SYSTEMIC FOUNDATIONS

Rafael Garberí Pedrós

Family Therapist and Psychiatrist

➢ Introduction

The notion of the system is as old as human thought, and the systemic doubts of today are problems humans have always created with another type of language.

The scientific paradigm from Galileo's days until ours has been one of reduction and its tendency has directed itself to break up the complexity into as many simple elements as possible. However, in nature, the norm has been and continues to be "the complex."

As a reaction to that fragmentary tendency of science and its incapacity to explain complexity, the General Theory of Systems (GTS) appeared in the middle of the 20th century. A theory of the whole, it was born with the job of overcoming the limits of scientific specialization, with the clear objective of converting itself into the universal paradigm and unifier. Biology was its source of inspiration and later its study spread to a multitude of fields and disciplines.

In 1929 Cannon wrote his work on home7ostasis and a few years later, Ludwig Von Bertalanffy orally stated the foundations of the GTS.

In 1954 the society for the investigation of general systems was founded, whose principal functions were:

- Research the existing isomorphisms between different laws and models.
- Boost the development of theoretic models.
- Minimize the duplication of efforts in different disciplines.
- Promote scientific unity, improving communication between specialties

The GTS was introduced to us in a new philosophy of nature that intended to explain the self-regulating phenomena of living beings in a scientific manner. The reductionism was substituted by the ideas of the whole and globality; the linear gave way to the circular and the individual lost relevance in the face of the interdisciplinary approach.

The GTS, which had received influences from the field of mathematics (Theory of logic types and theory of groups), presented the compound universe through an accumulation of matter and energy, related among itself and called "systems." Concurrent to the development of the GTS, the Theory of Information and the Theory of Human Communication developed in the field of Cybernetic science.

➢ First Order Systems and Cybernetics

The GTS and Cybernetics studied the same questions and have gone closely linked over the years. The GTS dedicated itself more to the depth of the study of internal structure, and cybernetics for its part dealt more with the related questions of the control of actions and the communication between systemic elements.

The GTS defines systems as “the joining of interrelated elements, where ‘the whole is something more than the sum of the parts’, always directed towards a purpose or end.”

From this definition one learns that the system would convert itself into an entity that would maintain thanks to the interaction of its parts, resulting in different properties than the ones than had existed separately. In this form, we could never predict the properties of a system by dividing and analyzing its parts, and we would already find in them “the essential.” The carburetor, the spark plugs, the gasoline, the steering wheel, etc…They would be elements of the “car system,” but the movement would be its resulting quality. We would all be systems in a world of systems (mechanical, political, social, economic, etc…), from the least complex to the greatest, such as the brain, where thousands of billions of connections make up the cortex.

The GTS would differentiate two classes of systems (closed and open). Open systems (living beings, biological and social) would maintain an exchange of matter, energy and information with the environment and would tend towards a constant evolution and conservation of structural order. This is in counter-position to the closed systems, isolated in their environments, without any permeability, without the possibility of importing energy and with a tendency towards disorder and no differentiation of its elements.

All systems would degrade little by little and would be subject to the 2nd law of thermodynamics, which states that there would exist a dimension called “entropy,” that corresponds with the decrease of order and free energy available within the system. In closed systems, the entropy would increase progressively until it arrived at what it knows as thermodynamic equilibrium and that corresponds with the death of the

system. This equilibrium would reach be reached if we isolated a biological or social system and left it to its luck, depriving it of whatever type of exchange with its environment and converting it to a closed system.

The entropy would be all of that energy that finishes dissipating itself as a result of the internal processes of the system not put to re-use to produce work and constituting itself as a measure of a system's disorder. Fortunately and on the contrary, open systems would compensate for this internal production of entropy, incorporating energy or information (negative entropy) of the environment, producing what Ilya Prygogine coined with the term "entropic balance." The exchange of entropy would come to be defined by the equation dS=dSi+dSe, where dSe (**negative entropy**), could compensate and even overcome the internal entropy of the system (dSi), contributing to the systemic development and evolution, moving away from this form to the system of the possibility of overcoming the fear of thermodynamic equilibrium, to which we have referred previously.

Within the Theory of Systems we can differentiate various postulates:

A – The Whole: The fact that "the total is more than the sum of the parts" would sum up the idea of the whole. The elements of a system only could be understood as functions of themselves. Each element would influence on the others and would be influenced by them and by the system itself.

B – Protection and Growth: Breaking from the ideas of Cannon about homeostasis, in the systems there would exist two types of forces, ones charged with maintaining stability (homeostatics) and others

charged with adapting to new situations (morphogenetics), permitting a constant dynamic equilibrium.

C – Circular Causality: This concept supposes an epistemological change, since the idea of the whole and the possibility of feeding back into itself, where the elements of the system influence themselves mutually, rules out linear causality. What is important would be the vicious circles that feed into themselves and block other possible routes.

D – Equivalent Aims: This principle would include the idea that "breaking away from distinct initial states, the systems could reach the same final goals." Open systems could not be explained in terms of linear causality since the initial circumstances could not be determined. The past would not be determined and we could not predict the future.

- **Cybernetics and Systems**

Cybernetics is a word that was used for the first time by Wiener in 1947 to define the science of control and information. The central concept of the new epistemology was the idea of Circularity that included all of the aspects related with self-feeding. Circularity and feed back happened to be common elements of all systems, and Wiener, father of cybernetics, called them "local anti-entropic phenomena." The concept of feed-back broke apart the idea of traditional causality, in which the effects align themselves in a linear form, driving inexorably the description of circular processes. All self-feeding would have in mind the information about past actions and with that they would decide later actions to follow, creating a circular ring structured in a way more complex than the merely lineal.

In all the system we could distinguish two types of self-feeding:

A. Negative Self-Feeding (R -) (Feed-back -); whose function would reside in controlling the deviations of systems and supporting stability. It would correspond to homeostatic forces. (Concept developed by Wiener)

B. Positive Self-Feeding (R +) (Feed-back +); whose function would be to facilitate change and the transformation of the system provoking a disequilibrium in itself and would correspond to the morphogenetic forces. (Concept developed by Maruyama)

In turn, the systems could change in two ways:

A. Substituting individual patterns or functions, and maintaining its inalterable structure (change of the 1st order)

B. Transforming the rules and the structure qualitatively (change of the 2nd order)

Systems capable of realizing qualitative changes (2nd order) would have greater ease in adapting to variations in their environment than would the systems that only accept changes of the 1st order, where negative feed-back would prevail.

Changes of the 2nd order would be in relation to the appearance of positive self-feeding that would deal as separate systems of equilibrium (concept developed for the Nobel Prize by Ilya Prigogine) with the consequent increase of the fluctuations and of the possibility that one of them diverts itself in a new structure. (Dissipative structures)

Also for Wiener, all of the vital processes were “information,” and all the flow of energy could express itself en terms of information (prime matter of communication), that would be captured from the environment and modified to the system, which one would see forced to readjust and achieve a new equilibrium.

In spite of this, the study of communication was not born with Cybernetics. Communication, as an exchange of ideas between individuals, would appear already, as nearly all things do, in Ancient Greece. But it was Harold D. Lawell who reflected on the communicative process, offering a model later developed by Shannon and Weaver, by always taking a lineal view of the process. Later the Palo Alto school would develop all those concepts, applying them to human conduct.

The incorporation of the cybernetic concept of self-feeding contributed to introduce a greater complexity to the communicate process, change the lineal causality for the circular and passing from a telegraphic model to another orchestral.

Until here Cybernetics is 1st. Later would come the 2nd order...but that’s another story...