Reflections on Ludwig von Bertalanfy's "General System Theory: Foundations, Development, Applications"

Shelia Guberman
PiXlogic, Los Altos, CA, USA
<sguberman@pixlogic.com>

"Something is rotten in the state of Denmark".
W. Shakespeare: Hamlet, Prince of Denmark.

Abstract:
The purpose of this paper is to analyze the basic concepts of General System Theory (GST) as they were described by Ludwig von Bertalanfy almost 50 years ago in the book "General System Theory: foundations, development, applications" (1968). All excerpts below are from the above mentioned book.

This study follows our previous paper dedicated to the analysis of M. Wertheimer's book "Productive thinking" published also a number of decades ago. In that paper we show how deep and wise the author was in his ideas, how much mistakes we could avoid if we pay more attention to them, how much we can still learn from that book for high-tech development in computers and internet. With the same attitude we started the analysis of L. von Bertalanfy's book on one of prominent lines of research in XX century - General System Theory.

I. Source.

B. did a great job attracting attention of the scientific community to important and complicated problems in understanding the Nature. "It was the aim of classical physics eventually to resolve natural phenomena into a play of elementary units. This however is opposed by another remarkable aspect. It is necessary to study not only parts and processes in isolation, but also to solve the decisive problems found in the organization and order unifying them, and making the behavior of parts different when studied in isolation or within the whole".(p.31). We are forced to deal with complexities, with "wholes" or "systems". (p.5). Here are the main notions, which attracted B's attention in the 20s and 30s and which promised (in his view) the resolution of modern scientific and technical problems: the whole, the parts, the units, the complexity, the organization. That was similar to the problems raised earlier by the Gestalt psychology. The difference was that the gestaltists treated the "whole" as a psychological phenomenon, the product of our mind, but Bertalanfy thought the "whole" exists independently and tried to create a regular scientific discipline - GST. At the same time B understood that "Gestalt psychology showed the existence and primacy of psychological wholes". (p.31)

It is true that the time of Gestalt-psychology flourishing was very different from the time of rapid growth of General Systems Theory. The beginning of the century was the "Silver age" of arts (particularly in painting, poetry and theater). The time of GST's raise – the middle of the century – was the "hour of triumph" of science (particularly in nuclear physics, electronics and molecular biology). That partially explains Bertalanfy's choice to look for the solutions on complexity problems, wholeness and so on in the exact sciences: "GST is a logico-mathematical science of wholeness" (p.256)

II. Definitions.

“We postulate a new discipline called General Systems Theory. Its subject matter is the formulation and derivation of those principles, which are valid for “systems” in general” (p.32). GST faces a lot of difficulties trying to define the basic notions. Here are some examples of definitions from his book with our remarks (in cursive).

1. GST is a logico-mathematical science of wholeness (p.256)
2. GST is a general science of organization and wholeness(p.288).
3. System theory is a broad view (p.VII).
4. New science (p.XVII).
5. System thinking (p.XIX).
6. The GST is scientific exploration of “wholes” and “wholeness”, which, not so long ago, were considered to be metaphysical notions. Novel conceptions have developed to deal with them (“wholes” and “wholeness” – S.G), such as dynamical system theory, cybernetics, automata theory, system analysis by set, net, graph theory and others”(p.XX). *But that claim does not fit the reality: none of these disciplines had defined such notions as “whole” and “wholeness”.*
7. GST is a general science of “wholeness”(p.37).
8. Systems philosophy – organismic outlook of the world as a great organization (p.XXI). *That kind of definition leads nowhere.*
9. What is to be defined and described (?) as system is not a question with an obvious or trivial answer. It would be readily agreed that a galaxy, a dog, a cell and an atom are real systems, and logic, mathematics and music are conceptual .systems” (p. XXI*). One would agree that the first are “real”, and the latter are “conceptual” objects, but one can’t agree that they are real systems and conceptual systems because the notion of “systems” was still not defined.*
10. Systems approach (p.4**)**
11. We are forced to deal with complexities, with “wholes” or “systems”. (p.5)
12. The general theory of hierarchical order obviously will be a mainstay of GST.
13. Gestalt psychology showed the existence and primacy of psychological wholes. (p.31)
14. Systems, i.e. complexes of elements standing in interaction (p.33) . *That definition is not acceptable because there is no definition for “complexes of elements*”.
15. Systems are “sets of elements standing in interaction” (p.38).
16. System of elements in mutual interaction (p.38). (defining “systems” by “systems”).
17. Organisms are, by definition, organized things.
18. If we are speaking on systems, we mean “wholes” or “unities”.

Some of his definitions could not serve as definitions as they use other undefined terms (for example, “*complexes* of elements standing in interaction” (14) or “*system* of elements in mutual interaction”(p.45).
When the definition is non-contradictory (“*sets* of elements standing in interaction”, (15), it is so broad that any arbitrary set of objects in the universe becomes a system. Such definitions single out no objects for investigation. B made an effort to substitute the definition of “system” by means of another basic notion: “If we are speaking on systems”, we mean “wholes” or “unities””(11). But “wholes”, or “wholeness”, or “unities” were also never defined.
The attempt to define other basic terms was also inadequate: ”Organisms are, by definition, organized things”.

Bertalanfy completely understood the situation: “What is to be defined as system is not a question with an obvious or trivial answer”(p.XX). . He admitted the problem and sometimes softened the rank of the GST using such terms as “system thinking” (p.XIX), “systems philosophy” (p.XIX), “systems approach” (p.4**)**

Because of the difficulties in straight definition of basic notions B tried to define the matter of the theory and the basic notions by examples. On the first page of his book he claimed: “An introduction into the field is possible in two ways. One can either accept one of the available models and definitions of systems

(?) and rigorously derive the consequent theory. The other approach – which is followed in present book – is to start from problems as they have arisen in the various sciences, and to develop it in a selection of illustrative examples" (p. XVII).
Such an approach was developed in the second half of the XX century into a technology known as Pattern Recognition. The main idea of Pattern Recognition is as follows. In many fields of science and business the decision making is complicated. It means that there is a lot of information but we don't know the laws that determine the outcome, so, we can't make the right decision. That is typical for medicine, geology, economy and so on. The Pattern Recognition technology gives a chance and a tool to improve the decision-making by learning based on experience, on cases with known outcome. The mandatory demand of that technology is the representation of all examples has to be in the same terms, so, they can be compared and a general decision rule can be created. That was not the case in the reviewed book. The example of "system concept" using geometrical objects (pp. 54–55) has no chance to be expressed as a system of differential equations from classical "theory of dynamic systems". If so, how can anybody generalize them?

Bertalanfy showed a lot of common sense in judging GST. Bertalanfy used a quotation from Ashby to describe the state of art in creating the new science. "Ashby has admirably outlined two possible ways or general methods in systems study: Two main lines are readily distinguished. One, already well developed in the hands of von and his co-workers, takes the world as we find it, examines the various systems that occur in it – zoological, physiological, and so on – and then draws up statements about the regularities that have been observed to hold. This method is essentially empirical. The second method is to start at the other end. It considers the set of all conceivable systems and then reduces the set to a more reasonable size" (p. 94).
It is remarkable that Bertalanfy didn't deny Ashby's view on his work as non-theoretical, but essentially empirical. Moreover, he admits that his approach "to the mathematically minded will appear naïve and unsystematic". Ashby itself choose the second way. He started with the definition of system but didn't succeed. As showed his definitions were not general enough.
At first, he recruited areas of science that use the word "system" but use them as a neutral word (non scientific term): 1) systems of differential equations, 2) open systems (well defined physical meaning), 3) nervous system, control system and so on. The point is that none of them deal with "wholeness". Secondly, Bertalanfy pointed out the difficulties in a particular area of science and declared a priori that "system approach" will resolve the problem. These areas mainly represent the sciences which are poorly formalized (biology, sociology, economics, psychiatry, etc).

III. Detailed analysis (mathematics, physics, computers, cognition).

Bertalanfy used a huge number of examples, which illustrated how the system approach works in science and technology. We will discuss in details some examples, which are more familiar to the author.

III. 1 - Elementary Mathematics.

The basics of system concept are explained in the very beginning of Chapter 3. We will quote the full text of the example (in bold) and follow it with our remarks (in cursive).
"In dealing with complexes of "elements" *(i.e. systems according the definitio*n) **three different kinds of distinction may be made …"**
The quotation marks on "elements" and use of "may be made" expression instead of definite "There are" reflect author's understanding that no precise statements can be declared and that the example is weak.

".. i.e. 1 according to their number; 2. according to their species; 3. according to the relations of elements. The following simple graphical illustration may clarify this point (Fig.1) with a and b symbolizing different complexes".

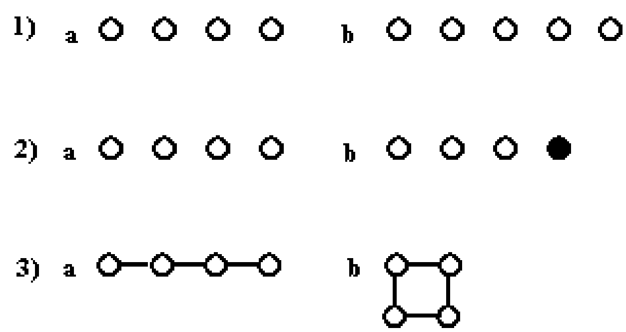

Fig. 1

*If we forget for a short while that all that has to be about GST, we will find a well-known psychological problem. Three similar problems are represented. In each problem two sets of elements are given. The question is: what is the difference between the two sets in each case? The answers are easy and obvious. In the first case two sets differ in the number of elements. In the second case two sets differ in the nature of the elements. In the third one they differ in geometry. It is obvious that the set **a** is the same in all cases and all the differences we can see exist in our perception only.*

"In cases 1 and 2 the complex may be understood as the sum of elements considered in isolation"
The use of words "understood" and "considered" shows that Bertalanfy was going to analyze a perception problem. It means that he was investigating the system not in the outside world but in our mind. Also it is impossible to understand the meaning of "sum of elements" as the notion of "sum" was never defined in the context of GST.

"In case 3, not only the elements should be known, but also the relations between them."
What is the reason to know something about the system? The answer is simple: for describing the difference between the given two "systems" (complexes of elements).

"Characteristics of the first kind may be called summative, of the second kind constitutive."
A question arises: characteristics of which objects are we talking about: elements or complexes of elements (systems)? The nature of the element is by definition a characteristic of an object. The number is a characteristic of a set of elements (it could not be applied to a single element). The relation between the objects is a characteristic defined for pair of objects. As a result one can't use the proposed classes of characteristics (summative and constitutive) to classify any kind of objects.

"We can also say that summative characteristics of an element are those which are the same within and outside the complex."
As we note above, between the two "summative" characteristics there is only one characteristic of an element – the nature of the element. According to the definition this characteristic is independent of the place or the position of the element because it is a characteristic of the element in principle. So, the last definition becomes a tautology.

“Constitutive characteristics are those which are dependent on specific relations within the complex …”
More precisely, the constitutive characteristics are not dependent on specific relations but they are the relations themselves (according to Bertalanfy description above).

“… for understanding such characteristics we therefore must know not only the parts, but also the relations”.
It seems that there is a tautology once more, because the constitutive characteristics itself are the relations.

Returning to the examples represented in Fig.1, it has to be noted that these examples lead to deeper understanding of the problem. The essence of the problem can be found by analyzing the set **a** only. Let us describe the set **a** so that one can reconstruct the image using the following description: “Four small white circles located on a horizontal line at equal distances situated in the center of the page”. That description potentially contains all possible oppositions between the set **a** and any other set. To get an opposition one has to change one of the descriptors. For example, changing “four” to “five” gives the difference in number; converting “white” to “black” creates the difference in the nature of elements; changing “horizontal line” to “vertexes of rectangle” creates the difference in relations between elements. One can see that there are not three but four kinds of possible distinctions between sets. The fourth distinction is the difference in the relation of the set **a** as a whole to the environment. In our case that distinction is represented by the direction of the line (horizontal or vertical) and the position on the page (in the center or at the margin). So, the emergent features (in this case it is the geometrical relations between the elements) don’t arise from nothing in a mystical process of creating the “whole”, but are chosen from the description generated in our mind by the given image.
Finally, it has to be mentioned that in the 60s, M. Bongard has published a book on pattern recognition [2], which contained a file of 100 cases similar to the three cases shown in Fig.1. He questioned if it is possible to develop a program that could find the distinction rule in each “puzzle” (some of them are not trivial to a human eye). Shortly he and V. Maximov succeeded in developing such a program.

III. 2 - Communication and computers.

The book contains a number of references to the field of communication and computer science. Some of them sound naive and don’t support the author’s idea.

III. 2. 1- “The general notion in communication theory is that of information”(p.41). The fact is that the definition of “quantity of information” exists, (it was introduced by C. Shannon) yet there is no scientific definition of “information”.

III. 2. 2 - “Examples can easily be given where the flow of information is opposite to the flow of energy, or where information is transmitted without a flow of energy or matter. The first is the case in a telegraph cable, where a direct current is flowing in one direction, but information, a massage, can be send in either direction by interrupting the current in at one point and recording the interruption in another”(p.42). It is not correct to think that in the cable the current move is only in one direction - from the battery to the far end. It is a fundamental law of electricity that the same amount of current that goes from the buttery to one wire comes back through the returning wire. That is why the cable line has two wires.

III. 2. 3 - “For the second case (when information is transmitted without a flow of energy or matter), think of the photoelectric door openers: the shadow, the cutting off of light energy, informs the photocell that somebody is entering” (p.42). Of course, the “mystical” communication without energy and matter don't exist (at least in science). The point is that the absence of light in the photocell is a signal only when that event is followed by a period of presence of light, which, unfortunately, demands energy.

The next reference to the communication field concerns the measurement of information. To represent the idea of the "bit" as a unit for measuring information, Bertalanfy wrote: "Take the game of Twenty Questions, where we are supposed to find out an object by receiving simple "yes" or "no" answers to our questions. The amount of information conveyed in one answer is a decision (!) between two alternatives, such as animal or non-animal. With two questions (?) it is possible to decide for one out of four possibilities. Thus, the logarithm (base 2) of possible decisions ("the number of possible decisions" will be correct because it is impossible to calculate the logarithm of decisions. – SG) can be used as a measure of information" (p.42). This story sounds very similar to the classical one but "small" differences change dramatically the understanding of the issue. Here is the classical story. Let us suppose we have eight golden coins looking identical. Seven of them are really identical but one coin is lighter then others. The question is: if one has a simple scale, what will be the minimum number of weighs to find the false coin. The right answer is three: first, compare the weight of any four coins and the rest four coins. Secondly, use the lightest set of four, divide it in two even parts and put them on the scale. Finally, take the lightest pair of coins and compare them. So, the false coin was found in three measurements.

Here is the difference between these two stories. In the classical case it is defined that one can ask only one question: "Which set of coins is heavier?" , and a tool is given that answers that particular question only. That means that the answer to the problem ("three weighs") doesn't depend on the skill of the questioner and therefore is a good measure of information. The story represented by Bertalanfy is different in the point that the questions are not predefined. So, the result of the game (i.e. the number of questions used to get the answer) depend on the skill (or the luck) of the questioner and one can't be sure that nobody will find a shorter sequence of questions to reach the answer. Therefore in that case the number of questions can't serve as a measure of information.

The classical story tells us that getting to the goal in the shortest way is necessary to divide the set we questioned in two even parts. That is why 2 was chosen as the base of the logarithm in the definition of the "bit". As a matter of fact in the "Twenty questions" game the questions never divide the set given at the particular step of the game in two even parts. That means that the answer to such a question doesn't contain one bit of information. It is true that in the "Twenty questions" game a good question is the one that divides the set of potential objects into two approximately even parts.

IV. The big mystery

In the middle of the book, in the ocean of examples dedicated to creation of a new physico-mathematical science, i.e. GST, appears an island of completely different approach. Bertalanfy wrote 10 lines that deeply and dramatically explain the essence of the system's problem, in a way completely different from the rest of the book.

IV. 1 - Bertalanfy dismissed the mysticism of "emergent characteristics" – one of the basic statements in system analysis - in the following couple of sentences: "The constitutive characteristics are not explainable from the characteristics of isolated parts (*because they are characteristics of different kind of objects: the whole and the parts* - SG). The characteristics of the complex, therefore, compared to those of the elements, appear as "new", or "emergent"". So, according to Bertalanfy the "emergent" features are simply characteristics of the relationships between the parts.

IV. 2 - Bertalanfy admitted that systems exist in our mind only: "A system as total of parts with its interrelations has to be conceived of as being composed instantly." Yes! It is true: an instant transformation is impossible in the physical world - it is possible in our minds only.

IV. 3 - Bertalanfy uncrowned the holy banner of system approach: “The whole is more then the sum of its parts”. Bertalanfy wrote: “If, however, we know the total of parts contained in a system and the relations between them, the behavior of the system may be derived from the behavior of the parts.”

In the last statement Bertalanfy explained that when the partition is wrong (i.e. when the “whole” is divided into inappropriate pieces), the “whole” can’t be understood and reconstructed from pieces. But if the “whole” is divided into right parts, the “whole” can be appropriately reconstructed from these parts. This transforms the cardinal problem of relationships between whole and parts into the problem of the appropriate partition of a given object. In other words Bertalanfy came to the problem of finding an adequate language of description.

IV. 4 - Bertalanfy explicitly admitted that only “Gestalt psychology showed the existence and primacy of psychological wholes” (p.31).

Then the biggest surprise follows. In his book Bertalanfy repeated dozens of times how great GST is and how it will completely reform the modern science - without defining the matter of research and any basic notions. But here, after the paragraph with cardinally important statements about “whole” and “parts”, about systems and emergent characteristics, he wrote: ”These statements are trivial”!

V. The cause of the GST' success

Despite all the difficulties in defining the subject of GST and its basic notions, the “system movement” has spread around the world and became an important part of the XX° century scientific life. What is the cause of that phenomenon?

V. 1 - There are an infinite number of phenomena that are extremely important in the mankind’s life but are very complicated and for now can’t be solved by scientists: in biology, sociology, geology, economy, culture, politics, war, cosmology and in science itself. It is a real challenge and a powerful stimulus for a creative mind to find a solution for either one of such problems, or a general solution for a broad class of problems. L. von Bertalanfy creates an environment that promotes the will to work on complicated problems. It is no wonder that many talented scientists respond to that call.

In time a lot of new constructions of GST appeared based on different basic notions but none of them succeeded, and the reason was the same: all authors attempted to create GST as a solid physical-like or mathematical-like science. It supposes that any dependence on our conciseness can’t be accepted. Therefore none of the theories catch the notion of “whole”, which is a product of our mind.

V. 2 - From the very beginning Bertalanfy tried to penetrate a lot of scientific areas, particularly poorly formalized areas (such as biology, medicine, psychology, sociology) and actively developing branches of science and technology (cybernetics, computers) that didn’t yet have a solid scientific background.

Scientists always want to represent their work in a frame of a solid scientific theory, particularly on the mathematical base. In the last two hundred years it was a common view that “the particular science contains as much science as much it contains mathematics”. The GST gave them some theoretical frame that emphasized the complexity of the problem, offers a set of pseudo-scientific terms, mathematical formulas and notions, and linked them to fashionable cybernetics, computers, game theory, etc.

V. 3 - Because GST community proclaims its revolutionary essence, it was favorable to all nontraditional hypothesis, theories and approaches. Therefore, many innovative scientific papers, which were rejected by solid professional – and of course conservative magazines and conferences, were welcomed on the GST forums. At these forums free discussions flourished and real progress in science took place.

It is a very symptomatic fact that 100% of the examples of systems in the book are natural objects – objects that are not constructed by humans. The reason is that in human creations the structure of the object, the parts constituting the object (the "whole") are known. So, there is no question on how to describe the object, nor on which parts the object consists of. It means that in these cases there is not any "system" problem and Bertalanfy understood it very well. From that point of view, it also follows that the complexity is not a necessary attribute of a "system". The "system" can be simple (for example a simple drawing) but still raises the problem of partition. As we show above, the proper definition of a "system" in GST is so broad that it covers any set of things in the universe and therefore is not acceptable in a physical theory. But as soon as one accepts the point of view on "systems" as a psychological problem, a Gestalt problem particularly, the unlimited definition of that notion becomes legitimate because then a "system" is a product of our mind and we are free to investigate any set as a "system".

VI. 50 years later

How does GST look today?

VI. 1 - The number of definitions multiplies – every second author proposes a new definition. It demonstrates that everybody understands the necessity of definitions and nobody is satisfied with any previously proposed ones. The following examples are taken out of a single book (Proceedings of Third European Congress on Systems Science, 1996):

- "Set of communicating components according one and only one type of communication"(p. 91).
- "A set of actions from a source on a sink represented by a messenger" (p. 427).
- "This system is defined from a set S of the internal states, a set I of the inputs an from application F of the Cartesian product of S x I in S" (p. 775).
- "Usually, we use the word Holistic in an abstract meaning, which says little or often nothing" (p. 59).

The number of examples may be increased. As a matter of fact mostly each definition is formulated a way which connects the content of the particular paper with the word "system".
Here is a prominent example of devaluation of the system theory notions: "From the systemic way of knowing … it's possible recognizing concepts as singularity, individuality, variety, dynamism, evolution, hierarchy, patterns, order-disorder, entropy and **as many terms of our systemic approach we like to use**" (p. 58). O, sancta simplicita!

A lot of papers use the word "system" in the title, in the introduction and/or in the conclusion of the paper. A very interesting paper on training of restaurant's waiters use the word system only once – in the last sentence: "Can the existing system evolve toward authoring shell?" (p. 767). At the same time the average quality of the papers is good – a lot of interesting and fresh ideas from all around the science.

VI. 2 - Many authors express their dissatisfaction on the state of art and admit that GST is still in the beginning of the way.

"The debate on GST that evolved in the last few years shows the development of different points of view and opinions about the definition of system" (p. 348).

"The systemic view of the 1950s-1970s may not help us much in the 1990s, for the former may be more introductory than substantively revolutionary" (p. 884).
None of "Bertalanfy's principles" are mentioned.

VI. 3 - The idea that systems are products of our mind, that the system problem is a problem of adequate description raised in B's writings in the 60s. Now it is still in discussion. "Matter and mind are getting closer and closer, language and objects may find their previous unity. I think that is a systemic goal we are going to achieve" (p. 59).

VI. 4 - GST forums still attract not only interesting, talented and serious works, but also some superficial papers that would be rejected by the professional magazines for fair reasons. Since the author of the present paper has been involved during 40 years in Pattern Recognition business I will mention only one paper from the same volume. It contains a full page of images (p. 25) that have to illustrate the power of a new kind of neuronal network (synergetic computer). On the first figure 10 portraits in gray are shown. Five more images represent different parts of one of the portraits (marked G). The claim was: our computer could recognize faces from fragments. This result is trivial because to perform the search the computer uses fragments of the image stored. Any substantial part of an image is unique, i.e. has a unique distribution of black and white pixels. Therefore it is only a matter of time to find the appropriate image in the database for any computer. This way any image can be identified using its part. The real problem is to identify a portrait in the database using a different picture of the same person.

The next statement in that paper was the following: our computer recognizes deformed faces. The corresponding figure contains three portraits (from ten mentioned above) and three rectangular grids slightly deformed: The grids show how the images were transformed. Two of them were deformed substantially, and one slightly. It turned out (by chance, of course) that the target image was the least destroyed one.
It is appropriate to mention that the idea that the problems of recognition can be solved by developing new sophisticated algorithms died long ago. The practice shows that most recognizers produce the same results if applied to the same data. The only way to improve the results substantially is to change the description of the objects. This point binds pattern recognition to the systems problems.

VI. 5 - The issue of complexity was one of the main concerns of GST and still is. Let us describe the problem in plain words. The words "complex system" mean that one can't predict the behavior of the system well enough. One cause of that could be the big number of parts in the system (for example, following Bertalanfy, the "three bodies problem"). We know the laws of interaction between the parts, but we didn't find an analytical solution, and the computations on the computer are consuming expensive. This case is not interesting for GST. GST concentrates on systems with descriptions that have failed to consider the relations between parts. The idea is that taking in consideration these relations will resolve the problem, i.e. one will be able to predict the behavior of the system. As a matter of fact that means that the description of the system has to be changed: a set of new parameters has to be involved. That way of resolving the problem contains a possibility of failure: the partition of the system could be wrong. In that case we will no find adequate rules of interactions between parts. That is the most common situation in the investigation of complex systems: the existing partition of the given system into parts is not adequate. From author's personal experience the resolution of a number of complex problems takes place only after new descriptions of the systems at hand (oil exploration, earthquake location, speech compression, and handwriting recognition). It seems that the huge enterprise – the Institute of complexity in Santa Fe (Arizona, USA) – did no progress in investigating culture, economy, ecology, etc, because the leading idea was to use non-linear equations and supercomputers to deal with the existing descriptions of these systems. To my knowledge the problem of new descriptions was never raised in that place.

VI. Conclusion

In his work Ludwig von Bertalanfy pursued the line of investigation started in the beginning of the century by Gestalt Psychology. The issue was the relations between “whole” and “parts”. That issue has a long history going back to Aristotle. The Gestalt psychology considers the problem as a psychological one, assuming that both “whole” and “parts” are products of our mind, our way to perceive the world. Bertalanfy’s intention was to create a mathematical science of “wholeness”, which does not depend on our mind, since a "solid science" should not. Unfortunately, he didn’t succeed in resolving these problems. His fate is similar to Einstein’s: he formulated the Unified Field Theory but didn’t succeed in resolving it.

The fact is that Bertalanfy saw the approach, the approach that continue the Gestalt’s psychology line, which treated “whole” and “parts” as products of our mind. He formulated shortly but consistently a number of statements that filled the new wine-skin with new wine. It is a mystery why Bertalanfy rejected that way. In author’s personal experience it was the second mystery of science which has happened during the second part of the XX century. The first one took place in German atomic project during the World War II. German physicists and chemists famous for their scrupulosity and precision have failed to measure the correct diffusion length of neutrons in pure graphite. They found the length equal to 35 cm though the correct answer was 70 cm. It meant that absorption of neutrons in graphite is too big. As a result the graphite pile, as a shortest way to get the chain was rejected.

Will these mysteries be ever resolved in the future?

General Sytems Theory. LUDWIG V O N BERTALANFFY Center for Theoretical Biology, State University of New York a t BuffaloQ. HISTORICAL PRELUDE. In order to evaluate the modern "systems approach," it is advisable t o look at the systems idea not as an ephemeral fashion or recent technique, but in the context of the history of ideas.Â The goal obviously is to develop general systems theory in mafhe-matical terms (a "logico-mathematical field," as this author wrote in the early statement cited in the section on Foundations of General System Theory) because mathematics is the exact language permitting rigorous deductions and confirmation (or refusal) of theory. Indeed, in order to be perceived in a reliable way, the company must be considered in a global way, as an entity working and evolving in a 690 given environment, with a purpose, i.e. a system 2 . In that line, many models have been developed, based on works in the areas of cybernetics, information theory, systems and decision-making (Mesarovic, 1964) (BertalanffyÂ This article organises reflections around the notion of industrial performance.Â Agile, and iterative, development methods for new product development are gaining in popularity under product engineers; where it initially was just applied for software development, now larger adoption takes place for product development in general.