Systemism

(Bunge - Wan)

Professor Muhammad Alhasan Biraima

IIIT-East Africa(2022)

The Systemic Approach To Transdisciplinarity

(A framework For The Integration Of Social knowledge)

The Recent Ontological Turn in Social Science

- The epistemological questions such as "how we provide scientific knowledge" should not be prioritized over the investigations into the (transcendentally) necessary conditions of science. It is the ontological question of "what the world must be like for science to be possible" that should be dwelt on. We should not confuse "what is" with "how we know,". Idealists and empiricists reduce the reality to our ideas and perceptions.

- All theoretical positions are dependent upon particular assumptions about **ontology** (theory of being: what is the world made of? What objects do we study?), **epistemology** (theory of knowledge: how do we come to have knowledge of the world?), and **methodology** (theory of methods: what methods do we use to unearth data and evidence?).

- The recent ontological turn in the social sciences (e.g. economics, political economy, sociology, international relations, organization and management studies), now even referred to as the “paradigm shift”, is a praiseworthy antidote to the fact that social researchers in the past tended to concentrate on epistemology and methodology (or research methods alone) at the expense of ontological issues.

- The result is that social researchers in various disciplines have come to recognize that “it is impossible to engage in any sort of ordered thinking about the socio-economic world without making a commitment (if only implicitly) to some social ontology, because any attempt to conceptualize socio-economic phenomena of interest inevitably involves the adoption (if only implicitly) of some picture of the nature of social being”

- This ontological turn is closely, though not exclusively, associated with the rise and diffusion of critical realism in the human and social sciences.The task is to explore all questions of social ontology, without presupposing in advance that one set of results or ontological conception will be found to do better in explanatory terms than competing conceptions. These scholarly works have contributed significantly to the ontological turn in social science.

- Researchers with a scientific or critical realist view of the world maintain that the ontological assumptions implicit in scientific practice must be uncovered and carefully examined before real advancement in theoretical and empirical research can occur.

- Investigators of social ontology may attempt to clarify the following questions:

(1) Are there social entities or social kinds? If so, what are they composed of ? Do they exist in their own right? On what basis and to what extent can they be identified, investigated and compared?

(2) What are the differences between natural and social kinds?

(3) Does "society" stand high above the individuals that comprise it? Are there "laws" of society other than the laws regarding individual behavior?

- Ontology, it should be stressed, does not have as its subject matter a world apart from that investigated by science. In as much as investigators in all branches of science are delving into the *composition*, *properties* and *change* of the *furniture of the world* ontology should become a *conceptual science* firmly grounded in and derived from current scientific knowledge about reality.

- What's involved here is the essential distinction between the *intransitive* (the object of scientific knowledge) and *transitive* (fallible scientific knowledge) dimensions of knowledge proposed by critical realists. the distinction between *intransitive* and *transitive* dimension of science implies that the world should not be conflated with our experience of it. Only on the basis of such a realist point of view can there be room for factual error, that is, discrepancy between idea and fact.

- *Ontology* itself should be kept distinct from the nature of the reality under investigation, because the latter is intransitive, while the specific ontological theories put forward by investigators are transitive. The term ontology refers to the *study* or *theory* of being, not to being itself. To have an ontology is to have a *theory* of what exists.

- Mario Bunge defines ontology as *"the branch of philosophy that studies the most pervasive features of reality, such as real existence, change, time, causation, chance, life, mind, and society."* His views on ontology may be summarized as follows:

1. Ontology can be classed into "*general*" ontology and "*special*" ontology; the former studies all existents, and the latter addresses a certain genus of thing or process such as those in physics, chemistry, biology and society.

2. It follows that "*general*" ontology probes into the concepts of time, space and event, and *social ontology* (as a special ontology) studies such general sociological concepts as *social system*, *social change*, *social relations* and *social structure*.

3. There are three approaches to the study of ontology: *Speculative ontology*, which may contain insights but is remote from scientific knowledge. *Exact ontology* draws explicit support from formal tools, but may neglect the philosophical tradition or contemporary scientific knowledge and thus become nothing short of applied logic. *Scientific ontology*, by contrast, is both exact and congruous with science. Logical or mathematical in form, it learns from formal and factual sciences, fixes unresolved problems, and poses new ones.

4. The significance of ontology lies in the facts that:

(a) all scientific research has to proceed by dint of some ontological hypotheses (e.g. "the world exists independently of the researcher"), and ontology can both facilitate and hinder interesting research questions and designs;

(b) every *world view* and *ideology* is a combination of ontological and value systems. Therefore, after the advent of modern science, *scientific ontology* becomes all the more important: science only makes nonscientific ontology obsolete.

5. Ontological statements, like scientific ones, are fallible. Ontological and scientific questions differ only in scope.

6. Formal sciences (logic, mathematics and semantics) study conceptual objects such as set and category, while factual sciences (natural and social science) and ontology deal with concrete objects. Therefore, ontology cannot be built merely on logic, since logic does not describe, represent or explain any factual items. However, any robust and exact ontology presupposes logic: deductive logic and pure mathematics are ontologically neutral, and hence instrumental in building ontological theories.

7. Scientific ontology deals only with the *real world* in light of the findings of science.

8. Scientific ontology has to start with the concepts of *things* and their *properties*. Furthermore, to be in line with contemporary science, it should regard concrete things as changeable (i.e. material or having energy).

9. The main objectives of scientific ontology are to analyze and to systematize the ontological categories and hypotheses germane to science, and to clarify whatever idea science takes for granted or leaves in the twilight.

10. The two major families of ontology are *materialism* and *idealism*. Further distinctions can be made and primary among them is the distinction between the *static* and *dynamic* ontologies. The static ontology is characterized by the belief that change is only a momentary departure from equilibrium or harmony, which would be the ideal state of affairs. By contrast, the central thesis of the dynamical ontology is that stasis is a particular and ephemeral case of process: that every state of a thing is either the initial, intermediary or final phase of a process. All factual sciences focus attention on change or the laws/trends of change.

11. Like extremely general scientific theories, ontological theories cannot be tested directly, but should be tested through the checking of more special theories gotten from the general ones by conjoining them with subsidiary assumptions.

- On the basis of the above ontological principles Bunge established a comprehensive, cogent and robust ontological system, which he called “***systemism***”.

Systemism

- Systemism is the approach adopted by anyone who endeavors to explain the formation, maintenance, repair, or dismantling of a concrete complex thing of any kind. Notice the use of the expression "**approach…**" not "systems theory". There are nearly as many systems theories as systems theorists. Systemism invites us to analyze wholes into their constituents, and consequently it rejects the epistemology inherent in holism.

❖ General Characteristics of Bunge`s Ontological System

1. *Exact***:** every concept used is exact or exactifiable;

2. *Systematic***:** hypotheses or definitions belong to hypothetico-deductive systems;

3. *Scientific***:** hypotheses are consistent with contemporary science;

4. *Materialist***:** every entity is material (concrete), and every ideal object is ultimately a process in some brain or a class of brain processes;

5. *Dynamicist***:** every entity undergoes changes;

6. ***Systemist*: every entity is a system or a component of one or more systems;**

7. ***Emergentist*: every system possesses (emergent) properties that its components lack;**

8. ***Evolutionist*: every emergence is a stage in some evolutionary process.**

- Bunge's ontology is centered around "things" and "systems" rather than events, processes or facts. Such a system is science-oriented, not only compatible with but conducive to the development of contemporary science.

- When philosophers and social scientists choose facts, events or processes as their research objects, they tend to neglect that every fact involves some *concrete* or *material* thing in that the fact is the state or change of state of something. *Static* facts are things in a given state, while *kinetic* facts are changes of state of things. Swift changes can be called *events*; if prolonged, we may refer to them as *processes*. In other words, facts do not exist independently of things.

- Bunge identifies *materiality* with *concreteness*. All things are material and thus concrete, and they may be imperceptible like an electron or biosphere, or tangible like a stone or a plant. He insists that there are no *properties* in themselves, because every concrete or substantial property, such as moving, reacting, or remembering, is the property of some thing or other—bodies, reactants, brains ...et cetera. One of the tasks of science is thus to *identify* and *interrelate* the properties that things possess, as well as the patterns of the associations and changes of these properties.

- The distinction between *things* and *facts* are *analytical* rather than *ontological*, because there are neither states nor changes of state in themselves. Nor are there things that fail to be in some state or other, or that undergo no changes. It follows the question is not to choose between *ontology of facts* and *ontology of things*. Instead, it is necessary for any careful researcher to *combine* these two ontologies into one single *ontology of things involved in facts* or *of facts involving things*.

- As regards scientific research, the adoption of a thing-based ontology implies that the analysis of any fact should start by identifying the thing(s) involved, such as reagents in the case of a chemical reaction, and brains in that of a mental process.

- Every object is either a material, concrete thing, or a conceptual construct, and none is both. *Therefore the three tenets of Bunge`s emergentist materialism are:*

(1) the world is exclusively constituted by concrete/material things;

(2) conceptual (abstract) objects, such as diagrams, hypotheses or theories, do not exist independently of the brain(s) that figure them out;

(3) *emergentist materialism* is not to be confused with physicalism or vulgar materialism, since it leaves sufficient room for supra-physical things—characterized by emergent properties—such as organisms and social groups.

- All things undergo changes. Bunge adopts a broad concept of matter, pointing out that *x is material* is tantamount to *x has energy* and *x is changeable*. In other words, "change is universal … Mutability is the one property shared by all concrete things, whether natural or artificial, physical or chemical, biological or social, perceptible or imperceptible". Shorter: *to be (material) is to become*. In contrast, *conceptual (abstract) objects* do not possess energy, undergoing no changes. What changes are not conceptual objects, but the material processes in the brain.

- When things interact intensively in a specific way, they *combine* into *novel systems*, namely, complex things structured in a definite (though not immutable) fashion. By contrast, *simple associations* (e.g. the formation of a sand pile or the coalescence of droplets) are not characterized by specific structures, but by a low degree of cohesiveness or lack of strong bonds, and thus may break up relatively more easily owing to internal rearrangement or external forces.

- Complex combinations result in systems with *emergent properties* that are absent from its components. For example, a proton and an electron combine to yield a hydrogen atom; two hydrogen atoms combine to form a hydrogen molecule, and so on. These combined systems differ from mere aggregates (associations) in at least three respects:

(1) the original items alter in the process, so that they are precursors rather than constituents of the whole;

(2) combinations … are more stable … because they are more cohesive;

(3) combinations take more energy, longer time, or rarer circumstances, as the case may be.

- Formally, *a system is a complex object whose parts or components are held together by bonds of some kind*. These bonds are logical in the case of a conceptual system, such as a theory; and they are material in the case of a concrete system, such as an atom, cell, immune system, family, or hospital. The collection of all such relations among a system's constituents is its structure (or organization, or architecture).
- Depending on the system's constituents and the bonds among them, a concrete or *material system* may belong in either of the following levels: *physical*, *chemical*, *biological*, *social*, and *technological*. The *semiotic systems*, such as *texts* and *diagrams*, are *hybrid*, for they are composed of material signs or signals, some of which convey *semantic meanings* to their potential users. *Mechanisms* are involved in the communication of such systems.

- Such an ontological system, which can be called *emergentist systemism*, rests on the following postulates:

  1. Every object, whether material or conceptual, is either a system or an actual or potential component of one;

  2. Every system, except the universe, is a *subsystem* of some other system;

  3. Every system has *systemic (emergent) properties* that its components lack;

  4. All things at each level are composed of things belonging to lower levels;

5. Every problem ought to be approached in a systemic (rather than sectoral) fashion;

6. Every idea ought to be put together into systems, preferably theories.

- The *ultimate goal of theoretical research*, be it in philosophy, science, or mathematics, is the *construction of systems*, i.e. theories … because the world itself is systemic, because no idea can become fully clear unless it is embedded in some system or other.

- *Events* and *processes* are what happens in, to, or among *concrete systems*, while the process or processes that *make a concrete system tick* could be termed a *mechanism*. Consequently, to place systems theory on a firmer ontological footing, it is necessary to address a number of crucial aspects of a *System worldview*, such as the *components* of a system and *their interactions*, the *level structure* of reality, *emergence*, *mechanisms*, and so on.

The Level Structure of the World

- In any given system (molecule, organism, family, school, factory, etc.), at least two levels can be discerned: the *macro* and the *micro*:

  The macro-level is the kind itself, that is, the collection of all the systems sharing certain peculiar properties. The corresponding micro-level is the collection of all the components of the systems in question. There may be more than one micro-level.

- For example, the atomic level is the collection of all atoms, while the molecular level is that of all molecules. Generally speaking, *an n-th level system is composed of things on level n-1*. The individuals may be the components of several types of systems, such as the family, school, or firm. And the individuals are in turn composed of subsystems like the central nervous system.

- It is of crucial importance to recognize that all *factual sciences* are confronted with the problem of *micro-macro linkage*, because all of them study systems, and *all systems under investigation have components (the micro-aspect) as well as systemic, emergent properties (the macro-aspect)*- see Fig. 1.
- Equally important is that *levels are collections of things*, and hence are concepts, not concrete things. Therefore, levels cannot act upon one another. In particular, the expression '*micro-macro interaction*' … does not denote an interaction between micro and macro levels but an interaction between entities belonging to a micro-level and things belonging to a macro-level.

Fig-1 Self-organization of Material Systems

- An ontological hypothesis involved in and encouraged by modern science is that *reality, such as known to us today, is not a solid homogeneous block but is divided into several levels, or sectors, each characterized by a set of properties and laws of its own …*
- A second, related presupposition is that *the higher levels are rooted in the lower ones*, both *diachronically* and *synchronically*: that is, the higher levels are not *autonomous* but depend for their existence on the subsistence of the lower levels, and *they have emerged in the course of time from the lower in a number of evolutionary processes*. This rooting of the higher is the objective basis of the possibility of partially explaining the higher in terms of the lower or conversely.

- One lesson to be learned from all this is that, while the various sciences do occupy different levels, they form part of a single connected structure. The unity of that structure is cemented by the relations among the parts. A science at a given level encompasses the laws of a less fundamental science at a level above. But the latter, being more special, requires further information in addition to the laws of the former. At each level there are laws to be discovered, important in their own right. The enterprise of science involves investigating those laws at all levels, while also working, from the top down and from the bottom up, to build staircases between them.

❖ Bunge Views on Levels

1. The world can be construed as a level structure. That is, things group into levels of organization. Every real (material) existent belongs to at least one level of that structure. At least five qualitatively different levels of entity may be distinguished: *physical*, *chemical*, *biological*, *social and technical*. Every level may in turn be subdivided into as many sublevels as needed. For example, the *biological level* may be split into at least seven sublevels: *cell*, *organ*, *organ system*, *multicellular organism*, *biopopulation*, *ecosystem*, *and biosphere*.

2. A level is a *collection of things* sharing a cluster of properties and relations among one another. In other words, it should be kept in mind that levels are *concepts* instead of concrete things.

3. Every concrete thing (system) on any given level is composed of lower level things (systems), and is characterized by emergent properties absent from these components.

4. The systems on every level have emerged in the course of some *process of assembly* of lower-level entities.

5. All processes of assembly are accompanied by the *emergence* of novel properties and the *submergence* of others. For example; the social level is composed of humans but is not an organism itself.

6. The process of assembly can happen either spontaneously (naturally, such as biological and cultural evolution) or artificially (man-made or man-guided, such as that in a laboratory). *Such a process is one of self-organization if and only if the resulting system is composed of subsystems that are not in existence before the very process* (e.g. the formation of an embryo’s organs).

7. Every level, both of the world and of science, has autonomy and stability to some degree.

8. The level structure of the world is far from being static but changes over time, tending to become more complex.

- The above ontological description of levels has the following epistemological and methodological implications:

1. Begin by studying the class of facts that concern us on their own level(s), and introduce further levels as required.

2. Do not skip levels.

3. When investigating inter-level relations, do not ignore the intermediate levels and sublevels, if any.

4. Try to explain emergence while acknowledging the ontological novelty at every level. Reduction is desirable and fruitful in scientific research, but reduction does not imply levelling: it relates levels instead of denying that they exist. Reduction, then, is a theoretical question that does not alter the level structure of the world.

5. Try to investigate the *genealogy* of emergent higher levels, since material emergence is emergence from precursors.

6. Try to integrate all the fields of knowledge that study the same objects.

- The following should be considered in substantive research:
  1. How individuals interact (micro-micro);
  2. How they combine to form systems with emergent properties (micro-macro);
  3. How (being part of) a system influences the individual component (macro-micro);
  4. How systems interact and affect one another (macro-macro);
  5. How individuals affect the system, which in turn exerts influences on the individuals (micro-macro-micro);
  6. What the impacts the system has on individuals, the resultant actions of which in turn bear on the system itself (macro-micro-macro).

❖ **The Social System as an Example** (see Fig. 2)

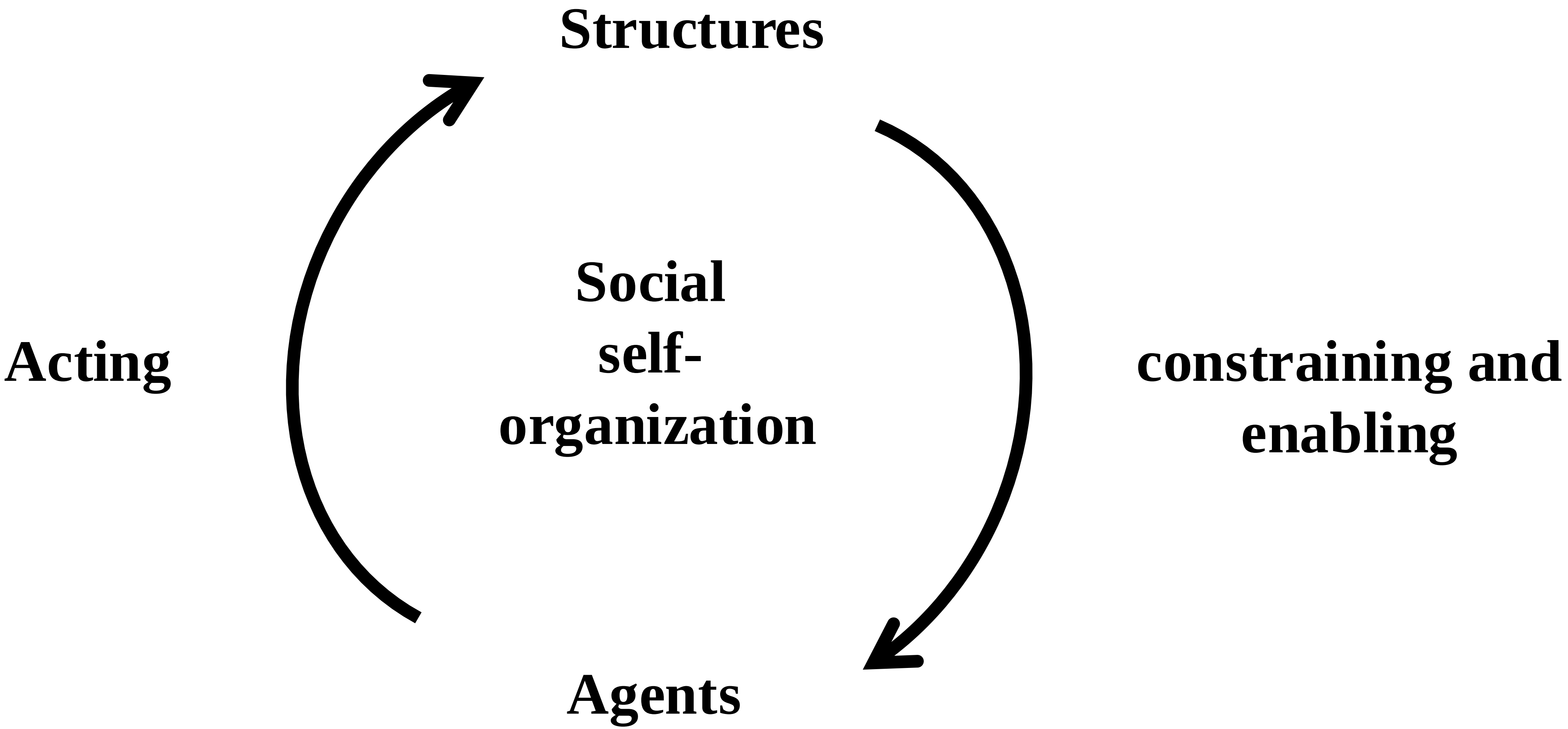
➢ Researchers should investigate the following**:**

(a) how persons or groups interact;

(b) how these interactions over time form relatively enduring social relations and social systems, which we take as social facts;

(c) how these social relations and systems provide contexts that constrain and enable the actions of individuals or groups while affecting their intentions, desires and beliefs, or to put it differently, how individuals or groups alter their thoughts and actions for being *part* of a social system;

Fig-2 Self-organization of Social Systems



(d) how social systems interact and act upon each other;

(e) how individuals or groups influence (thwart, facilitate or transform) the workings of specific social systems, which in turn affect their members; and

(f) how changes at the systemic level influence the individuals, who in turn act in ways that reproduce or alter the workings of systems.

- So far we have established the centrality of the *part-whole* relation and *level structure* of the world in constructing an ontologically grounded theory of systems, and now it's time to introduce and discuss the *CESM* model laid down by Bunge.

The CESM Model

- An ontologically solid foundation of a systemic approach needs consideration of:

  (a) what it consists of (*its composition*);

  (b) the environment in which it is located (*its environment*);

  (c) how its components and environmental items are related to one another (*its endostructure* and *exostructure*); and

  (d) how it works, or what makes it what it is (*its mechanism*[s]).

- Therefore a system **s** is to be defined by the collection:

$\mu(s) = \langle C(s), E(s), S(s), M(s) \rangle$, where

1. C(s) = Composition- Collection of all the parts of ***s***;
2. E(s) = Environment- Collection of items, other than those in ***s***, that act on or are acted upon by some or all components of *s*;
3. S(s) = Structure- Collection of relations, in particular bonds, among components of ***s*** (endostructure), or among these and things in its environment (exostructure);
4. M(s) = Mechanism- collection of processes that allow **s** to perform its specific functions.

Remember:

- The distinction of a system **S** from its model(s) **μ(s)**, just as the electrician distinguishes an electric circuit from its diagram(s). In Bunge's materialist ontology, only concrete (material) systems have mechanisms. Conceptual systems (e.g. theories) and semiotic systems (words, musical notes, figures and graphs) have compositions, environments, structures, but no mechanisms.

- All four components of the model μ(s) are taken on a given level, such as the person, the household, or the firm in the case of social systems. They are also taken at a given time. In particular, M(s) is a snapshot of those processes in the system in question that are peculiar to its kind, such as research in a scientific team, and combat in a military unit. In turn, a process is a sequence of states; if preferred, it is a string of events. And whereas the net effect of some processes is to alter the overall state of the system, that of others is to maintain such state. For instance, wind moves a sailboat, whereas the impacts of myriad water molecules on the hulk keep it afloat.

The Nuclear Family as an Example for CESM Model

Its *components* are the parents and the children; the *environment* is the physical surroundings, neighborhood, workplace and so on; its *endostructure* consists of biological and physiological bonds such as love and sharing, while the *exostructure* is made up of the relations of its members with people in other social systems; lastly, its *mechanism* consists of daily chores, parent-child interactions, and the like.

- Why is the notion of *mechanism* of central importance? The answer is that it is the key to the workings of a system: once the original mechanism is undermined or undergoes changes, the (kind of) system that it makes possible will probably break down or transform. This is why a *deep (mechanismic)* explanation has to include the notion of mechanism. By contrast, the *covering-law* explanation and *functional* explanation are both *shallow* explanations- mere *descriptions***.**

❖ Note the following about mechanismic explanation:

1. Since there may be a number of mechanisms operating and interacting in one and the same system, it is recommended that ***essential*** mechanisms be distinguished from ***non-essential*** mechanisms. While the former are specific to a given kind of system, the latter may also occur in different kinds of systems. For example, organized teaching and research is an essential mechanism of a university but inessential to a firm.

- *An essential mechanism of a system is its peculiar functioning or activity*. In other words, an essential mechanism is the specific function of a system— that is, the process that only it and its kind can undergo.
- The above conflation of 'mechanism' with 'specific function' is not advisable when one and the same task can be performed by different mechanisms—the cases of functional equivalence. For example, some birds can advance by walking, swimming, or flying; documents can be reproduced by printing presses, mimeographs, or photocopiers; markets can be conquered by force, dumping, free-trade agreements, or even honest competition.

- Because the functions-mechanisms relation is one-to-many, we should keep the two concepts distinct while relating them. Another reason is that a purely functional account, such as “cars are means of transportation,” though accurate, is superficial because it does not tell us anything about the mechanism whereby the function in question is carried out.
- **A warning is in place:** there are no *universal mechanisms*. All mechanisms are stuff-dependent and system-specific. For instance, only live brains, when properly trained and primed, can engage in original research; and only brains in certain abnormal states can hallucinate. Still, mechanisms, like anything else, can be grouped into natural kinds, such as those of cooperation and competition, stimulation and inhibition, blocking and facilitating..etc.

2. Mechanisms are typically unobservable or concealed, so they have to be ***conjectured***, not by wild speculations, but with imagination constrained and stimulated by data, well-established hypotheses and mathematical concepts.

3. There is no unique method or logic for conjecturing mechanisms. It's more an art than a rule-directed technique.

.

4. Since most mechanisms cannot be observed directly, their description necessarily contains concepts that are absent from empirical data, and this is why mathematical thinking, which comprehends the complexity of the world better, is conducive to identifying mechanisms.

5. The *black box* approach (phenomenological, descriptivist, holistic approach) describes the working of the system in question only in terms of its input and output, thus failing to uncover *its components*, *environment*, *structure*(s), and especially *its mechanisms*.

6. How are the concepts of *mechanism* and *law-statement* related? Mechanisms without conceivable laws are called *miracles*. Scientific research presupposes **(a)** *materialism*, or the hypothesis that the real world is material, so that it contains no autonomous (subject-free) ideas; and **(b)** the principle of *lawfulness*, according to which all events satisfy some law(s). Trust in the first principle allows scientists to dispense with the ghostly. And trust in the second principle sustains their search for laws and the rejection of miracles.

- However, in the social sciences, law and mechanism are necessary but insufficient to explain, because almost everything social is made rather than found. Indeed, social facts are not only law-abiding but also norm-abiding; and social norms, though consistent with the laws of nature, are not reducible to these, if only because norms are invented in the light of valuations—besides which every norm is tempered by a counter norm.

- All real mechanisms are lawful, but the laws-mechanisms relation is one-to-many rather than one-to-one. For example, pollen particles, drunkards, and financial markets move similarly (random walk); the exponential function, another ubiquitous pattern, describes both the growth of a population with unlimited resources and that of scientific papers.

- Because the *patterns-mechanisms relation is one-to-many*, the search for either can be uncoupled from the search for the other. However, barring miracles, there are no lawless mechanisms any more than there are mechanism-less patterns. Hence, any mechanism-free account must be taken to be shallow and therefore a challenge to uncover unknown mechanism(s). By the same token, any mechanism unsupported by some law(s) must be regarded as ad hoc and therefore equally temporary.

- The mechanism-based explanation has received growing attention in recent years. Scientists from both natural and social sciences, including biology, psychology, cognitive neuroscience, physics, sociology, economics and political science, have engaged in the debates over the status of mechanism-based explanation and modeling, even though most of them refer to the explanation based on mechanisms as "mechanistic" explanation instead of what Bunge calls *mechanismic explanation*.

Systemism and Social systems

- **For Bunge:**

1. *A social system is a concrete system* composed of gregarious animals that **(a)** share an environment; **(b)** act upon other members of the system; and **(c)** cooperate in some respects and compete in others.

2. *A human social system* is a social system composed of human beings and their artifacts, held together by feelings, beliefs, moral and legal norms, and mutually related actions.

3. A human social system can be **(a)** *natural* (spontaneous) if it emerges by way of free association or reproduction (e.g. families, circle of friends, street-corner gangs); **(b)** *formal* (designed) if it is formed in compliance with explicit rules or plans (e.g. schools, armies, business firms, political parties, NGOs).

4. A human society is a social system composed of four major subsystems: **(a**) *biological system*, whose members are bound together by sexual, kinship, and friendship relations; **(b)** *economic system*, the bonds of which are relations of production and exchange; **(c)** *political system*, characterized by the coordination and management of social activities and the struggle for power; and **(d)** *cultural* system, the members of which engage in cultural or moral activities like learning, teaching, inventing, designing, singing, painting, and so on.

- These four subsystems partially overlap and interact with one another, because most people are members of at least two of them. Bunge calls this systemic view of human society the *BEPC model*, which he contrasts with the traditional base/superstructure model of Marxism. According to the BEPC model, every social fact has five interrelated aspects: *environmental*, *bios-psychological*, *economic*, *political* and *cultural*.
- Equally important is that every subsystem of society evolves according to its own dynamics as well as under the influence of the other subsystems. sometimes one of the subsystems takes the lead and the others follow, but at other times it is the turn of a different subsystem to start a new development. there is no single prime social mover, not even in the last analysis.

5. A *supersociety* is a system composed of tow or more human societies, such as the European Union.

6. The *world system* is the supersociety composed of all human societies.

7. A *social process* (or activity) is a process that involves at least two interacting persons and occurs in a social system of all sizes, like *getting married*, *rearing children*, *making friends*, *working*, *trading* and *waging war*.

8. A *social movement* is a directed social process that takes place in at least one social system and incorporates people into it.

❖ Implied theorems and postulates for a systemic sociology:

1. Every human being belongs to at least one social system.

2. Social systems are held together by various types of links: *biological* (including psychological), *economic*, *political* or *cultural*. *Social segregation* of any of these kinds weakens social cohesion.

3. The *beliefs*, *desires*, *intentions*, *preferences*, *choices* and *actions* of every individual are *socially conditioned* by his or her membership in social systems: there are neither *fully autonomous* nor *totally heteronomous* persons.

4. The changes of a social system arise from **(a)** endogenous changes in its members, **(b)** interactions among its members, or **(c)** interactions among these members and items in the environment.

5. Every social system can be analyzed into its *composition*, *environment*, *endo*- and *exostructure* and *mechanism*(s) (recall the CESM model).

6. From 2 and 5 readily follows that the study of any social system involves investigations into **(a)** its *CESM*, and **(b)** its *BEPC* subsystems.

Transdisciplinarity Needs Systemism

(Bunge - Hofkirchner)

- From a philosophy of science perspective, sciences can be classified according to three dimensions of knowledge: the *technological* (praxiological), the *theoretical* (ontological), and the *methodological* (epistemological) dimension.

- Technology is objectivated knowledge about objects for objectives. Theory is objectivated knowledge about objects. Methodology is knowledge of how to objectivate knowledge, that is, to process it in a social procedure such that it is not only subjective but might be used as an objective basis for knowledge about objects, which is required for fulfilling objectives.
- Technology incorporates the aims of scientific studies; it directs theory towards practical application. Applications intervene in the real world so as to help solve problems. Problems stand at the beginning of any science because they form ends for any science. Problems are, in the last resort, social. Sciences provide the means to reach a goal, given a point of departure.

- Theory embraces the scope of scientific studies; it gives deep insights in the functioning of the real world—insights that can be functionalised for the solution of problems, by informing the practice about the way to a goal from a point of departure.

- Methodology provides the tools of scientific studies; it is a framework through which understanding of the functioning of the real world can be generated to serve its function during problem-solving.

Transcending the Disciplines

- Scientific disciplines are determined by specific aims, by a specific scope and by specific tools. The objective is a determinate problem solution, the object of study is a determinate piece of reality, and the objectivation is guided by a determinate mixture of methods. However, given the rise of complex problems, monodisciplinary approaches do not fit the situation any more. Multi-, inter- and transdisciplinary approaches are needed. Transdisciplinarity has been gaining considerable attention since. It differs from disciplinarity in the following: **(a)** aims, **(b)** scope, and **(c)** tools.

(a) Aims: disciplines shall be transcended by the inclusion of stakeholders through participation in the processes of research and development as well as through diffusion of innovations, which allows them to co-determine what shall be regarded as a problem and what shall be regarded as a solution. By doing so, technological knowledge shall be constructed for solving problems that are complex.

(b) Scope: disciplines shall be transcended by the inclusion of interdependencies between factors across space (long-range effects), time (long-term effects), and matter (side effects) in the focus of the study. By doing so, theoretical knowledge shall be enabled to depict a bigger picture than mere isolated pieces of reality to underpin complex problem-solving.

(c) Tools: disciplines shall be transcended by the inclusion of a common code that shall perform the translation of concepts of one domain to those of other domains. By doing so methodological knowledge shall orient towards the identification of similarities across domains to gain a deeper understanding of complex problems.

- Systemism is not merely an option that can be taken up according to the researchers’ preferences. It is far more a well-founded approach best suited for cases in which trans-disciplinarity is needed. This holds not only for particular projects. It has the potential to give the whole edifice of sciences a new shape.

- **Fig-3** summarizes the hierarchy of science in the mainstream (positivism), which involves:

  (a) philosophy on the uppermost general level;

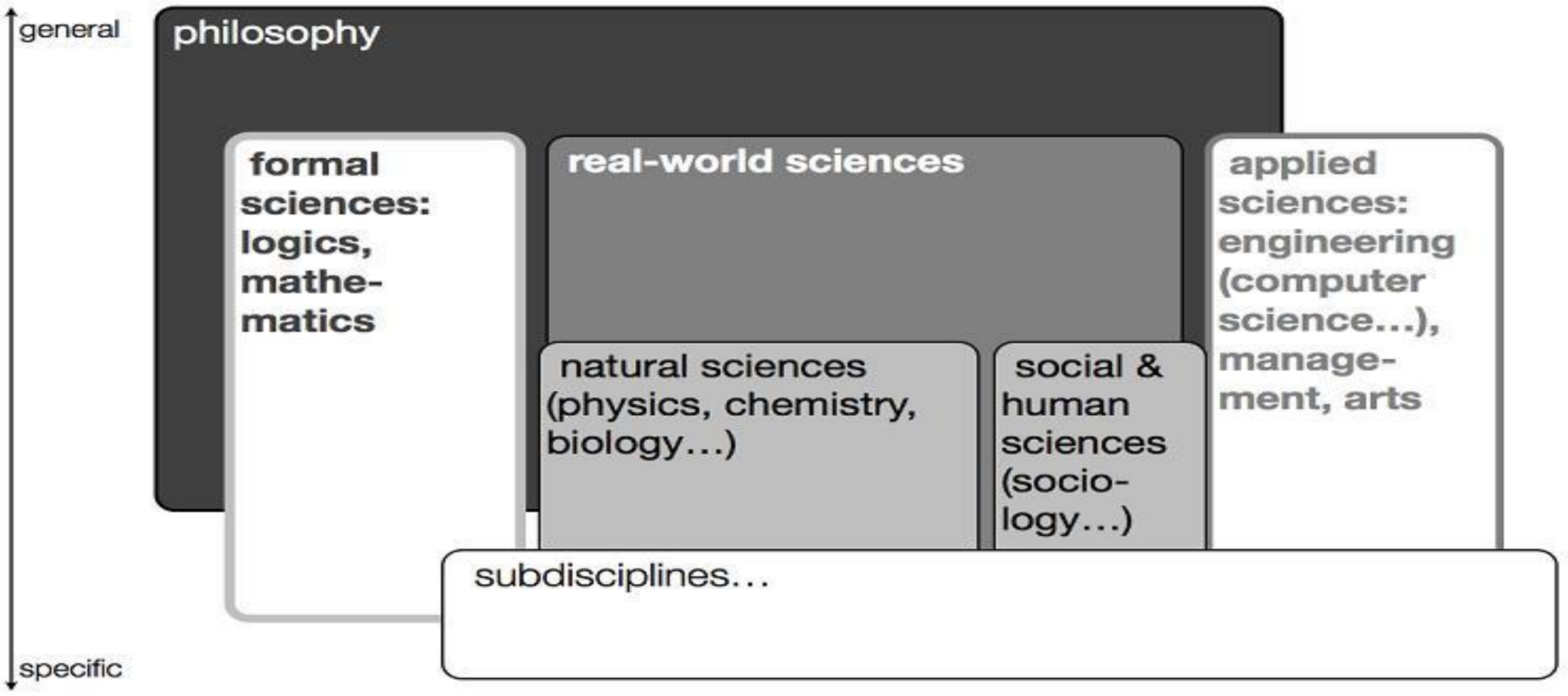
(b) formal sciences, real-world sciences, and applied sciences on a next level;

(c) subgroups of the former;

(d) their sub-disciplines and sub-sub-disciplines, and so forth.

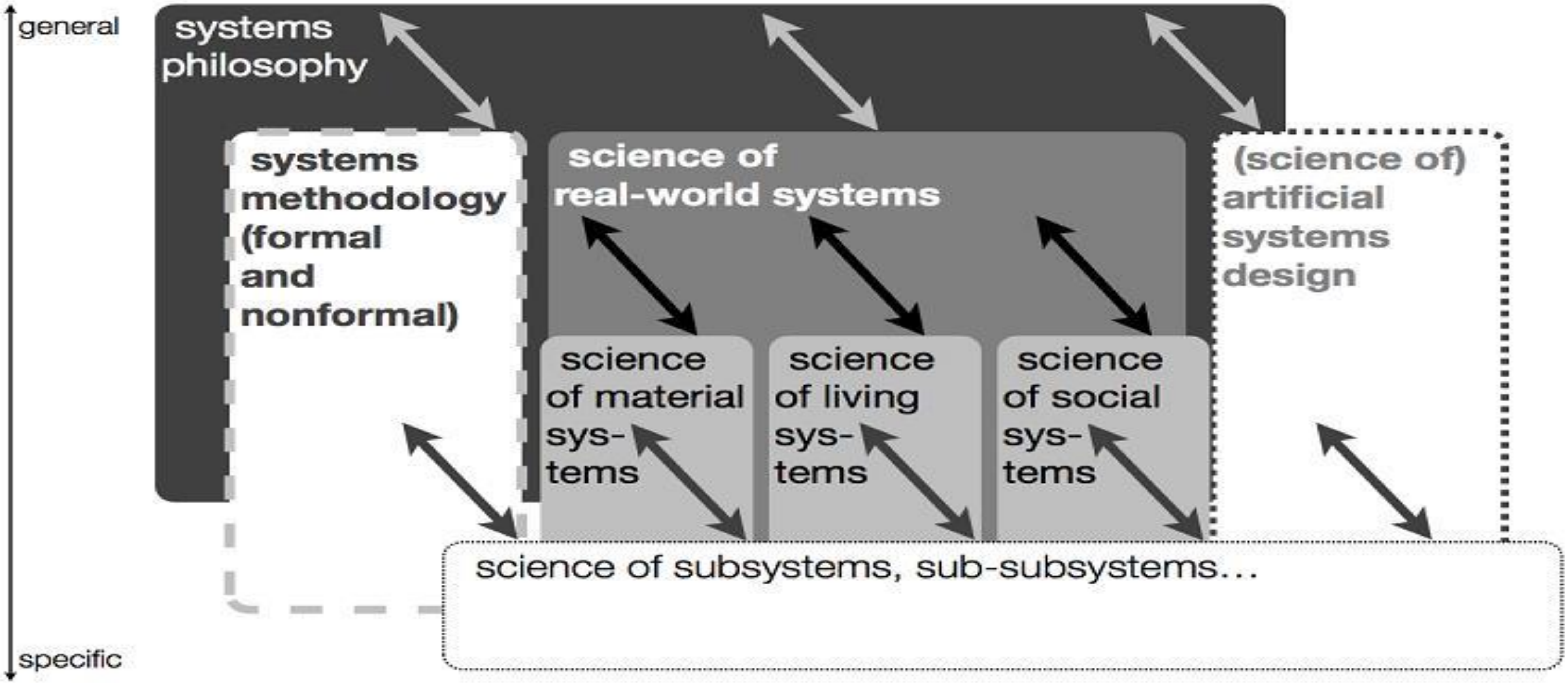
- Those sciences are imagined to have well-defined boundaries and to interact at best without undergoing fundamental changes themselves. Thus is the image of positivist sciences.

Fig-3 The Hierarchy of Positivistic Science



- **Fig-4** shows that systemism comes with a new conception of science. The systemist conception of sciences assumes semi-permeable boundaries and upward and downward interactions across the levels between all sciences. This is substantiated through defining any science in the context of discovering, describing and dealing with an overall systemic interconnectedness.

Fig-4 The Hierarchy of Systemic Science



- *Formal sciences* become part of a *systems methodology* that embraces formal and non-formal methods to understand systems features; *real-world sciences* turn into a science of different *real-world systems* that can be categorized as *material systems*, *living (material) systems*; and *applied sciences* turn out to be a science of the artificial design of those systems. Any science is open to *systems* further specifications of subsystems, and so on.

- *Systemism* has been effecting a *paradigm shift* that can transform positivist disciplines into *parts* of an overarching *transdisciplinary* endeavor. However, there have been drawbacks: the resistance of the positivist science establishment has proven strong; *systemism* has itself branched into a plethora of different schools. Though systems terms flourished , the meaning of the terms is heterogeneous. The paradigm shift is far from being completed.

- The need for science and technology responses to global challenges in an intelligent way has been supporting the attraction of *transdisciplinarity* among the scientific community. Theoretical efforts underlying *complexity*, *emergence*, and *self-organization*, can help sharpen *transdisciplinary* efforts. In particular, it is these features that play an innovative part in supporting the *transdisciplinary agenda*: *systems technologies* can be characterized by a new *world view*, *systems theories* by a new *world picture*, and *systems methods* by a *new way of thinking*.

- These issues can be dealt with as follows:

1. A New, Systemic Way of Thinking: *Integrationism*

- Complex problems need an *epistemological approach* that does justice to the complexity of reality from which systems phenomena emanate. In many cases, if not in any case, an assumption has to be made about which is the interrelation of phenomena of different degrees of complexity:

  How does the lower-complexity phenomenon relate to the higher-complexity phenomenon and (vice versa)?

- Three ways of thinking to approach this question**:**

1. A *universalist* way of thinking that gives priority to uniformity over diversity. It comes in two varieties:

(a) the levelling down of phenomena of higher complexity to phenomena of lower complexity; identity of the phenomena is established at the cost of differences; this is known as *reductionism;*

(b) the levelling up of phenomena of lower complexity to phenomena of higher complexity; identity of the phenomena is established for the benefit of one difference; this is called *projectionism*; higher complexity is erroneously conceptualized at a level where it does not exist.

2. A *particularist* way of thinking in which priority is given to the singularity of a difference or the plurality of all differences over unity. The disjoining of phenomena of different degrees of complexity establishes the identity of a particular difference at the cost of an identity common to the phenomena. That is called *disjunctionism*.

3. A third approach is that of *systemism* which negates universalism and particularism as well and *interrelates phenomena* to each other through *integration* and *differentiation* of their complexity degrees. *The union of identity and differences yields unity through diversity.*

- That is, the phenomenon with a lower degree of complexity shares with the phenomenon with a higher degree of complexity at least one property, which makes both of them, to a certain extent, identical, but the latter phenomenon is in the exclusive possession of at least another property, which makes it, to a certain extent, distinct from the former. *So both phenomena are identical and different at the same time.*
- The *method of transdisciplinarity* can take advantage of bringing this new systems method to bear: framing the phenomena through the equilibration of *integration* and *differentiation* during the *processes of conceptualization* in order to rule out reductionist, projectionist, and disjunctionist ways of thinking.

Example

- Let us take the relationship of social science and engineering science as an example for how to transcend the borders of both disciplines by making use of a systemic framing and transform their relationship into a true transdisciplinary one.

- In order to combine social science with engineering science, representatives of the latter might be inclined to reduce that which is human to that which is engineerable: *man is deemed a machine*. Mechanical architectures and functioning that are constituents among others of human life structures and processes are analyzed and hypostatized as sufficient for the comprehension of man "*techno morphism*".

- Or representatives of social sciences might share a preference to understand the whole world, including artifactual mechanics, by projecting characteristics of the social world onto the former: *the machine is deemed man-like*. The conception of social forms is thought necessary for the comprehension of everything.
- Or segregation might be made for the sake of either the identity of social science or that of engineering science: anthropocentric or, better, sociocentric positions traditionally distinguish the investigation of man as exclusive and belittle engineering undertakings, whereas trans- and post-humanistic positions argue for an imminent advent of a technological singularity that will make machines outperform man and thus the human race obsolescent.

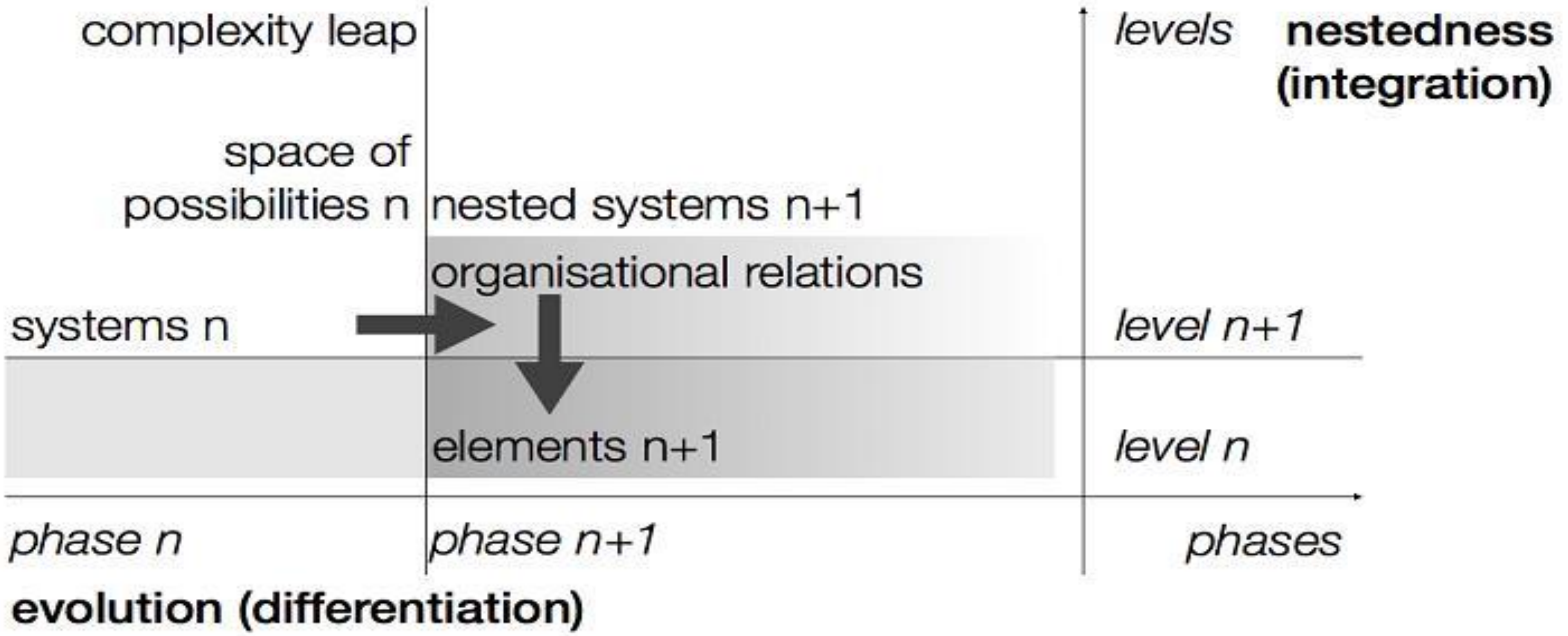
- None of these options does establish true *transdisciplinarity*. A way out can be seen through an approach that assumes an interrelation of both disciplines in a systemic framework that grants (relative) autonomy to each of them according to their place in the overall framework. Both disciplines complement each other for the sake of a greater whole. That greater whole is achieved by framing both disciplines in a systems perspective, that is, by framing them as part of systems science. *Social and engineering sciences combine for a common understanding of the systemic relationship of society and technology—of emerging techno-social systems. They make use of systems methodologies for empirically studying social systems and the artifactual in the context of technological applications implemented by social systems design.*

- The social and the engineering parts of *techno-social systems science* are coupled so as to promote an i*ntegrated technology assessment and technology design cycle in a transdisciplinary sense*. By doing so, they can form a never-ending cycle in which each of them has a determinate place: social systems science can inform engineering systems science by providing facts about social functions in the social system that might be supported with technological means; engineering systems science can provide technological options that fit the social functions in the envisaged techno-social system; social systems science can, in turn, investigate the social impact of the applied technological option in the techno-social system and provide facts about the working of technology.

2. A New, Systemic Picture of the World: *Emergentism*

- Systems theories provide an ontology in which complex problems are pictured as complex because they take part in an overall interconnectedness of processes and structures that are constituted by *self-organizing real-world systems*. Those systems bring about evolution and nestedness as emergent features of reality. The world is pictured according to a *multi-stage model of evolutionary systems*- see (Fig-5).

Fig-5 Multi-stage model of evolutionary systems



- *Systems* evolve during a phase n. Spontaneously, at a certain point in time, *a leap in complexity emerges* and one possibility out of the space of possibilities that are rooted in the reality of the systems during the phase n (which form the necessary condition for the transition to phase n + 1) is realized such that *new organizational relations emerge*. Those organizational relations realize a higher order in that they nest the old systems n as elements n + 1 of the new systems n + 1 during the phase n + 1. Thus they form another level n + 1 above the level n that is being *re-ontologized*, *reworked*, *reshaped*. Emergence of new systems in the course of evolution (*differentiation*) entails dominance of higher levels through the reconfiguration of what is taken over from the old (*integration*).

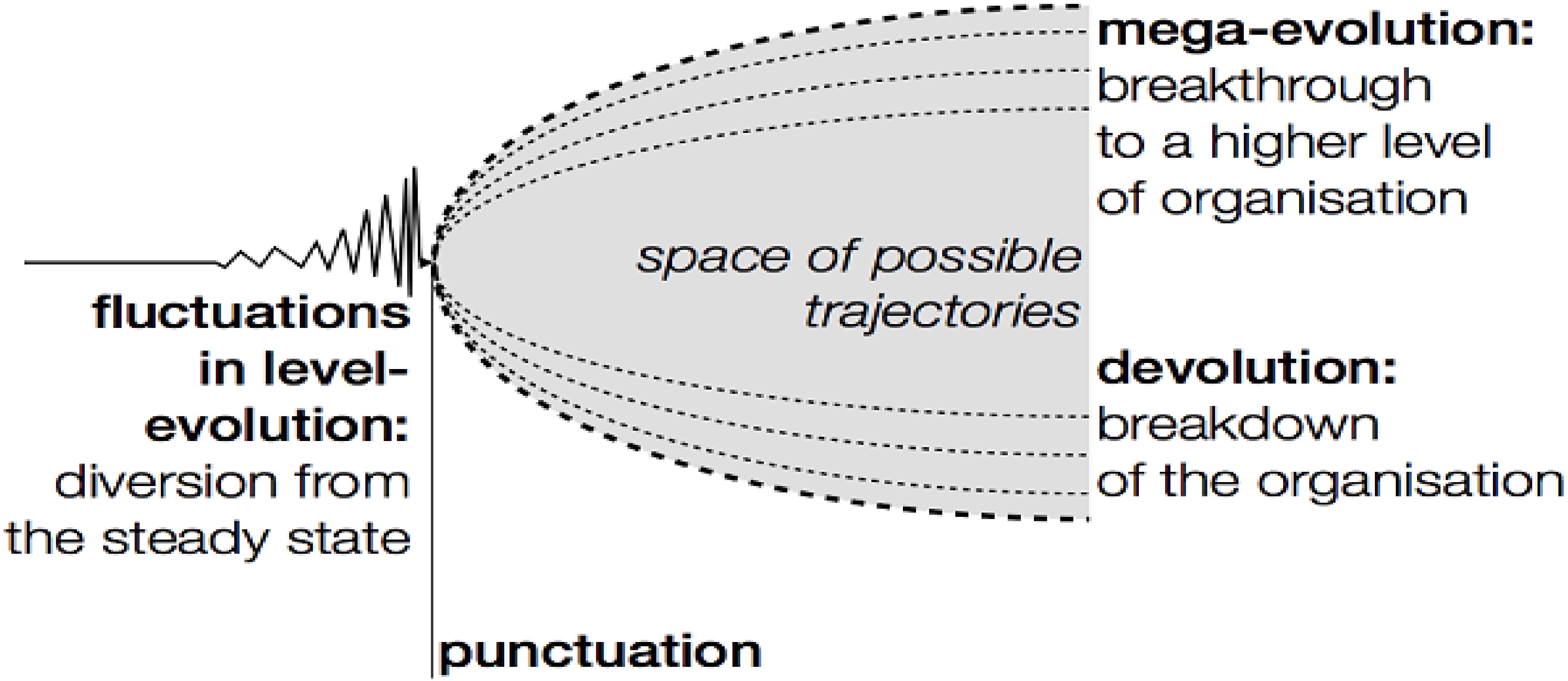
- *Emergentism* is an important ingredient of systems theories. It helps understand events and entities that function as less than strict deterministically. *Transdisciplinarity* must take into consideration *less-than-strict determinism*, which means that the mechanisms of the real world are not machine-like. *Emergentism* provides an ontological superstructure for *epistemological integrationism*. *Integrationism can integrate because evolution lets new features emerge*.

3. A New, Systemic World View: *Synergism*

- Acting in the face of complex problems is based on *praxiological* assumptions about the interference with *self-organizing systems*. Known mechanisms can be furthered or dampened according to what the goal shall be.

- In the course of evolution, systems move on *trajectories* on which *bifurcations occur*. Bifurcations come up with a variety of possible future trajectories. Systems might not be in the position to avert *devolution* (a path that leads to the breakdown of the system) or they might be able to achieve a *leap* from the previous level of evolution on which they could enjoy a steady state onto a higher level which forms part of a *successful mega-evolution* (a breakthrough to a path that transforms the system)- (Fig. 6).

Fig-6 Bifurcations in systems evolution



- *Self-organizing systems* have as raison d’etre the provision and production of *synergetic* effects. If the organizational relations are not able any more to provide and help the *elements produce synergy*, the system will break down. Hindrances of letting synergy emerge are called *frictions*. Any social system is a social system by virtue of organizational relations of production and provision of *the common good*, that is, *the commons* are the social manifestation of *synergy*. Hindrances of the commons supply are frictions that are *systemic dysfunctions* due to the *suboptimal organization of the synergetic effects*. *Any meaningful technology is oriented towards the alleviation of frictions and the advancement of synergy.*

- Thus *systems technologies* can help orient *transdisciplinarity*. *Meaningful technology* is technology endowed with meaning by:
  - **(1)** the participation of those affected in an integrated technology assessment and design process (that is, design builds upon assessment);
  - **(2)** the reflection of the expected and actual usage of technology: the assessment and design criterion is social usefulness, that is, the reflection of both;
    - **(a)** the purpose itself (the function technology serves; orientational knowledge: know why and what for).
    - **(b)** the adequacy to the purpose (utility; operational knowledge: know-how).

- The purpose is advancing the *commons*. *Synergism*, the orientation towards synergy for every real-world system and towards the human value of the commons in the case of social systems—which is a world-view because it is value-laden—is the praxiological superstructure for *emergentism*. *Synergy emerges*, *emergence brings about synergy*.

Conclusion

- *Systemic transdisciplinarity* has the power to transform the disciplines because:

  (a) it aims—by a systems world-view—at providing *scientific knowledge* for *solving problems of frictions* in the functioning of *real-world systems*, in particular in processes of the *provision and production of the commons* in social systems through *meaningful systems technologies*;

  (b) it has as its scope the *functioning of emergent real-world systems in the interconnectedness of their evolution and their nestedness*, the scientific knowledge of which is a *theoretical systems world picture* needed for alleviating frictions;

  (c) it uses tools that generate scientific knowledge through a systems way of thinking by the method of equilibrating integration and differentiation for a proper understanding of how complexity grows.

تم بحمد الله