INTRODUCTION TO SYSTEMS AND SYSTEMS PHILOSOPHY

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System is an old concept based upon the Aristotelian explanation for the world view point with its WHOLISTIC notion that 'A WHOLE IS MORE THAN THE SUM OF ITS PARTS. He advanced Teleological out look that objects in this world fulfilled their inner nature or purpose. [Teleology is based on the belief that things happen because of the purpose or design that will be fulfilled by them.]

EMERGENCE OF SCIENCE

The pre-Greek era was gripped in the realms of Religion & Magic. The main contribution of Greek Philosophers was to remove the world from the pangs of Magic and religion and to create an explanation to the working of the world – A Rational Explanation- which was the subject of a new kind of enquiry.

Aristotle explained the solar system as consisting of crystalline spheres upon which the planets moved in perfect circles.

The scientific revolution started in the 17^{th} century due to the pioneering work of Copernicus and Kepler pertaining to the solar system and that of Galileo & Newton pertaining to terrestrial and celestial dynamics which is proved to be the most powerful activity man has discovered. Copernicus & Kepler's heliocentric model of the solar system demolished the Aristotelian solar system. Galileo propounded that earth is not the centre of the world but Sun is the centre and immovable. His work directly challenged the Aristotelian view that motion needed a force to maintain it and proved that force does not produce motion, but changes it to produce acceleration.

Newton developed the concepts and definitions to be used and stated the THREE LAWS of motion governing classical dynamics. He discussed the motion of bodies in vacuum thereby providing the basis of celestial mechanics, discussed the modifications introduced in fluids and ultimately demonstrated "THE FRAME OF THE SYSTEM OF THE WORLD", applied the ideas to the solar system to accurately predict the facts about the motion of planets and developed the LAW OF GRAVITATION. He advocated the importance of expressing nature's behaviour in the language of mathematics.

Thus, present day science may be seen as applications of Galilean – Newtonian methodology to the study of phenomenon. Newton's Physics provided a mechanical picture of the universe which survived severe tests. This made Aristotle's Teleological out look and his wholistic notion an unnecessary doctrine.

Newtonian mechanics succeeded because its protagonists asked questions within the range of an experimental answer by limiting their inquiries to physical, rather than Metaphysical problems and in particular on those aspects of the physical world which could be expressed in terms of mathematics.

The core of scientific revolution was the belief in rational modes of thought applied to design and the subsequent analysis of experiments. This combination of Rational Thinking and Experimentation is outstanding in that it works. Within well defined limits, scientific evidence is Trustworthy and that is why it has created the 'PRESENT WORLD'.

METHOD OF SCIENCE

Scientific Methodology is a way of acquiring publically testable knowledge of the world. It is characterized by application of RATIONAL THINKING to experience gained from observation and from deliberately designed experiments, with an aim to develop the concise expression of the laws which govern the regularities of the universe and expressing them mathematically, if possible.

This particular pattern of human activity, in which lies the power of science, can be summarized in three critical characteristics – 3R'S namely REDUCTIONISM, REPEATABILITY and REFUTATION.

REDUCTIONISM

There are three senses in which science is a reductionist.

1. Real world is so rich in variety, so messy, that in order to make coherent investigations of it, is necessary to select some items only to examine, out of all those which could be looked at .To define an experiment is to define a reduction of the world, one made for a particular purpose.
2. Reductionist in Explanation, i.e. accepting the minimum explanation required by the facts.
3. Breakdown the problem and analyze it piecemeal.

REPEATABLITY: Repeatability of experiments at different places and at different times and by different people makes the knowledge public or scientific and this is the strength of the science. Eg. Literary knowledge is a private knowledge. A critic who wishes to convince us Mr. X is a great novelist, will explain why he thinks so. He will try to influence our opinion about a book of Mr. X. We may be convinced or not and whether we agree or not depend upon our own taste. It is also possible that one of us or both of us may change our view at a later date. Such knowledge is private.

The scientific experiments may be repeated and verified by one and all. Thus they are public knowledge.

REFUTATION: The method of science is the method of bold conjectures and ingenuous & severe attempts to refute them. The important message is – Do not be satisfied with scientific surmise and guess. Try to find out ways of challenging the paradigm. Thus, science makes intellectual progress by the refutation of the hypothesis.

In brief, we may reduce the complexity of the variety of the real world problems, whose results are validated by their Repeatability and we may build knowledge by Refutation of hypothesis.

The power of science opened a virgin field for researchers in the area of well structured physical systems and scientists directed their intelligence and creativity towards materialistic gains. This resulted in the scientific and Industrial Revolutions – Invention of the gear changed the mechanical world drastically and invention of Junction diode, Transistor, Integrated circuits transformed the world of communications and entertainment. Physical distances and communication distances are obviated and man became purely materialistic.

The well structured and explicitly defined problems of Laboratory have resulted in a most comfortable life style for the last above 400 years .

PROBLEMS OF SCIENCE & EMERGENCE OF SYSTEMS PHILOSOPHY

Science has its own limitations and Reductionism which is its powerful tool also happens to be its weakness. Scientists assume that the components of a whole remain the same even when examined in isolation. This is true only for well

structured and regular physical sciences. However, if we move beyond them to study complex phenomenon such as Human society, scientific methodology fails. This is more so in Biological Sciences etc and the 3R'S of science are not capable of coping up with the inherent complexities.

In unrestricted sciences, progress is slow and methodological problems abound. This requires that different and new ways of thinking is to be explored.

It is in this connection that Ludwig Von Bertalanffy tried to exploit the Aristotlien wholistic notion that a whole is more than sum of its parts to advance SYSTEMS PHILOSOPHY about 70 years ago.

SYSTEMS PHILOSOPHY OF THINKING

Bertalanffy argued that Aristotle's WHOLISTIC NOTION forms a definition of the basic System problem which is still valid. According to him, order or organization of a WHOLE or a SYSTEM, exceeding its parts when these are considered in isolation, is nothing metaphysical, nor a superstetion or a philosophical speculation, but is a fact of observation encountered whenever we look at a living organization, a social group or even an atom.

Renowned for his celebration of WHOLENESS AND COMPLEXITY, Tagore said "By plucking her petals, you do not gather the beauty of the flower"

ARTICULATES OF LUDWIG VON BERTLANFFY :

- The fact that the study of living Systems is a study of commonalities shared by Systems of differing physical structures.
- That physics cannot encompass organic phenomenon without fundamental modification and extension.
- That the Commonalities characteristic of Biological systems is exemplary of other kinds of Commonalities which could form the basis for a General Theory of Systems per se.
- That Biological systems (i.e. Developmental systems) are open systems, able to exchange matter, energy and information with their environments and consequently the second low of thermodynamics which states that material systems should proceed from ordered to disorder states, is not even directly applicable to them, and finally.

- That apparently purposive, tellic behaviour of developing systems is entirely plausible.

Therefore, we see that there is a sense in which we can learn something about a system, say S1, such as a developing organism by studying, some other system, say S2, which perhaps is completely different from S1 and which manifests the same behaviour. Thus, the two distinct systems S1 and S2 can behave similarly only to the extent that they comprise alternate realizations of a common Mathematical or Formal Structure.

It is perhaps ironic that a few achievements of world of science should be of Non-reductionist character typical of System – Theoretic arguments. One such example is given below

Hamilton showed that two distinct and independent branches of physics –viz Optics & Mechanics could conceptually be unified, not through Reduction of optics to mechanics or vice-versa but rather through the fact that both the systems obeyed the same formal law i.e. realized the same formal systems. Hamilton stopped there probably because scientists of the times could not appreciate this approach. After 100 years later, Schrödinger exploited the commonalities between the two entirely different areas and developed WAVE MECHANICS.

This clearly demonstrates that where science fails to explain, systems approach of exploiting commonalities comes in handy.

DEFINITION OF SYSTEM AND SYSTEMIC METHODOLOGIES

1. A.D. Hall and R.E. Fagon have thoughtfully defined a system as "A system is a set of objects together with relationships between the objects and between their attributes" Here OBJECTS are simply the parts or components of the system. ATTRIBUTES are properties of the objects and RELATIONSHIPS are those that tie the components and the System together.
2. A system is a collection of objects united by some form of interaction or interdependence to constitute a unity or an organic whole.
3. According to Websters International Dictionary "A system is an aggregation or assemblage of objects united by some form of regular interaction or interdependence.

A group of diverse units so combined by nature or act as to form an integreal whole and to function, operate, or move in unison and often in obedience to some form of control.

4 As a broad definition, any entity which may be sub-divided into component parts may be considered as a system.

5 One line of advance may be that of SYSTEMS THINKING which accepts that at the level of complexity observed in the real world, there will be emergent properties characteristic of the wholes. The systems approach seeks relations between emergent properties and the wholes which exhibit them.

6 Science and scientific models are based on Reductionism whereas system and systemic model formulation is based on INTEGRATION. The System Model is obtained by connecting, according to the structure of the Study System, one component at each level of interconnection. This is repeated till all the components are connected. The method is known as Component-to-Sub-System-to-System construct.

7 However Systems modelling methodology is a scientific process.

ILLUSTRATIVE APPLICATIONS OF SYSTEMS METHODOLOGY

* Schrodinger's wave mechanics arrived at, in accordance to Von Bertlanffy's first articulate exploits commonalities between optics and mechanics.
* Identity of structure has been exploited to study socio-economic systems based upon the structure of certain physical systems.
* Based upon methodology -6, employing System theoretic component- to- Sub-System –to- System approach, a model of National Economy was developed to promote National Economic- Environmental Systems Studies. Components in these studies are set of interdependent geographical regions and their activity sensors.

The same methodology has been applied for

* Transportation System Studies
* Electrical Power and Energy System Studies
* Education Systems
* Health-care Systems
* Water- Resources Systems

* Marketing Strategies
* General system theory has been applied to mathematics
* Application to literature -

  Structuralism has been attempted to identify and define the constituent units, their inter- relationships and their syntax in Hardy's Novels by means of structural analysis.

GENERAL SYSTEMS THEORY

Systems concept is a most general concept used widely and with different cannotation depending upon the convenience of the situation

TYPE & AREA WISE CLASSIFICATION OF SYSTEM THEORIES

TYPE-1: Discipline oriented Special Theories.

Eg: Mechanics, Electrical Circuits, Optics, etc., etc.

TYPE-2 Systems Theories which generate one or more fundamental or non-fundamental Basic-Traits usually applied in nature.

Eg: Generalized Rotating Systems, Generalized Machine Theory, Electrical Analogies, Engineering Systems etc.

TYPE-3: System Theories, which attempt to capture all basic traits or fundamental System traits

Eg. Physical Systems Theory

TYPE-4: Mathematical Theories of Abstract Systems which are not measurable and have no Physical Interpretations or concepts. This type is not at operational level.

It may be noticed that as we move down from Type-1 to Type-3 Systems, the generality in the treatment increases and Type-4 System is an abstract one.

Type-3 Systems are usually selected for modeling and analysis, which are sufficiently general in nature to encompass all Systems in the real world without sacrificing operational level.

Application of Systems Methodologies to Type-3 system proved to be computationally more economical and more meaningful.

Up to TYPE -3 Systems the powerful scientific methodology of Systems could ccpe-up and at this level, perhaps saturation is

approaching. This is the reason, that now scientists are diverting their attention towards **Esoteric Systems.**

It is truly said that where the 3 R's of scientific methodology fails, systemic methodology comes handy.

But it is more apt to conclude that because the science has been so powerful and successful in dealing with well structured problems, System Methodologies are being sought to continue the pursuit into TYPE – 4 Systems.

In a Discourse delivered to the Satsang- World, the TYPE-4 Spiritual System is termed as SPIRITUAL EDUCATION.

Probably we may draw up the following analogies as given in the Table below.

S.No.	Stage of Life	Level of Education	Means of Education
1.	**Child hood** बाल अवस्था	**Learning by own actions and actions of others**	**Imitation**
2.	**Youth** कौमार अवस्था	**High School Level (Physical & Mental Development)**	**Elementary Scientific Methodologies**
3.	**Man-hood ,** युवा अवस्था	**College & University Level (Intellectual level)**	**Scientific Methodologies of Highest order (Induction & Deduction)**
4.	**Old Age** प्रौढ़ अवस्था	**Spiritual Education (Pursuit of Spiritual Goals)**	**Systemic Methodologies (Best upon Analogs)**

It is in connection with the Spiritual Education that **all the Satsangis are considered Esoteric or Spiritual System Scientists.**