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Ludwig von Bertalanffy
Forerunner of Evolutionary Systems Theory

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ABSTRACT

Ludwig von Bertalanffy is known as founding father of the General System Theory (GST). When Ludwig von Bertalanffy created his GST amidst the last century, he was able to overcome the deep cleft between the controversial theoretical approaches to biology – mechanicism and vitalism. He did so by formulating laws of organisation ruling biota and after generalising them he successfully applied them to different domains such as medicine, psychology, psychotherapy. Methodologically, Bertalanffy revived synthesis, ontologically, he advocated perspectivism, and, ethically, he was humanist. His main concern was the fate of the human civilisation and the new way of thinking necessary for the survival of mankind.

Evolutionary systems theory thus is the most recent elaboration of Bertalanffy's original GST-ideas. "Unity through diversity" is the motto that holds for evolutionary systems theory, too – epistemologically, ontologically, and ethically, if it takes advantage of categories of dialectical philosophy already existing in philosophia perennia and modifies them to suit the modern findings.

Keywords: new way of thinking, unity through diversity, dialectics, consilience

1. GENERAL SYSTEM THEORY

Ludwig von Bertalanffy is known as founding father of the General System Theory (GST) [1, 2, 3, 4] (an outstanding introduction into life and work of Ludwig von Bertalanffy was written by Mark Davidson [5], a book that has also been translated into Japanese and German [6]). He was born in 1901 near Vienna, graduated in theoretical biology, became teacher at the Zoological Institute at the University of Vienna during World War II, and emigrated after that to Great Britain, Canada, and, finally, the United States. In 1972 he was proposed to be nominated for a Nobel prize candidate, but unfortunately he suddenly passed away.

When Ludwig von Bertalanffy created his GST amidst the last century, he was able to overcome the deep cleft between the controversial theoretical approaches to biology – mechanicism and vitalism (mechanicism is the materialistic approach that tries to reduce life phenomena to phenomena that can be explained by physics, vitalism was the idealistic conviction that there is something metaphysical that transcends being explained by physics). He did so by formulating laws of organisation ruling biota and after generalising them he successfully applied them to different domains such as medicine, psychology, psychotherapy. The idea of general organisation rules applicable to diverse phenomena was born.

He called his idea "Allgemeine Systemlehre" which was translated into English as "General System Theory" – a term he did not like. One reason for that was that his idea cut across what is known as weltanschauung, a kind of worldview entailing epistemological, ontological, and ethical implications. All of these resemble a principle which became the title of the festschrift published only posthumously: "unity through diversity" [7].

Epistemologically, Bertalanffy revived synthetical thinking, thinking that puts things together after having put them apart, ontologically, he advocated perspectivism, that is, he did not consider general rules as abstract schemes that subordinate phenomena, and, ethically, he was not a positivist denying the importance of values in scientific research. These three traits characterise his GST and are tied together. His main concern was the fate of the human civilisation and the new way of thinking necessary for the survival of mankind.

In order to understand the consequences of Bertalanffy's GST weltanschauung a close look at categories of scientificity is helpful.

1. 1. Science levels

There are three aspects that have been distinguished in the literature so far: first, a context of discovery in which scientific knowledge is conjectured and theoretical assumptions are formulated in relation to empirical findings, second, a context of justification in which scientific knowledge is critically exposed to possible refutations and corroborated in as far as it is not refuted and theories are comparatively assessed and, third, a context of application in which scientific knowledge is used for solving problems and is transformed into technologies, whether material or ideational.

It had been this third context that had been contested with considerable amount of attention in the second half of the last century. Positivism tried to exclude this context by terming it a factor external to science. Nowadays, in social science there seems to be a consensus on rejecting the ideology of value-free science.

It makes sense to let these aspects form a hierarchy of levels: the first level concerns the approach of a scientific discipline, that is, how research is done, which methods are made use of; the second level concerns the domain of a scientific discipline, that is, the fields of research, the subjects that are dealt with, the object the discipline is about; it seems clear that the methods used depend to a certain degree on the object to be investigated; the third level concerns the task of the discipline, that is, the purpose for which this discipline has been established or which is served by it, the objective to contribute to the solution of societal problems by providing scientific, theoretically founded knowledge about these problems; and it seems clear, too, that the object – the boundaries of that section of reality that is researched – is to a certain degree set by the practice that requires certain problems to be solved.

On the other hand, it goes without saying that there are feedback loops from the lower levels to the higher ones. There is to some degree a bottom-up conditioning from the method to reality, that is, looking with certain methods at reality do yield only certain results on how this reality is assumed to manifest properties. And there is to some degree a bottom-up conditioning from reality to practice, since certain properties of reality do constrain the options of actions that can be taken.

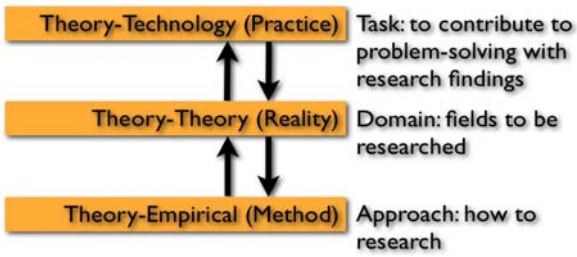

Fig. 1: Levels of science

Thus, by conceptualising the methodical objectification, the real object of study and the practical objective as different levels these dimensions of science are conceptualised according to the nestedness of systems in systems thinking (Fig. 1).

Each level has got its cardinal question. The first level addresses the opposition of analytical versus synthetical, the second level the opposition of constructivist versus realistic, the third level the opposition of descriptive versus normative – which of the opposites is prior?

Bertalanffy did not hesitate to be clear about what to prioritise:

- GST is synthetical, but without denying the role of analyses,
- GST is realistic, but without denying the role of constructions,
- GST is normative, but without denying the role of descriptions.

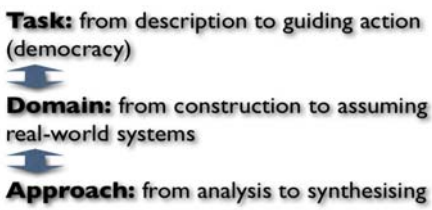

Fig. 2: The legacy of Bertalanffy's GST

Thus, the legacy of his GST which can be summarised in the following way is important to characterise the

new way of thinking system theories should adhere to (Fig. 2):

- methodologically, we need to shift from analysis towards synthesis,
- ontologically, we need to shift from constructions towards real-world systems,
- ethically, we need to shift from descriptions towards guidelines for action.

In detail.

1. 2. The approach of Bertalanffy's GST

In finding rules of organisation and founding modern systems thinking Bertalanffy ties up to the Aristotelian saying "The whole is more than the sum of its parts". He does justice to the old Greeks' concept of cosmos and Aristotle's holism and teleology as well as to Galilei's metodo resolutivo. For he argues that analysis is necessary but nevertheless it does not suffice.

Bertalanffy when trying to reconcile contrary or contradictory positions seems to have made use of the notion of the "coincidentia oppositorum" (the coincidence of opposites) he learned from Nicholas of Cusa.

"Unity-through-diversity" means in this respect the obligation of not being satisfied with the analytical method that yields detailed results of diverse parts but to long for a bigger picture by means of synthesising these results. Actually, this is the core of systems thinking. It is this approach that makes systems thinking the outstanding method appropriate to coping with complexity.

The fact that the subsequent development of systems science lead to several threads that neglect this genuine trait made Bertalanffy critique the real implementation of systems thinking. In too many cases, he critisised in 1968, the term "system" is nothing but a modern label. Instead of overcoming the academic specialisation system theory has become just another discipline in which students are trained as specialists [5].

1. 3. The domain of Bertalanffy's GST

Bertalanffy's methodological stance goes hand in hand with his ontological stance. He supported Nicholas of Cusa's idea "ex omnibus partibus relucet totum" (each part reflects the whole). This is the basic structural assumption of Bertalanffy's GST. It is well justified to look upon this assumption as something that later on became known as downward causation [8].

As to the basic dynamical assumption of reality, Bertalanffy supported the idea of evolution. He said that both the scientific view and a religious mystic view reveal the same idea when the first is is referring to homo sapiens as by now the ultimate product of terrestrial evolution and the second is underlining that it is god who becomes aware of himself in the course of evolution [5]. This assumption anticipates the idea of system theorist Bela H. Banathy and others that circumscribes the shift from the evolution of consciousness towards a conscious evolution [9].

This is the realistic part of Bertalanffy's GST. Unlike today's radical constructivism Bertalanffy supports the idea that we are dealing with real-world systems and not with mere constructs. However, there is also a constructivist part in his GST perspective, for he appreciated the fact that it is models we construct in dealing with reality and that it is models that determine how we perceive reality. He called his view "perspectivism" which is neither absolutism nor nihilism. He stated that, e.g., a fly, a dog or a human being has only limited knowledge of the world, but that this knowledge has some validity because otherwise the fly, the dog, the human would not have been able to survive for long [5].

"Unity-through-diversity" fits as well to describe Bertalanffy's structural and dynamic assumption and his perspectivism, too. Diverse parts are united in a whole, evolution is one that yields the many, and there are many models of the world which altogether comprise one and the same domain.

1. 4. The task of Bertalanffy's GST

At the end of his life Bertalanffy devoted his thoughts to the future of humanity. He admitted that Oswald Spengler [10] in his writings had omitted that our civilisation is disposing over the technologies required for overcoming any plague that has beleaguered mankind so far and that we are empowered today to act upon the global challeneges globally. But he did not rule out the possibility of extinction. Breakdown or breakthrough – to a well-functioning peaceful and flourishing world community that inheres cultural and individual creativity.

This possible design of future humanity is the meaning of "unity-through-diversity" in the context of the social task of the GST. Bertalanffy identified the causes of environmental pollution, waste of natural resources, population explosion, arms race, and so on, not in psychic features of wicked people that are in power but in systemic features of the civilisation, in the design of

socio-cultural systems. System theoretical insights are to be applied to contribute to that aim. Bertalanffy's GST is a humanistic one [5]. Thus all his descriptions of humans and social systems serve the function to help to formulate guidelines for acting towards humane norms and values.

2. EVOLUTIONARY SYSTEMS THEORY

Evolutionary systems theory – a term coined by Ervin Laszlo [11], Vilmos Csanyi [12] and Susantha Goonatilake [13] – as a theory about evolving systems and as a theory that is the result of the merger of systems theory and evolutionary theory which nowadays not only applies to biotic and human or social systems but also to physical systems, that is,, to the cosmos itself [14, 15], is the most recent elaboration of Bertalanffy's original GST-ideas. It revolves around the notion of self-organisation. It provides a transdisciplinary framework for consilience throughout science. "Unity through diversity" is the motto that holds for evolutionary systems theory, too – epistemologically, ontologically, and ethically. It adopts the new way of thinking Bertalanffy envisioned. For self-organisation studies may be interpreted in different ways. One way – and probably still the mainstream way – is to interpret them from the perspective of classical science including engineering science (computer science) and parts of social science. In this perspective self-organisation is not a phenomenon that entails changes in the world picture, weltanschauung or philosophy. Mechanicism and rationalism suffice for explanation. Another way – still en vogue in esotericist circles and beyond – is taken by New Age ideology. Starting from idealistic interpretations of quantum theory also self-organisation is said to illustrate indeterminism. There is a third way that sublates the one-sidedness of the former ones and which turns out to be the logical base for theorising self-organisation. This solution may be sketched as emphatic on reflexive rationalism, less-than-strict-determinism and deliberate activism [16].

In detail.

2. 1. Evolutionary systems methodology

Reflexive rationalism is the philosophical background of evolutionary systems methodology.

Emergence in phases of evolution, including the appearance of novel qualities in developments, and differences between system levels cannot be formalised in a way that there is a transformation that leads unequivocally from one to another. Evolutionary systems methodology therefore has to recognise the principles of formalisation gaps: in the case of phase transitions where a leap in quality exists between the state of the system at one point of time (t) and the following state (at time t+1) and in the case of level shifts where a leap in quality exists between one layer of the system and the adjacent layer up or down (micro- and macrolevel). It holds it is impossible to find an operation in the mind that accomplishes the leap from one quality to another in an unambiguous and compelling way.

However, in a general philosophical perspective, there is a terminology that allows to mediate different qualities. With the help of this terminology the one can be described as the condition for the other and the other, then, can be described as the conditioned. This is the way out of the deductivism-irrationalism chasm. Deductivism favours complete deducibility while irrationalism is willing to accept any nondeducible statement.

What here is termed reflexive rationalism abstains from providing causal explanations and predictions which are conclusions drawn from premises as deductive rationalism would do and it refrains from disseminating narratives that deny inferences as irrationalism would do. Reflexive rationalism establishes the unity of essence and appearance by announcing the principle of the search for the approximate necessary, but not in all cases sufficient, condition. The ascendence from the necessary to the contingent as well as from the universal to the particular is carried out by jumps from the condition to the conditioned (Fig. 3).

2. 2. Evolutionary systems modeling

Less-than-strict-determinism is the philosophical background of evolutionary systems modeling.

Evolutionary systems undergo stages. The stage model of evolutionary systems is based upon the principle of emergentism and the principle of asymmetrism. Emergence takes place in transitions in which by the interaction of proto-elements systems are produced. Asymmetry describes the supersystem hierarchies in which subsystems are encapsulated.

If we try to generalise these system theoretical findings and raise them onto a philosophical level, we are confronted with the determinism-indeterminism divide. There is no determinacy without indeterminacy and no indeterminacy without determinacy.

Less-than-strict-determinism is not a preformationism according to which evolution is only unfolding of something already existing – an unfolding of one into many – and not a merism according to which wholes can be reduced to their parts – and the one can be disaggregated into many. It is not teleologism or holism – the projection of one onto many – and it is not a dichotomism of the one and the many. It tries to work out the unity of one and many by the ascendence from the old to the new and from the parts to the whole (Fig. 3).

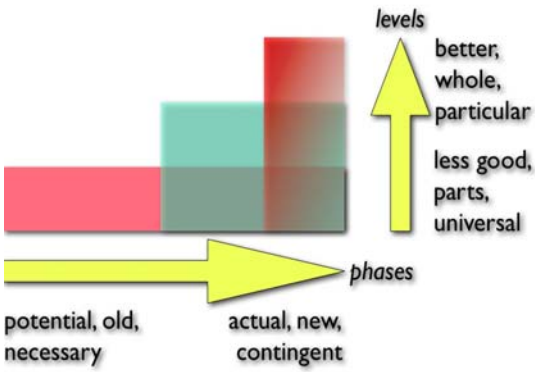

Fig. 3: Dialectics of the feasible and the wishful, of the one and the many, and of essence and appearance in evolutionary systems

2. 3. Evolutionary systems design

Deliberate activism is the philosophical background of evolutionary systems design.

Evolutionary systems design principles encourage to make use of the systems' dynamic and stress the point that knowing about nonlinearity and sensitivity may help to choose those inputs that trigger developments in the overall self-organisation process of the system that are favourable to those who make the inputs. System processes may be facilitated or may be dampened. Also it is important to influence the general set-up of the system only and abandon instructions down to every detail so that relative autonomy is granted to the subsystems.

In a philosophical perspective, deliberate activism is not a practicism that guides action according to the maxim that all that is feasible shall be realised thereby assuming that it is desired too. Nor is this kind of activism a utopian or romantic wishful thinking that holds that what is desired is feasible too. Both practicism and wishful thinking believe in total controllability and result in expensive brute-force interventions. Nor is this kind of activism an inactivism that believes in total uncontrollability, condemns any kind of intervention and fails to reconcile the feasible and the wishful. On the contrary, it takes responsibility for producing the unity of the feasible and the wishful. And it does so by working out the ascendence from the potential to the actual and the ascendence from the less good to the better (Fig. 3).

2. 4. Consilience

Evolutionary systems methodology, evolutionary systems modeling and evolutionary systems design aim at fulfilling Bertalanffy's legacy at the levels of the approach, the domain and the task of system theory. In this sense evolutionary systems theory is the basis for the unity of knowledge through the diversity of disciplines – it is the means to achieve transdisciplinary understanding. It represents the new way of thinking that is necessary to get a grip on the global problematique.

Ways of thinking can be seen as ways of considering how to relate identity and difference [17].

There are, in terms of ideal types, several ways conceivable:

- one establishes identity by eliminating the difference;
- another eliminates identity by establishing the difference;
- a last one establishes identity as well as the difference.

Regarding identity and difference while approaching complexity, the question arises as to how the simple does relate to the complex, that is, how less complex problems or objects or phenomena do relate to more complex ones. Accordingly, we can distinguish between four ways of thinking:

- a first one establishes identity by eliminating the difference for the benefit of the less complex side of the difference; it reduces "higher complexity" to "lower complexity"; this is known as reductionism;
- a second one establishes identity by eliminating the difference for the benefit of the more complex side of the difference; it takes the "higher" level of complexity as its point of departure and extrapolates or projects from there to the "lower" level of complexity; it is the opposite of reductionism and might be called projectionism;
- a third one eliminates identity by establishing the difference for the sake of each

manifestation of complexity in its own right; it abandons all relationships between all of them by treating them as disjunctive; it is opposed to reductionism as well as to projectionism, it is referred to as dichotomism;

- a fourth one establishes identity as well as difference favouring neither of the manifestations of complexity; it integrates "lower" and "higher complexity" by establishing a relationship between them that, in particular, might be characterised by the following criteria: firstly, both sides of the relation are opposed to each other; secondly, they depend on each other; thirdly, they are asymmetrical. When all these criteria are met the relationship is usually called "dialectic". This way of thinking opposes reductionism, projectonism, as well as dichotomism.

It is only this last way of thinking that provides the basis for successful changing the world. It is this way of thinking that Bertalanffy already followed.

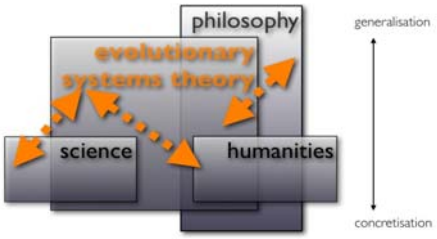

Fig. 4: Evolutionary systems theory as transdisciplinary mediator between philosophy and disciplines

And it is this way of thinking that makes evolutionary systems theory the transdisciplinary mediator between philosophy and the disciplines (Fig. 4). Furthermore, it deploys unifying capacities vis-à-vis the natural sciences insofar as it may refashion physics, chemistry, biology as studies of physical, chemical, biotic self-organising systems. Besides it promises to reconcile the action theoretical and structuralist/functionalist paradigms in social sciences.

Consilience is the prerequisite for survival.

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