good example of this, the complex molecule that transports oxygen, which was invented a long time ago in the scale of vertebrates. As long as life reaches the functional model, it maintains the model, adding other structures and, by doing this, conquers new niches for exploitation, experimentation and production of life.

Regina: How can life guarantee a stable design for the body of each species?

Rogério: In order to be able to transmit the hereditary characteristics of each species, life created the very elegant model with only four nitrogen bases that constitutes RNA and DNA. These four bases are the letters of the immense genomic alphabet - the hereditary code for all living beings. This biological device came into existence since the primitive bacteria and has continued until the more complex form of life, the *Homo sapiens*. It is the same model that life invented and continues to repeat until today.

This formative model, however, is not enough to fulfill the formative concrete needs of the organisms' structures. The contribution of the genetic initial impulse in body formation is limited. Tens of thousands of genes are insufficient to induce the complete formation of the anatomical structures that compose an adult body. In the case of *Homo sapiens*, for instance, we know today that only around 30.000 genes are the basic inductors of the development of these structures. This fundamental contribution is clearly insufficient.

An additional process is responsible for completing the initial formative impulse of organisms induced by the genes. It is the epigenetic impulse (Gerald Edelman) – ethimologically, *beyond genetics*, in which cell communities compete among themselves in the different places where the new body structures are created. In this competition, that follows the rules of Darwinian natural selection, the cell groups with more fitness will predominate in establishing the new anatomical structures. This process implies division, differentiation, movement of these cellular groups, besides death of cells with less fitness. In the formation of the central nervous system, for instance, the epigenetic process strongly acts discarding up to 70% of the cells involved in the laborious activity of their sculpting its structures. The term *Topobiology* was created by Gerald Edelman to describe the local activities of cell groups.

In embryogenesis, the cellular groups with more fitness have influence upon the genes that gave the start - the initial sketch of the structures in formation. In this manner, the structures in formation in different places of the organism modify the initial impulses of the genes themselves. This process explains the formation of the different structures, involved in the constitution of the body.

Regina: There is an important point for us at this point: this selective parallelism, at genetic and local level, that we can see in Topobiology. This means that there is an innate genetic program but the lived demands, this going back and forth between genes and cellular groups, determine modifications in the structures that are undergoing formation. Even innate neural programs, for instance, are selected following the self-use of one's self.

Rogério: It is the same going back and forth process, having reciprocally an influence in the development of the action and the formation of what is structural. It is similar to Escher's image of the hand that draws itself and, at the same time, it is drawn by the drawing itself.

Regina: At this point there is a crucial question in the formative process: the lived solidifies itself and, at the same time, the solidification of the lived molds the conditions of the becoming in the process itself.

Rogério: The formation of the body of the multi-cellular beings has some analogy with the passage from unicellular beings, like bacteria and protozoa, to constitute colonies, communities of unicellular bodies.

Regina: It is important to give emphasis to the idea of pool, environment and cooperation. It seems to me that the evolutionary process, from the unicellular level to the multi-cellular organization, establishes immediately, since the very beginning, a principle of cooperation, environmentalization and work division.

Rogério: Yes, we can see these principles ruling the cells in their working in the formation of tissues, we can see also in embryogenesis. The first layers to appear, in evolutionary terms, were the ectoderm and the endoderm. Both, in its nature, are epithelial tissues. Ectoderm will give origin to epidermis, the most superficial layer of skin, layer of protection and contact. Another derivative of this ectodermic layer is the whole nervous system. Endoderm, by its turn, will originate the epithelium specialized in absorption, related to nutrition, that lines the interior of the digestive tube. So, epithelial cells join together, cooperating, to form layers, layers that fold themselves, roll to form tubes as Keleman describes in EA. It is the epithelium that lines all the digestive tube, the endothelium that lines the vases, arteries and veins, and also the interior of the bronchial tube. Layers of epithelium roll in tubes, tubes dilate in bags and, if we place the pulse inside, we will have this wonderful systemic vision.

The third embryonic layer, the mesoderm, develops itself in between ectoderm and endoderm. It will originate the tissues in charge for sustaining shape, actions, form, locomotion.

The complexity of human body requires a great number of different types of cells, even before the construction of tissues and organs. It was necessary to evolution to constitute 200 different types of cells to be able of structuring this body we have today. It is an incredible order and sustenance of basic principles.

Regina: This conquest of the planet and the cooperative creation of the biosphere implied on the acquisition of new sources of nutrients and energy to the increasingly more complexes organisms. Can you tell us how this happened?

Rogério: A living cell is a self-assembling, self-adjusting, self-perpetuating isothermal system of organic molecules which extracts free energy and raw materials from its environment (Lehninger). The energy for all living cells' processes in the biosphere is captured from solar radiation, in the process of photosynthesis led by the green plants. In this process, electrons are used in the building of small molecules with a high content of chemical energy (specially ATP), which are used by those plants as energy sources to make carbohydrates and other organic compounds.

Regina: This formative, selective and cooperative idea has a capital importance not only in an existence but as something that permeates everything that exists since the Big-Bang and, step by step, advances forward in layers of organization. It is an assembly of organized pulses inside a given architecture. It is evident how, going from the cell until formation of the tissues and layers, the same organizational principles take place. (proceed, carry on). It is an organization that, in the micro as much as in the macro, is self-pulsating, self-formative, has a membrane, an inside and an outside, presents growth and layers on time, getting more complex with increased fitness.. Continuity is uninterrupted. All these micro-steps, the in betweens, the formation of one thing from another, are selected and precise. Inside this process, the living tries to

construct diverse strategies to go ahead. Facing the power of the living, we can see how much life struggles to endure and proceed. Life is also so strong, exactly because it has fantastic safety systems, at any level, to avoid what can disaggregate its parts.

Rogério: A clear example of this is the DNA nuclear, very well protected by this cellular central safe, the nucleus. The DNA molecule has a self-repair system that functions when a fragmentation in an extremity occurs. The DNA self-repairs itself continuously for maintaining the hereditary code and the synthesis of proteins, to support the formative potency, to be able to resist and proceed, even in adverse conditions.

Regina: When you say that the DNA self-repairs itself continuously to keep identical to itself, this is what we do, as human bodies, to proceed in spite of aggressive factors to our integrity. The startle reflex mechanism functions in this protective device and the ability of disorganizing it that the motor cortex and striated muscles offer together is a continuity of this primal system of self-reparation.

Rogério: When we speak of functioning structure we may also go to the micro and we may understand something about the neural-motor system. In muscular system, the essential components are protein molecules - actin and myosin – that enchain to form filaments, biological polymers. The muscular contraction, in essence, at the molecular level, depends on the displacement of thin filaments of actin over a thick filament of myosin, promoted by change in spatial geometry of these molecules.

Regina: In the mid 90s, Stanley introduced me to Gerald Edelman's books on neuroscience whose ideas belong to the same Darwinist family of ideas than the Formative ones. Actually, Edelman's ideas resonate with Stanley conception of "the body's mind and the mind's body" conceived already in the mid 70s. It has been an incredible luck to have you by, Rogério, at the time to decipher Edelman's writings. Today they are totally included in your classes and our conversations in the EA Seminars. Let us, so, speak as selection and connectivity are also in the Neural Darwinism.

Rogério: In neuroscience, in our days, the wider, unitary and better accepted concept about the nervous system, is the **Theory of Neuronal Group Selection (TNGS)** proposed by **Edelman**. In his theory he tries to explain all the structuring and functioning of the human nervous system using only **three tenets**. His theory even searches for an anatomical and functional explanation for consciousness and tries to provide an unitary body-mind vision.

Briefly, his three tenets are concerned with the establishing of an anatomy of the brain during embryogenesis, functional modifications in the neural network promoted by experience along a lifetime and, the more important for us, the reentry concept that is a process of signaling between neurons of different groups (neural maps).

The first tenet considers the formation of the neural and anatomical characteristics of a given species. It takes into account the selection in intra-uterine life, in which groups of neurons, in a selective process, compete with other groups (**topobiological competition**) to construct the neural structures. In this competition, 70% of the neurons in certain places of the nervous system can die, as mentioned above. The result of this **selective process** – the establishment of the network in the central nervous system - is called **primary repertoire**.

Regina: I would like to emphasize this from the evolutionary point of view. You are considering now something that, in our comprehension, is present all the time in Keleman's thinking. There is this first moment, embryogenesis, in which the nervous system of species is sculpted with the best material. This is our anatomical heritage. In

connection to what you are saying - this kind of sculpture in which 70% of neurons are discarded - I see Keleman's idea of inhibition. This means that there is an inhibition of everything that effectively has no use to emerge, what is less functional to the situation that has less power. In this case, everything that has no power in the continual becoming of a body is inhibited.

Rogério: In neural terms, there is always interplay between inhibition, blockage and the force from which you speak, excitation. All the nervous system, from the first simpler neuron, until the most complex structure, implies inhibition and excitation. This is a fundamental point to the comprehension of the nervous system functioning. It is, also, a concept of capital importance in Keleman's vision.

Regina: We can see, easily, how the thinking and practice developed by Keleman are totally coherent with the evolutionary thinking: all the nervous system functioning is selective, proceed by the evolutionary model. The behavior, the trait, the action that functions better emerges if you silence what is not functional anymore. Or, even, inhibit what does not fit properly to that specific purpose. Keleman's view of body production is closely related to this interplay inhibition-excitation, present in all the evolution. Keleman, for me, has a total coherence in all his vision, where the practice has exactly a relation with what he thinks from the genetic level, to embryogenesis, to the experiential level of production of the topobiological body along a whole life, at the level of neural maps and of the social interactions.

Rogério: The second tenet of TNGS says that – after the neural network has been sculpted in the process of embryogenesis, **the primary repertoire** – it will happen a functional selection in the neural network as a result of one's life history, with personal experiences. Upon this network of the innate species body, will occur a selective action from everything that is more used and stimulated, resulting in modifications in the synaptic power. This reinforcement of synapses will facilitate the passage of nervous impulses. We are born with a neural system that is the nervous system as a whole which is the one of the species. We, along all a lifetime, however, will reinforce different synaptic groups, different nervous pathways. This modification of the original neural network, the primary repertoire, is called **secondary repertoire**. This is what is giving the unique characteristic for each one of us.

Regina: Here, in this second point of TNGS, there are the synapses that are selected and no more the primary network of neurons. That means the inter-neuron connections that better facilitate the experience of life from that particular developing organism, in that particular environment. We are talking, here, of the material that constitutes the **three brains**: what connects better with what - for constructing a path in excitation - supports life in that specific organism in the biosphere. There is a number of potential pathways and possibilities. Some are more used than others.

Rogério: The third tenet of TNGS, certainly the more important, is concerned with the connection of neural maps – groups of neurons, in distinct cerebral areas, interconnected and acting in the same neural function. A neural map is related to vision, for instance, another one with the tactile sense. A unique neural function may require the connection of various maps. It is the case of the visual system of monkeys that has, as refers Edelman, over thirty different maps, each one with a certain degree of functional segregation – for orientation, color, movement, shape, among others. The **third tenet** considers the interconnection between neural maps, of diverse neural functions, by massively parallel and reciprocal connections. This sort of interaction is called "**reentrancy**"; reentrant signaling occurs along these connections. This means, continues Edelman that, as groups of neurons are selected in a map, other groups reentrantly connected to different maps, may also be selected at the same time.

Correlation and coordination of such selective events are achieved by reentrant signaling and by the strengthening of interconnections between the maps within a segment of time. Neural maps, thus, are dynamic, not static structures, that change in time. A fundamental premise of TGNS is that the selective coordination of the complex patterns of interconnection between neuronal groups by reentry is the basis for new behaviors forming.

Regina: Through learning, that means, through the assimilated lived experiences, there is cooperation between networks that begin to interact to produce another design, cartography. The novelty is in the selection and cooperation of neural maps, because as we know, in this moment of adult life there is no more production of neural tissue but only intensification of synapses. Keleman's focus in his last papers is totally in the synaptogenic power of the 5 step practice.

Rogério: It is well known that after birth there is no production of new neurons, only loss of this nervous cell (with the exception of possible creation of neurons in adult life, by transformation of stem cells). Every day we lose millions of neurons.

Regina: This is the optimization of neural patrimony, this reentrancy of maps that sculpts new possibilities through new synaptic combinations.

Rogério: The classic idea that there is a hierarchy of recent neural structures, the neo-cortex for instance, that would control the whole nervous system, becomes totally worthless with this concept of **reentrant maps**. In this new vision, in last instance, what we call "me" is determined by global reentrants maps that function in a fantastic dynamics, susceptible of changes by learning.

Regina: - The "me" is a construction of reentrant maps in action, temporarily stabilized, producing life in a certain way, in a certain environment. In reality there are multiple selves, as says Keleman and other contemporary authors that have not the old idea of a monolithical self. It is in reentrancy that happens what still does not exist. How many neural maps reentry are needed to build up a modification or a new behavior?

Shaking hands, for instance. The connections between two areas that have sensibility, a motor organization, a pulse, an excitation, and then you have a behavior that is established. How is a firm hand shaking? How is to shake hands with seduction? How is to shake hands with authority or restriction? Each one of these behaviors affirms it self when you repeat it. It is the combination of motor neural maps with touch maps, temperature maps and so on. An excitatory molding that we organize in us, with a lot of variations, that means, many reentrances.

Rogério: Modifying proprioception, joint and deep muscular sensibility, for instance, in which we use different sensibility terminals

Regina: Regulating tonus and making distinctions in the different qualities of the action. We can understand, then, that behavior is made of itineraries, giving us the possibility of making a narrative. The crossing over that happens in form, forces us to organize reentrancies in order to assimilate new intensities and being able to interact with those new flows. This operation produces unique layers and new reentrancies.

Rogério: I consider fantastic this passage that you did now and that Keleman did, brilliantly, in his work. Molecular biology and neuroscience, with all their interpretative power, stopped at the limit of explaining a body at its the personal configuration. Keleman, with his theory and practice, with his vision, did clearly this passage. This is Emotional Anatomy.

Regina: When he takes this molecular biology and Darwinist neuroscience and sets them directly in relation to people's lived processes, we can see clearly how and of what people's life is made of and we can understand how complexity and subjective biodiversity can be enhanced and carefully molded. All this is directly related to the continuity of body production. The more diversity and neural motor organizations we have, the more efficient I'll will as a subjective soma. This is the evolutionary gift for each one of us to be used in a lifetime.

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