Being and Systemacy

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Igor Furgel
(office@furgel.com)

Current thoughts consider being as one of the property of systemacy.
Having introduced the 'assembling' operation ('making sth. to a system'), we could show that the complementarity principle (by N. Bohr [1]) results from the existence and applicability of this operation; furthermore, categorially complementary terms (e.g. {being, nonbeing}, {structure, function}) generated by application of this operation relate to the resulting system as a whole, but not to its single parts.
Further considerations have shown that
- existing objects/processes can only be systems and nothing else;
- basically, 'the very elementary bricks' of nature, i.e. those, which could not be represented as an ensemble of other entities do not exist.
Moreover, it has succeeded in closing the question, whether complementarity is immanent in objects themselves or a property of the consciousness of contemplator, namely: this question is principally undecidable.
In the second chapter, we also discuss the notions of being, nonbeing, infinity and time. It is shown that being, time and finiteness are tightly linked to each other.

Compared to the first edition, the current edition is supplemented by chapter "Being and 'Existential Triads'" and by Annex.
In the chapter "Being and 'Existential Triads'", we consider necessary and sufficient conditions for the existence of a system. There, we define the term 'existential triad' and showed that the presence of the 'existential triad' being reducible to the set {substrate, property, relation} represent such a necessary and sufficient condition of the related system. Besides this, we introduce the term 'relation-control-information' and analyse its connection with the Principle of Least Resources Consumption as well as discuss the general notion of 'resource of a system'.
In the Annex, we discuss an important concomitant topic of the conjunction of systems in a system hierarchy.

Current thoughts may attract attention of an audience who is interested in philosophical topics in general and in the complementarity principle and the system approach in particular.

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1 Rationale for the complementarity principle

1.1 Definitions

Def. 1:
Let there exist a confined population (set) of terms comprising more than one term. Terms out of the population are called *categorially complementary* to each other if:

1) These terms can exist exclusively jointly, in concert, i.e. the existence of a term necessarily causes the existence of all other terms of the population, and
2) A term out of the population cannot be defined by using any subset of other terms of the population.

Def. 2:
Let there exist a confined population (set) of properties comprising more than one property. Properties out of the population are called *attributive opposites* if each item of the population represents merely a specific extreme value of one and the same attribute, and, hence, can be defined by using another item of the population.

Distinguishing between *attributive opposites* (e.g. {high, low}) and *categorial complementarities* (e.g. {form, content}), let it be said that attributive opposites are basically not categorial complementarities because each item of an attributive pair can be defined by using another member of the pair. For example, the attribute 'size' can take extreme values {big, small}; these values can be expressed by each other.
Attributive opposites always describe properties/qualities, i.e. values of an attribute, but never – terms. Thereby, changing the value of this attribute at the transition from one to another extreme occurs without 'jumps', i.e. without a change of symmetry degree (without 'second-order phase transitions'). Attributive opposites often imply the presence of an etalon, i.e. a 'norm', what the estimation of the value of the respective attribute relates to (e.g. {expensive, cheap}, {good, evil}).
Attributive opposites almost always are reflected in language by antonymous pairs, whereas categorial complementarities are by no means always representable by them.

1.2 Philosophy and Algebra: Assembling Operation

The properties of categorial complementarities in **Def. 1** have induced a working hypothesis about a possible parallel between categorial complementarities and certain algebraic structures, namely – linear symmetric operators.

Linear symmetric operators:

1) possess only real eigenvalues,
2) their eigenvectors related to different eigenvalues are orthogonal to each other (i.e. they are linearly independent and, hence, cannot be mutually defined).

Thus, a linear symmetric operator induces a basis (i.e. a population) of linearly independent (i.e. not mutually definable using each other) eigenvectors.

This property of linear symmetric operators exactly coincides with the properties of categorial complementarities in **Def. 1**.

If this parallel is a substantial one, the following question arises: ‘Is there a ‘philosophic’ analogy to the linear symmetric operator? Or in other words, does an operation (or operations) exist inducing single pairs (or greater sets, e.g. triples) of categorial complementarities?’

If such an operation does exist, then, in analogy to a linear symmetric operator,

1) it shall induce a set of categorial complementarities, and
2) its application to each single term out of this set shall not change this term, i.e. shall retain it.

A first attempt to answer this question is to introduce the operation of ‘assembling’ of something, i.e. ‘making sth. to a system’, ‘organising single items into a system’.

The term *system* is defined according to Uemov (see chap. 5 and [2], chap. 4, § 1):

Def. 3:
A *system* (ensemble - IF) is any given entity, at which a relationship, possessing an arbitrarily taken certain property, is implemented.
Or equivalent:
A *system* (ensemble) is any given entity, at which some properties, being in an arbitrarily taken certain relationship, are implemented.

Let us define now the *assembling* operation:

Def. 4:
The *assembling* operation with regard to an entity is that this entity is considered not disconnectedly, but as part of a system (ensemble) with a suitable ‘system-constituting concept’[1].

Note that a system according to **Def. 3** is always self-consistent, i.e. properties (attributes) and relationships implemented in the system correspond to each other.

There is also an inverse operation *disassembling*, such that a sequential application of the operations *assembling* and *disassembling* to the respective entity retains this entity invariable: ‘*assembling*’ * ’*disassembling*’ = ‘*identity*’.

Def. 5:
The *disassembling* operation with regard to a system (ensemble) with a given system-constituting concept is that one distinguishes isolated entities in this system, which possess the properties (attributes) and are able to enter into relations corresponding to the constituting concept of this system.

[1] the original term by Uemov in Russian: ‚системообразующий концепт’

Note that entities themselves can also be systems.

Returning to algebra and linear symmetric operators, let us remark that if an operator **A** is invertible, then all its eigenvalues are non-zero, $\lambda_i \neq 0$; thereby, the eigenvalues of the inverted operator $\mathbf{A}^{-1}$ are numbers $(\lambda_i)^{-1}$, and the corresponding eigenvectors both of the operators are identic.

Since eigenvectors both of such operators are identic, the *disassembling* operation, similarly to inverted operator,

1) shall retain the entire set of the categorial complementarities being inherent to the initial system, and
2) its application to each single term out of this set shall not change this term, i.e. shall retain it.

1.3 Assembling Operation and Complementarity Principle

Let us consider now the pair {properties, relations} as an example. It is really generated by the assembling operation applied to any entity: whatever is included in a system shows within the latter certain properties and enters into the corresponding relationships with other elements of the system.
A dedicated application of the assembling operation to the term 'property' does not change this term: it does not become a 'relation' and, moreover, does not bear any characteristics of 'relations'. This is due to the fact that a system is always already self-consistent, i.e. all the relations necessary for this system exist already and the system does not need any additional 'relations' because they would be superfluous.
A similar reasoning is also valid concerning the application of assembling operation to the term 'relation'.

Thus, the assembling operation (= 'making sth. to a system') generates the pair of categorial complementarities {properties, relations}, and its application to each of these terms retains them.

This pair of categorial complementarities obviously relates to the system, which has evolved as a result of the 'assembling', as a whole, but not to each single entity of the system.

Considering other categorial complementarity {cause, effect} similarly, we come to a conclusion that the assembling operation generates also this pair if one means here by system a process unifying cause <-> effect. Also, this pair of categorial complementarities relates to the system, which has evolved as a result 'assembling' (i.e. to the process as a whole), but not to each single entity of the system.

It is interesting to consider the relationship of the assembling operation to the pair {matter, information}[2]: here, this operation – applicable to an entity – means that the entity is considered as an element of Nature, i.e. the system is the entire Nature in this context. Matter shapes itself according to the related information, and the existence of this information is only

[2] Aristotle understood matter as the opposite to form

perceptible due to the matter possesses a shape, i.e. it is inhomogeneous, asymmetric. That is, matter and information become observable, see [7], sec. 2.4.
This means that the assembling operation, if applied to the elements of nature, is equivalent with the operation 'making observable', 'making existent', see also sec. 2 below. The pair {matter, information} generated by ,making observable' relates to nature as a whole[3].

STM. 1:
In this regard, **the complementarity principle is a result of the existence of the *assembling operation* and its applicability to different entities. Categorial complementarities being generated by this operation relate to the resulting system as a whole, but not to the single entities constituting the system.**

Since the pair {being, nonbeing} represents categorial complementarities, and since the latter always relate to a system as a whole, the pair {being, nonbeing} also relates to any system as a whole, but not to its single elements.

STM. 2:
Thus, **if it is possible to claim the mere existence (= being) of an object/process, then this object/process can only be a system**. That is, **existing objects/processes can only be a system, but nothing else**.

It can directly be inferred from this knowledge, among others, that there cannot be non-disassemblable, 'elementary' entities. A non-disassemblable entity does not represent any system (else, one could disassemble it) and, hence, it is impossible to ascribe to it any categorial complementarities including {being, nonbeing}[4].

One of the practical consequences of this inference is that **there are no the 'very elementary bricks' of nature, i.e. those, which cannot be represented as an ensemble of other entities** (in other words, which cannot be disassembled anymore).
In this sense, the search for 'the very elementary particle' seems to be without prospects: it just cannot exist.

1.4 Complementarity: the Property of Object or Observer?

The assembling operation can be applied an unlimited number of times. I.e., it is being applied to any entities the first time. As the result of this application, the system of first order arises. Then the assembling operation is being applied to these systems of first order representing now entities for the assembling operator. As a result, the system of second order arises, and so on.

According to **Def. 4** and **Def. 5**, a multiple application of the assembling or disassembling operation to an arbitrary term out of a population of categorial complementarities does not change this term, as such a term is an eigenvalue of these operations.

[3] assembling operation has here statically-dynamic character, as the system (= nature as a whole) in this case encompasses objects and processes, as well
[4] Categorial complementarities in themselves represent a special case: concerning a pair from among them, it is impossible to ascribe to it other categorial complementarities.

In this regard, categorial complementarities as notions could have aspired to the role of 'elementary entities' if the latter had existed. As often as the assembling or disassembling operations are being applied to them, it does not change categorial complementarities.
In contrast to this, any other than categorial complementarities entities[5] definitely change by the application of assembling or disassembling operations, as such entities are not the eigenvalues of these operators, see detailed examples in sec. 4.1.

Is it possible to take an entity in and of itself, separately, i.e. is it feasible to isolate an entity[6]?
We proceed from the assumption that entities exist and are observable. The operation 'observation' necessarily presumes an interaction between the observer (actual, participant) and the observable (here: entity). An interaction, in turn, necessarily presumes including the object of observation in an observation system. Thus, the fact of observation itself makes the observation object – in our case assumed 'isolated entity' – part of the system with the system-constituting concept 'observation'. Please note that the system-constituting concept 'observation' exists even then, when there are no other system-constituting concepts, as the system-constituting concept 'observation' is immanent, by definition, in any observable entity.
That is, the observation operation itself assembles any observation object (including any observable entity) in a system, and, thus, enables ascribing categorial complementarities to the system.

Therefore, **any observation process – as an observation system – can be described by categorial complementarities**, for example, in terms of form and content, cause and effect, purpose and means, and several other dependent on the concrete observation situation (system), cf. sec. 4.2.
For example, for the literary analysis of a text (= observation process), a literary critic may use terms form and content, structure and function, purpose and means, rationality and emotionality and other.

STM. 3:
Since categorial complementarities relate to the arisen system as a whole, it is **principally impossible** to discern, whether the pair of categorial complementarities being perceived by observer is an **attribute of the observable or an attribute of the observer**, as the latter represent merely single entities of the observation system.

If the observer is, in particular, a human being, this inference is commensurate with the existential *Dasein* by Heidegger: the human being (Dasein) is such a specific being, for whom in its being it deals with the very being itself, i.e. understanding of being is itself a determination of being of human being. That is, the human being as Dasein perceives all the existing about itself being part of it[7].

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[5] which can only be systems, see chap. 1.3
[6] In the sense Ding an sich (thing in itself) of Kant, см. [3], I. Transzendentale Elementarlehre, Erster Teil, Transzendentale Ästhetik, Zweiter Abschnitt, Von der Zeit, § 8, Allgemeine Anmerkungen zur transzendentalen Ästhetik
[7] see [4], § 4: „Das Dasein ist ein Seiendes, das nicht nur unter anderem Seienden vorkommt. Es ist vielmehr dadurch ontisch ausgezeichnet, daß es diesem Seienden in seinem Sein *um* dieses Sein selbst geht. ... *Seinsverständnis ist selbst eine Seinsbestimmtheit des Daseins.“*

STM. 4:
That is, **the long-standing question, whether complementarity is immanent in objects themselves or it is attributed to the process of cognition by observer, is closed, namely in such a way that this question is basically undecidable**.

2 Being, Nonbeing, Infinity and Time

As already mentioned in chap. 1.3 and being discussed in more detail in [7], sec. 2.4, *being* and *nonbeing* are obviously connected with *symmetry/asymmetry*. Being of material objects is observable, only if they possess at least one asymmetry, as absolutely symmetric objects cannot react to any action.
In order to react to an action, i.e. in order to somehow modify a material object by the interaction, this object must be asymmetric with respect to this action. If an object is absolutely symmetric, no action can change it, hence, also no interaction is possible with such an object.

The interaction process between material objects and information has a direct affinity to asymmetry:

– presence of asymmetry is information, i.e. asymmetry is to equate with in*formation*,
– being of material objects is observable, if and only if they possess at least one asymmetry.

Thus, in*formation* provides matter with a *form* of its existence and matter gives information a *content* of its existence.

Is it possible to define the notions of *being* and *nonbeing* on a less abstract level than their relation to symmetry and asymmetry?
Yes, it is possible based on the ideas set forth in [7]. Here, we merely briefly regive the corresponding results.

In each moment, nature is in a 'state'[8]. These microstates can be indeterministic (probabilistic) and deterministic, cf. sec. 4.2, table C) above; a detailed statement is given in sec. 2.1.3, [7].
Only probabilistic microstates are principally *observable* and *differ from each other* ([7], ibid). These 'microstates' of nature are being assembled in its 'macrostates', see sec. 1.4 in [7], and, thus, can constitute objects.

Def. 6: Objects ‚assembled' from *observable* microstates of nature are *existent*; they are in the state of *being*.

In order to give a definition for the term 'time' (the flow of time) let us regard again to the following chain: existence of information causes asymmetry, and asymmetry is a necessary condition for the observability of states. If these states had been indiscernible from each other, they would have been observed as one and the same static, constant state.
Therefore, it is just the next logical step to define the term 'flow of time' as the discernibility of observable states.

Def. 7: The discernibility of the microstates of nature from each other is the flow of time (i.e. time itself), see sec. 1.3 in [7].

[8] termed ‚microstate of nature' in [7]

Thus, exactly *observable* microstates of nature represent a necessary condition of the existence of time.

Deterministic, equally as impossible[9] microstates of nature are basically *non-observable*, see sec. 2.1.3 in [7]. Due to their unobservability, it is impossible to judge, whether states of such a type are deterministic 'in fact' or impossible. Therefore, these both types of states – deterministic and impossible – just concur with each other: they are basically indistinguishable.

Def. 8: Objects ‚assembled' from *non-observable* microstates of nature are in the state of *nonbeing*.

STM. 5:
The term 'time' is not applicable to non-observable states as they are indiscernible from each other.

It is interesting to remark that A. Schopenhauer came to the conclusion about the impossibility of the existence of the different types of *nonbeing*, at least of human nonbeing. He writes: 'After your death you will be what you were before your birth'[10], [6], § 135. Schopenhauer reasons this thought by assuming the contrary: if there had been a form of being after death, then this form would have been another than while being alive; i.e. then there would have been two different types of the being of man. Simultaneously, it would have assumed the existence of two different forms of nonbeing, from the point of view of a living man: before birth and after death. But, if one presumes the existence of only one form of being for a man – its life, then there cannot be two different forms of nonbeing.

Def. 8 enables only one single form of *nonbeing*, as objects assembled from *non-observable* microstates of nature are principally indistinguishable from each other because they are generally indistinguishable due to their non-observability.

Now, we turn to the question about the connection between finiteness/infinity and being/nonbeing, to be more precise – between the infinite extent of a system and the possibility of its existence.

In a material confined (finite) system being in a thermodynamic disequilibrium, the entropy is produced in its entire volume and transported to the outside through its surface.
Let us notice that the relation volume/surface area is increasing unlimitedly towards infinity if the system extent is growing unlimitedly.

Let us assume that a system of the infinite extent is in a state of thermodynamic disequilibrium. This would lead to an inevitable growth of its entropy, as the production of latter would be bigger than it could be conveyed to the 'outside' of the system. Hence, sooner or later, the entropy would take its maximally possible value for this system. This, in turn, would mean that the system would be in the state of thermodynamic equilibrium. However, this contradicts the initial assumption.

[9] creating an ‚impossible' microstate would have required infinitely much resources; impossible states can also be considered as deterministic, as they definitely cannot occur.
[10] „Nach deinem Tode wirst du sein was du vor deiner Geburt warst"

From this it follows that a system of the infinite extent
- either cannot exist at all
- or can be exclusively in the thermodynamic equilibrium, i.e. possess the maximally possible entropy value.

What can be said about the *observability* of a system of the infinite extent?

Let us assume the existence of a system of the infinite extent. Then, it must possess the maximally possible entropy value.
A system can react to a communication attempt with it from ‘outside’, only if this communication signal elicits a disturbance inside the system. Any such disturbance would mean a thermodynamic disequilibrium of the system, what is impossible in a system of the infinite extent (its entropy possesses already the maximally possible value). Therefore, any communication attempt with such a system has to go unanswered by the system, cf. [7], sec. 2.2.1.
It means that a system of the infinite extent, even if it existed, would be basically *non-observable*.

STM. 6:
A logically equivalent statement is that **observable**[11] **systems must have a finite extent**.

Since our Universe is observable, it is definitely of a finite extent.

The systems of the infinite extent are either basically non-observable, if they existed, or they do not exist at all, what again leads to their non-observability. Due to their principal non-observability, it is impossible to judge, whether the systems of the infinite extent do not exist ‘in fact’ or they do exist, but are non-observable. Hence, these two options just concur: they are principally indistinguishable.

There is an absolutely similar situation concerning the *observability* and *existence* of the states of nature, see above in this section and in [7], sec. 2.1.3: the observable states of nature cannot be deterministic; they must be indeterministic (probabilistic).

In this respect, the property of a system ‘to possess a finite extent’ has the same meaning as the property of a state of nature ‘to be indeterministic’.
It is currently difficult to say, whether these properties are unreservedly equivalent to each other, though there is every indication for this.

In distinction from the pair <‘to possess a finite extent’|‘to be indeterministic’>, it is possible to make a certain statement about the equivalence of the pair <‘to possess an infinite extent’|‘to be deterministic’>:
These both properties – infinite extent of a system and determinism of a state of nature – signify the *non-observability* of such systems and states, and, hence, their *nonbeing*. In this regard, these properties are strictly equivalent to each other.

[11] observability is a necessary condition of being/existence, see **Def. 6** above.

3 Being and 'Existential Triads'

Let us consider now the pair of categorial complementarities {state, process}. As already mentioned in chap. 2, the term 'process' can - in turn - be expressed by another pair of categorial complementarities – {information, matter}. In this manner, the categorial complementarities in the triad { state, process } ≡ {{information, matter}, interaction process between them} represent a set of the eigenvectors of the assembling operator, s. sec. 1.2.
The tuple {{information, matter}, interaction process between them} is the equivalent of the observability of states, cf. [7], sec. 2.4, and the observability of states is the equivalent of being, s. chap. 2 above. From this we infer that

STM. 7:

The tuple {{information, matter}, interaction process between them} **is** being.

Now let us consider the question about the necessity and sufficiency of these three elements for the state 'being'. As already discussed in chap. 2, the elements

- information,
- matter,
- the interaction process between them

are necessary for the creation of the observable microstates of nature and, thus, for the creation of objects in the state 'being'.

These three elements taken together are also sufficient for the creation of the observable microstates of nature and, thus, for the creation of objects in the state 'being', but only if the interaction process between information and matter

- has fundamentally *stochastic*[12] character (s. [7], sec. 2.1.3 and sec. 4.2, C)) and
- *statistically* obeys a certain law, namely the Principle of Least Resources Consumption[13], s. [7], sec. 2.1.5 and 2.3.2.

The evolution of nature follows this character of the interaction process between information and matter, which represents the *'interaction-control-information', or, synonymously, the 'relation-control-information'.*

Generalising, we can state the necessity of a triad of categorially complementary elements for achieving observable states and by this, for the creation of objects in the state ‚being'[14]. For this reason, we call these triads 'existential'.
The first element of the existential triad shall be a medium[15] (*substrate*, matter). Medium supplies / provides multiplicity of opportunities. Theoretically, medium can be even in the

[12] *probabilistic, indeterministic*
[13] the principle of most entropy, the principle of least action
[14] in Hegel's terminology, it would be a tetrad: three mutually-complementary theses and synthesis
[15] ru.: среда

absolutely homogeneous, absolutely symmetric state with unlimited multiplicity of opportunities: it is unobservable then.
The second element of the existential triad shall be a disturbance (information). This disturbance has, per definitionem, an asymmetry with respect to at least one of possible characteristics, i.e. this disturbance represents a *property*.
The third element of the existential triad shall be the interaction process between the substrate and the disturbance, i.e. shall represent a *relation*. As the result of this interaction, the substrate loses its homogeneousness, its symmetry, namely exactly according to the disturbance (*property*).
In other words, amongst all the existing opportunities potentially can be provided by the substrate, only the opportunity that corresponds to the interaction between the substrate and the disturbance becomes the reality on the substrate. In this way, the system arose on the base of this existential triad becomes observable and, hence, is in the state of 'being'.

STM. 8:

Thus, **the existential triad {substrate, property, relation}**[16] **is necessary for the creation of the state 'being' of the system based on this existential triad**.

The same triad always creates a system with the respective system-constituting concept, cf. [2].

STM. 9:
If 'relation' in an existential triad has fundamentally *stochastic*[17] character **and** *statistically* obeys a certain law (cf. [7], sec. 2.1.3, 2.1.5 and sec.4.2, C) beneath), then this triad is not only necessary, but also sufficient for the achievement of observability and, thus, for the creation of the state 'being' of the system based on this existential triad. The evolution of this system will follow the character of the 'relation' in the existential triad.

STM. 9 represents a ‚principle', i.e. an abstract rule, in this particular case – the relation-control-information[18]. This 'principle of sufficiency of the existential triad for the creation of the state 'being' of a system' – the relation-control-information – represents *the property of relation*, i.e. the *relation* as it is in the frame of the primary system, based on the given existential triad, simultaneously is the *substrate* of other system, namely of 'the system of sufficiency of the existential triad for the creation of the state 'being' of the primary system'.

In this other metasystem,
- the *substrate of the metasystem* is 'the *relation* in the frame of the primary system, based on the given existential triad',
- the *property of the metasystem* is the relation-control-information, concretely – 'the principle of sufficiency of the existential triad for the creation of the state 'being' of the primary system', i.e. **STM. 9**,
- the *relation of the metasystem* is interaction between the *substrate of the metasystem* and the *property of the metasystem* (i.e. between the 'principle of sufficiency' and the 'relation/interaction' in the frame of the primary system), and
- the *system-constituting concept* of the metasystem is 'sufficiency of the given existential triad for the creation of the state 'being' of the primary system, based on this existential triad'.

[16] the dyad {property, relation} has different names: A. Uemov [2] calls it 'structural factor', N. Luhmann [8] – 'form'.
[17] *probabilistic, indeterministic*
[18] synonymously: interaction-control-information

Further particular properties of **STM. 9** as specific relation-control-information are discussed in sec. 4.1, 4) ‘conjunction of systems‘.

Generalizing, one can state that any ‘rules’ / ‘principles’, regulating the character of *relations* (of interaction) between *substrate* and *structural factor*, always represent a relation-control-information. In this context, the *substrate* of any ‘principle’ is always a *relation* (interaction) as a sub-aspect of the structural factor of the system that meets this ‘principle’, and the *structural factor* of any ‘principle’ is always the character / properties of the *relation* in the frame of this system. The *system-constituting concept* of any ‘principle’ is always ‘sufficiency of the given existential triad for the creation of the state ‘being’ / ‘observability’ of the system, based on this existential triad’.

As for any pair {substrate, structural factor}, the following relationship is valid: existence of substrate (here: of interaction) enables the structural factor (here: interaction-control-information) to become apparent, and existence of structural factor (here: interaction-control-information) makes the substrate (here: interaction) inhomogeneous and, hence, observable.
By the example of physics: existence of physical fields (i.e. of the curvature of space) enables the Principle of Least Action (PLA) to become apparent, and PLA makes physical fields (i.e. the curvature of space) observable.

The analysis of the character of the interaction between substrate and structural factor in the systems of different types – physical, social, linguistic, see in this chapter below and in sec. 4.1 ‘Conjunction of Systems in a System Hierarchy’ – brought us to a reasonable assumption that

STM. 10:

The Principle of Least Resources Consumption is relation-control-information and regulates not only the process of interaction between matter and information in the Nature[19], but also between the *substrate* and the *structural factor* of **any** system – physical, social, communicative, etc. – based on a *stochastic* process.

What does the term ‘resource’ mean in this context? The ‘resource’ of a system is its internal capacity / the ability of the system to change its state or, equivalently, it is ‘the residual information value’ of the current state of the system[20]. The more decisions a system can make at a transition into its other state, the higher the ‘residual information value’ of the system is. The amount of such decisions is product of ‘the number of steps on the way into other state’ into ‘the number of alternative decisions/opportunities at each such step’.

Thus, the ‘resource’ of a system can abstractly be represented as the product of two categorially complementary terms:

‘resource’ = ‘action’ * ‘choice’,

see details in [7], sec. 2.3.2.

[19] as the principle of most entropy ⇔ the principle of least action, see. [7], sec. 2.1.5 и 2.3.2
[20] ‘the residual information value’ of the current state of the system is the difference between the maximal possible entropy value of the system and its current value, see details in [7], sec. 2.2.1

A concrete implementation of 'steps on the way into other state' and of 'alternative decisions/opportunities at each such step', i.e. a concrete implementation of 'action' and 'choice' is individual in each system and shall be determined for each system separately.
For example, the 'resource' of physical systems is the number of action quants needed for the transition of a system in other given macroscopic state[21]; the 'resource' for communication (including the communicative function of language) is the number of single positions in a message (text) * the number of different characters (e.g. letters and punctuation marks) needed for conveying given content; the 'resource' for educative – in fact, for any social process is the number of particular topics * the number of alternative (didactical) methods needed to be considered and applied, respectively, for the achievement of given (educational) objective.

For systems based on a *stochastic* process, the fulfilment of the Principle of Least Resource Consumption automatically ensures 'sufficiency of the given existential triad for the creation of the state 'being' / 'observability' of the system, based on this existential triad'. In such systems, their stochastiveness on one side and the fulfilment of the (statistic by its nature) Principle of Least Resource Consumption on the other side always ensure an adequate balance between 'freedom of choice' and 'freedom of action' for the *substrate* of these systems and, in such a way, their stability.

For other type of systems based not on a stochastic process, but on the execution of the 'free will' (of the freedom of choice) of their substrate[22], a fulfilment of the Principle of Least Resource Consumption **would** also ensure an adequate balance between 'freedom of choice' and 'freedom of action' for the *substrate* of these systems and, in such a way, their stability.
But, such *non-stochastic* systems do not possess an automatic, immanent to these systems mechanism of following the Principle of Least Resource Consumption. This absence often leads to an inadequate interaction between the *substrate* and the *structural factor* of such systems and, therefore, to decreasing their effectiveness compared with ideally possible one (if to follow the Principle of Least Resource Consumption).

The evolution of stochastic as well as non-stochastic systems follows the character of the interaction process between their substrate and structural factor, i.e. follows 'the principle of sufficiency', i.e. relation-control-information.

Let us illustrate these results by the following examples:

a) physics

Let us consider macroscopic matter in any aggregate state (gas, liquid, solid state) as a system. For this system, 'substrate' is represented by molecules, 'property' – by the concrete laws of intermolecular interaction, and 'relation' – by the process of the application of these laws to particular molecules, i.e. the interaction process itself between the molecules, cf. sec. 4.1.
The microscopic movement (the kinetic behaviour) of particular molecules is fundamentally *stochastic* (probabilistic). Simultaneously, the movement of a statistically big number of molecules (ensemble) as well as the movement of particular molecules in statistically big

[21] i.e. physical quantity 'action' ($kg \cdot m^2 \cdot s^{-1}$) / h (Planck constant – the value of the action quant)
[22] the substrate of such systems (sociums) is biological systems: the latter represent macroscopic systems that make their decisions in indeterministic way

periods obey certain regularities / laws, for example the ideal gas equation, the Van-der-Waals equation (for gases) or Navier-Stokes equation (for liquids) and so on, i.e. **STM. 9** (‘the principle of sufficiency of the existential triad’) is met.
The universal physical principle, regulating any – already known and still undiscovered – physical interactions, is the Principle of Least Action (the Hamilton’s Principle). The Principle of Least Action (PLA) always meets ‘the principle of sufficiency of the existential triad’, i.e. **STM. 9**, and represents the interaction-control-information for physical systems. As the interaction-control-information for the interaction between matter and information, PLA determines the character of this interaction, see **STM. 9**. For example, PLA determines the character of (bosonic) fields, which, in turn, implement the interaction between (fermionic) substance.

b) education

We consider now education system. For this system, ‚substrate‘ is attributed to pupils (their minds), ‘property’ is teaching stuff, and ‘relation’ is represented by the process of interaction of this stuff with pupils’ minds, i.e. the teaching process itself. This process includes – along with the ‘primary’ teaching – pupils’ reaction on the teaching as well as the observation of the pupils’ reaction by teacher, and the teacher’s reaction on the pupils’ reaction, as well.
Since there are no two absolutely identical psyches and minds among pupils (psyche is not copiable), the process of interaction of teaching stuff with the minds of particular pupils is fundamentally *probabilistic*. However, a *statistically* big number of pupils, as a rule, digests the teaching stuff within (statistically) certain timespan, i.e. **STM. 9** (‘the principle of sufficiency of the existential triad’) is met.

c) linguistics

For the illustration of our results at the example of linguistics, let us consider a sufficiently big text, i.e. a text containing statistically big number of signs. *Text* represents a system aiming fixation and perception of rational and/or emotional content. The final ‘substrate’ in this system is phonemes (signs), the ‘property’ – the totality of phonetic, word-building, syntactic and grammatical rules, and the ‘relation’ – the process of application of these rules on the respective language levels (phonetic, morphologic, lexical, syntactic, semantic), i.e. the speaking process itself, cf. sec. 4.1.
The language means for the creation of a *text* are developed to such extent that they can fix and percept practically unlimited variety of contents in the frame of the *area of mutual understanding*, see [9], chap. 3. Thus, possible content of *texts* in this frame is also unlimited and unpredictable. Thus, the order of phonemes (signs) representing *texts* is also fundamentally *probabilistic*.
On the other side, the order of phonemes in any *text* represents regular Markov chains and, hence, *statistically* obeys the respective laws as A. Markov convincing demonstrated by the example of the first 20.000 signs of the poem ‘Eugene Onegin’, see [10]. Thus, **STM. 9** (‘the principle of sufficiency of the existential triad’) is met also here.

4 Annexes

4.1 Conjunction of Systems in a System Hierarchy

Now, we consider a hierarchy of systems. i.e. a system built up on other systems. We call the systems in this system hierarchy as systems of different hierarchical orders. Per definitionem, the existence of all the systems of lower orders N-1, N-2, ..., N-N is the necessary (but not sufficient) condition of the existence of the system of order N.

Let us consider some illustrative examples of such hierarchic systems moving from the systems of lower to the systems of higher hierarchic order:

1) physics

quarks <-> elementary particles <-> atoms <-> molecules <-> matter.

2) sociology

external (in relation to living organism) physical information carriers (acoustics, optics, etc.) <-> biochemical processes in neurons <-> consciousness[23] <-> communication (society).

3) linguistics

phoneme (sign) <-> morpheme <-> lexeme (word) <-> sentence <-> text.

The general statement is

STM. 11:
The ‚system-constituting concept‘[24] of a system of given hierarchical order N shall represent either the ‘substrate’ or the ‘structural factor’ of the system of the next higher hierarchical order N+1.

Rationale:

1) Let us assume that the system-constituting concept of the system of order N does not participate at all in building the system of order N+1. Then it is impossible to state that the system of order N+1 is ‘built up’ on the system of order N. That, in fact the availability of the system of order N is the necessary condition of the existence of the system of order N+1.
The system of order N differs from all other systems exactly by its ‘system-constituting concept’. Hence, the ‘system-constituting concept’ of the system of order N – as its *unique* differentia – has to participate in building the system of order N+1.

[23] communicative sub-process of consciousness; it includes:
(i) attitude: external or internal priority (authority) at decision making,
(ii) perception: intuitive understanding and sensory skill, including pre- and post-semantic processing of information: deformatting the received message and formatting an answer,
(iii) judgement (semantic processing of information): feeling and thinking, and
(iv) reacting: active or passive.
[24] see chap. 5 for definitions

2) Let us now assume that the ‘system-constituting concepts’ of the system of order N and of the system of order N+1 – their *unique* differentia - are identical with each other. Then, these systems could not be distinguished from each other and, hence, they would represent one single system, what contradicts the initial premise.

But if

(i) the ‘system-constituting concept’ of the system of order N has to participate in building the system of order N+1 and
(ii) the ‘system-constituting concept’ of the system of order N+1 has to differ from the ‘system-constituting concept’ of the system of order N,

then the ‘system-constituting concept’ of the system of order N has to participate in building the system of order N+1 either as the ‘substrate’ or as the ‘structural factor’ of the system of order N+1, what fully complies with the initial statement.

We wonder if a situation were possible, where the ‘system-constituting concept’ of the system of order N would participate in building the system of order N+1 simultaneously as its ‘substrate’ and as its ‘structural factor’, as well?
Let us assume that such a situation has become reality. Then, the ‘substrate’ as well as the ‘structural factor’ of the system of order N+1 would be identical with each other, because they would be built on one and the same ‘system-constituting concept’ of the system of order N. But the identity of the ‘substrate’ and of the ‘structural factor’ of one and the same system (here: of the order N+1) is impossible according to the definitions of these terms, see chap. 5. Therefore, a situation, where the ‘system-constituting concept’ of the system of order N would participate in building the system of order N+1 simultaneously as its ‘substrate’ and as its ‘structural factor’, as well, is impossible.

The next examples illustrate particular branches in different system hierarchies.

1) society

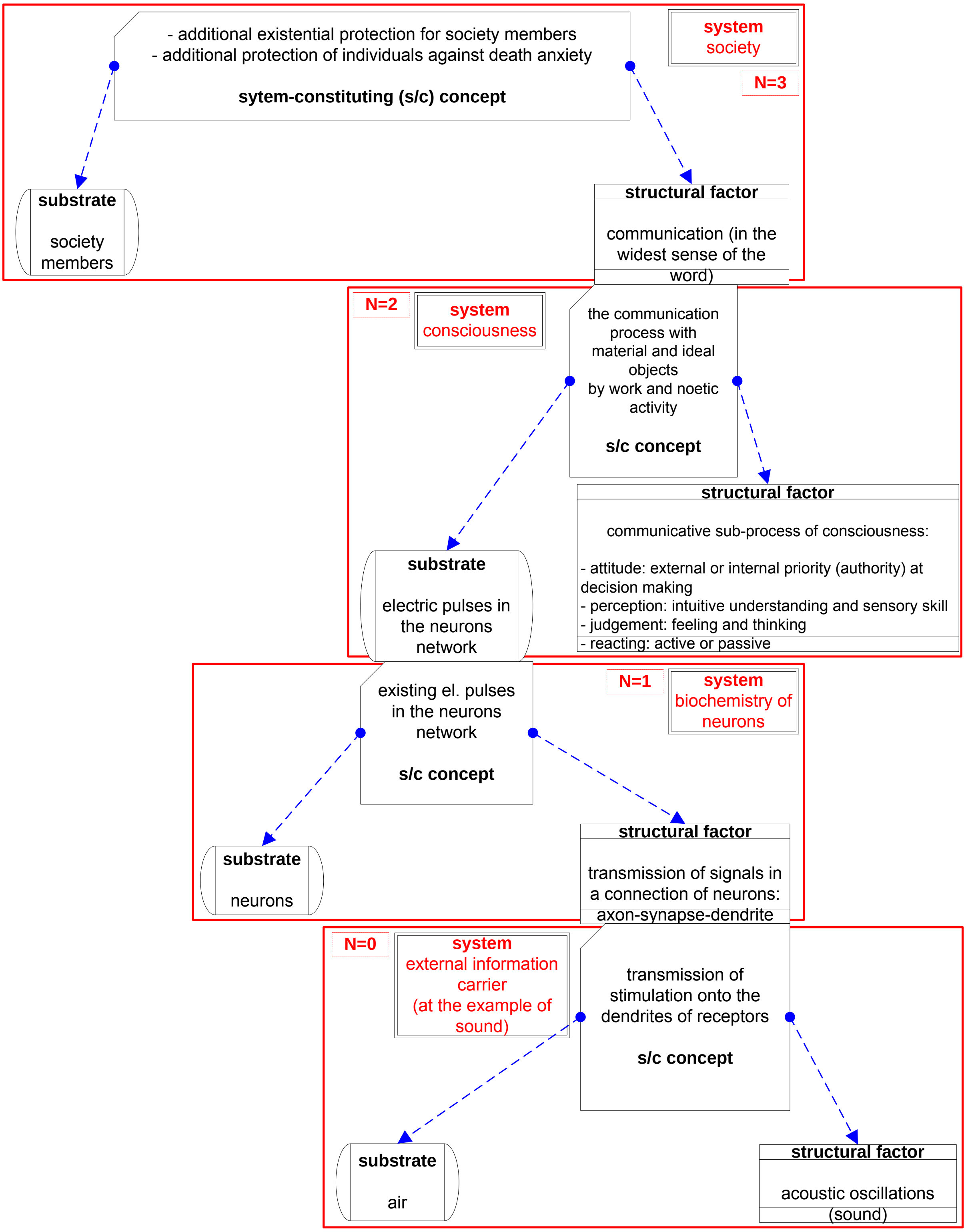

Figure 1: System hierarchy for society

2) physics

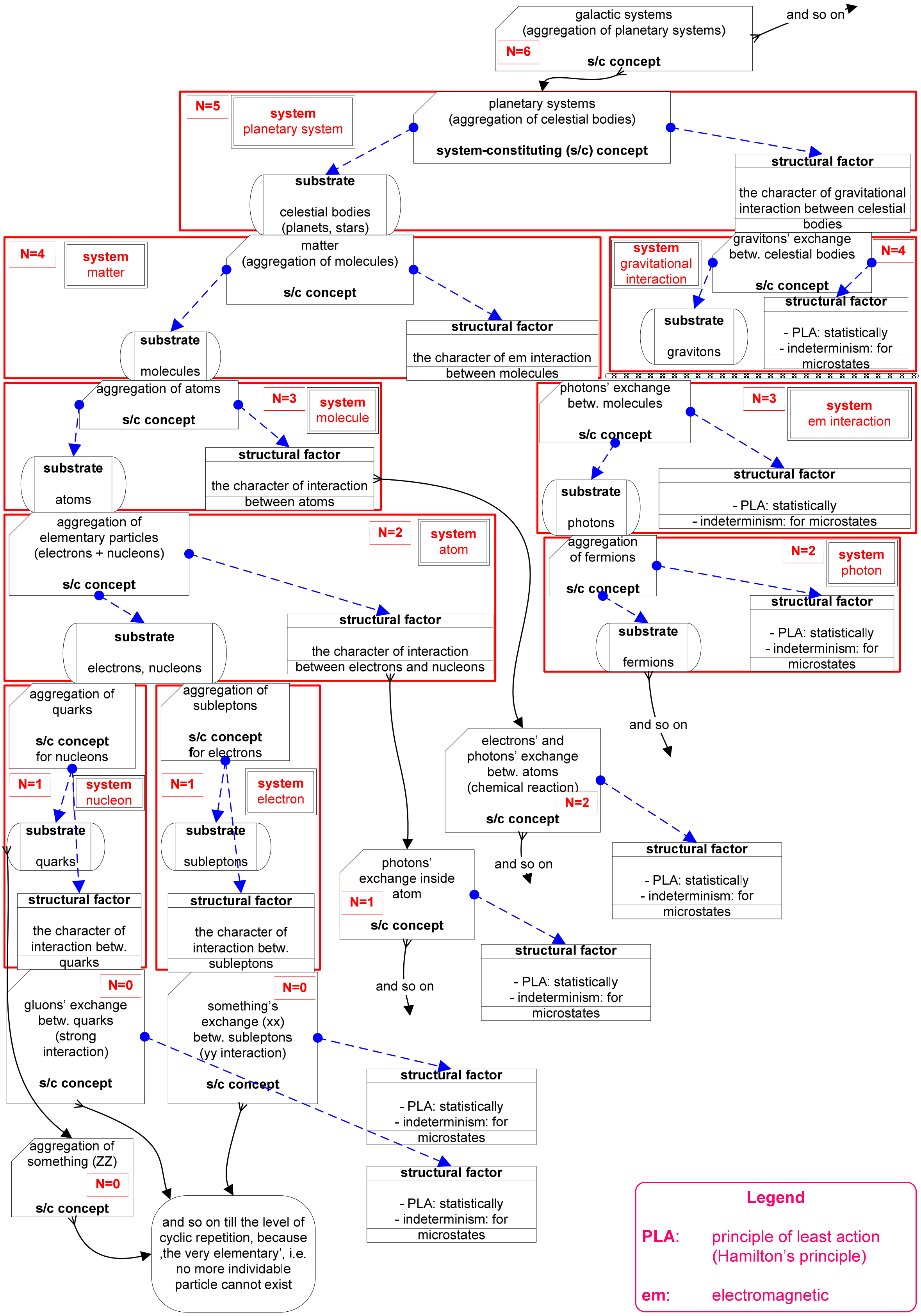

Figure 2: System hierarchy for matter

3) linguistics

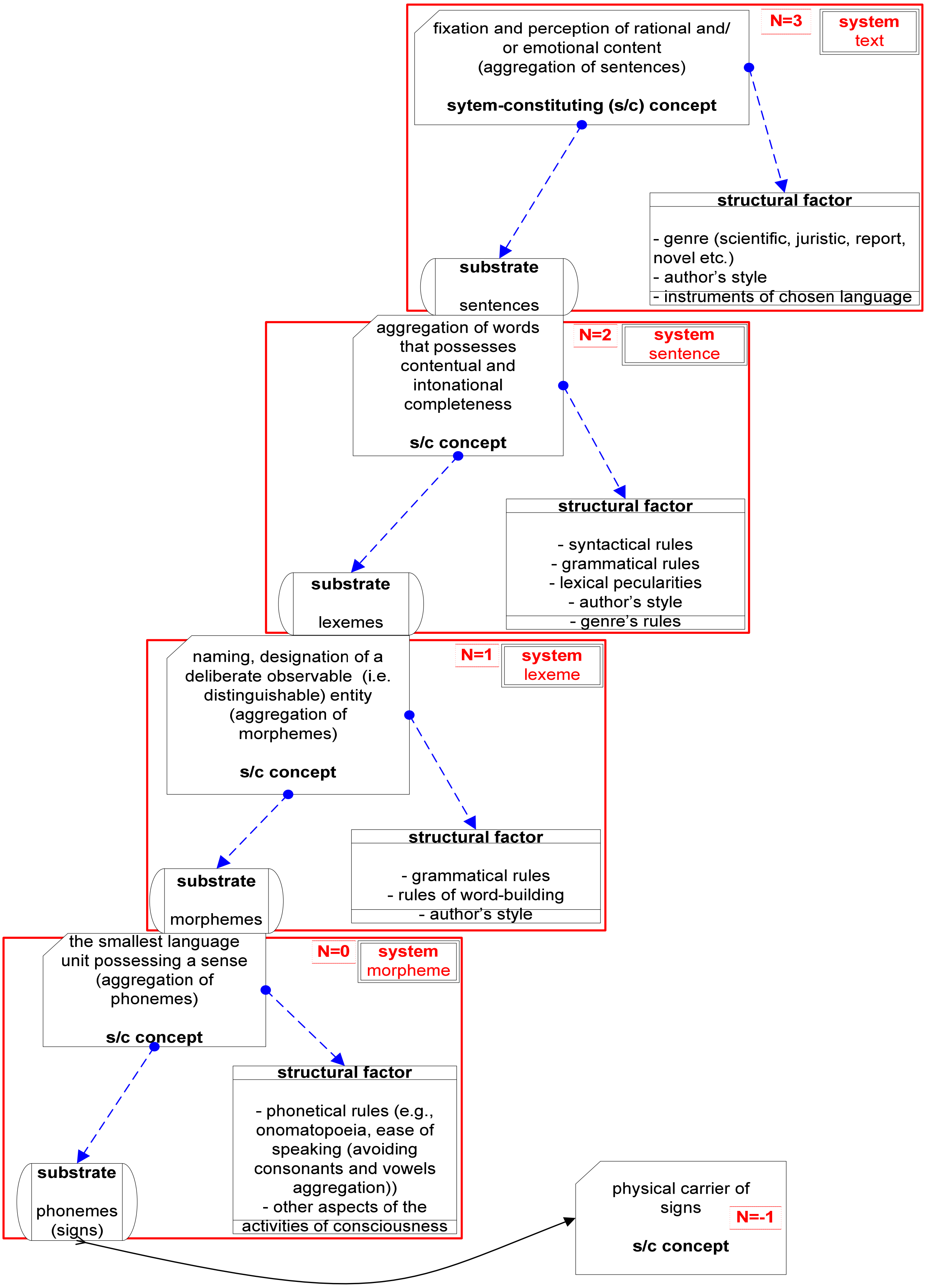

Figure 3: System hierarchy for text

4) conjunction of systems

It is interesting to notice that the **STM. 11** itself can be represented as the system that we call 'conjunct system' with the system-constituting concept 'conjunction of systems in a system hierarchy'. The substrate of this system is represented by single systems in the given system hierarchy, and its structural factor is its construction rule, i.e. the **STM. 11** itself:

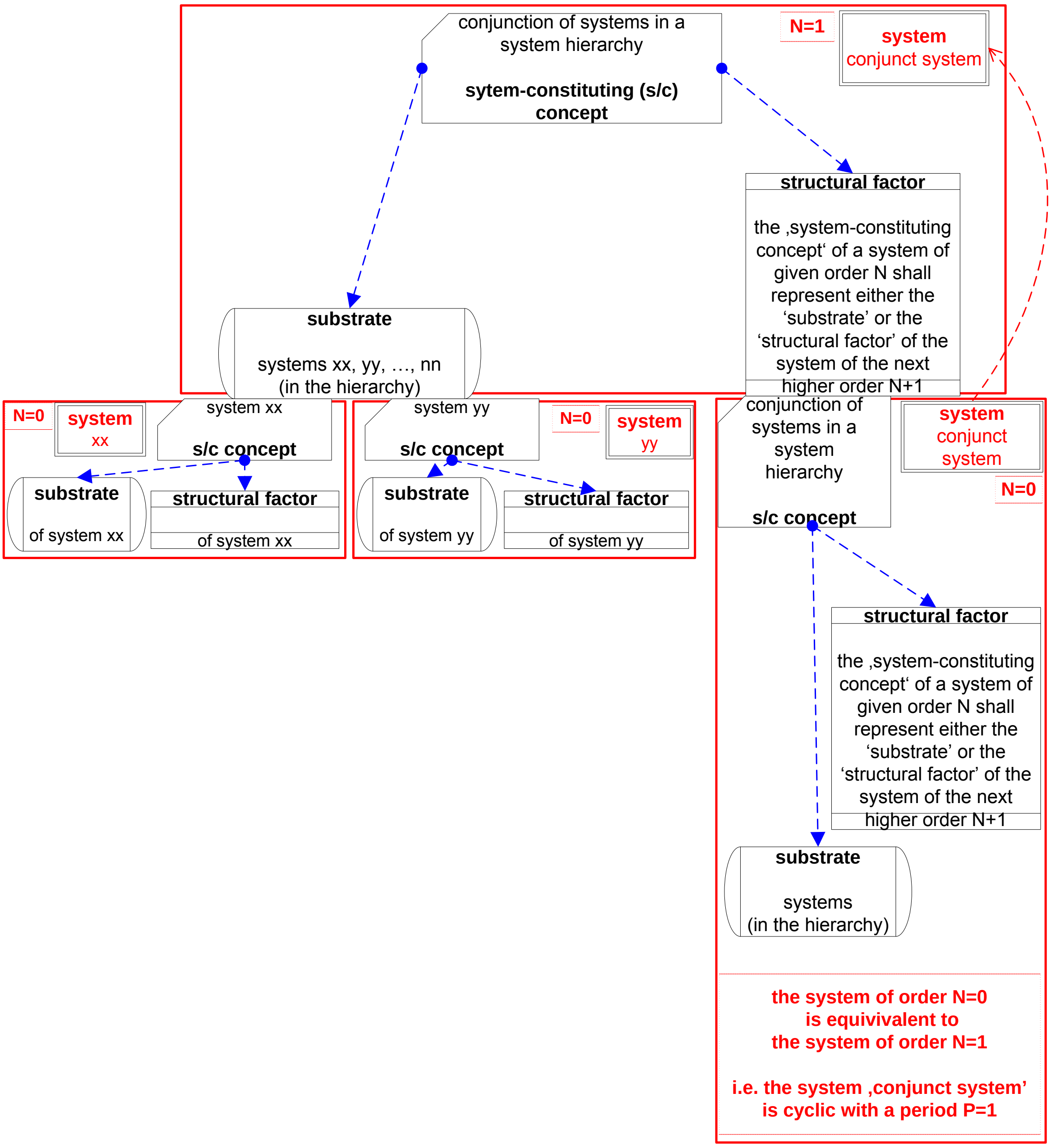

Figure 4: System hierarchy for 'conjunct system'

As indicated in Figure 4, the structural factor of the 'conjunct system' (of the order N=1), i.e. the **STM. 11** itself, is built up on the same system-constituting concept of the system of the lower order N=0 as the system-constituting concept of the current system of the order N=1. Thus, the 'conjunct system' is a cyclic one with the period P=1 as it is directly based on itself (when one walks bottom-up in the hierarchy) or it directly reproduces itself (when one walks top-down).

The process of the application of the **STM. 11**, i.e. the process of the *conjunction* (coupling) of systems in a system hierarchy, represents the *assembling* (when one walks bottom-up in the hierarchy) and *disassembling* (when one walks top-down) operations. Figure 4 obviously indicates that the *conjunction* operation, when applied to any ‘conjunct system’, retains this system ‘conjunct’. In other words, the application of the operation ‘*conjunction of systems*’ (= *assembling / disassembling*) does not change the characteristic of systems ‘be conjunct’ and, thus, retains them hierarchical. This conforms to the result about the impossibility of the existence of non-disassemblable, ‘elementary’ entities, see sec. 1.3.

Let us draw our attention to the fact that the **STM. 11** represents just a certain general ‘rule’, regulating the character of *relations* (of interaction) between the system of the order N and the system of the order N+1 in a ‘conjunct system‘, whereby any ‘conjunct system‘ is subject to this rule. Therefore, **STM. 11** – as well as **STM. 9**[25] – represents a principle, i.e. an abstract rule, in this case – the relation-control-information[26].
Thus, one can state that any ‘rules’ / ‘principles’, regulating the character of *relations* (interaction) between *substrate* and *structural factor*, can always be represented as cyclic systems with the period P=1, i.e. they as a system directly reproduce themselves. It means that such **‘rules’ / ‘principles’ do not have any internal evolvement, and their *observability* bases on the process of their application to different substrates**, cf. Figure 4. This result does not astonish, if we remember that a ‘rule’ represents (relation-control-)information, see chap. 2.

To illustrate this observation at an independent example, let us represent the structural factor of the system "sentence" (see Figure 3) as an independent system. For ease of illustration we confine ourselves to the syntactical rules only, among them – to a single rule concerning the order of the members of sentence in declarative sentences in English. This rule establishes the following order of the members of sentence: subject -> predicate -> object.
The system-constituting concept of this system is ‘aggregation of words in sentences’, the substrate – ‘lexemes’, and its structural factor is its construction rule: in our simplified illustration: ‘the order of the members of sentence: subject -> predicate -> object’.
Comparison of the components of this system built for ‘syntax rules’ with the components of the system ‘sentence’ in Figure 3 makes clear that these systems are identical. So, the syntactical rules as the system directly reproduce themselves that confirms the observation made.

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[25] ‘the principal of sufficiency of existential triad’
[26] synonym: interaction-control-information

4.2 Frequently Encountered Categorial Complementarities

A1) Frequently encountered categorial complementarities being perceived synchronously relating to a certain state of a system:

		comments
Information	matter	
form (phenomenon [Ger. Erscheinung])	content (substance [Ger. Substanz])	
Structure	function	
Purpose	means	
Cause	effect [Ger. Wirkung]	In fact, cause and effect occur synchronously[27]. It is especially obvious in the case of strong interaction between the participants of cause-effect process, cf. [5].
reality (action [Ger. Handlung])	possibility (choice)	
form [Ger. Gestalt, Form]	substrate, medium, vehicle [Ger. Medium]	
Property	relation	
quantity [нем. Extensität]	quality [нем. Intensität]	
Process	state	
justice [Ger. Gerechtigkeit]	merciness [Ger. Barmherzigkeit]	
particular, concrete	whole (entirety), abstract	
freedom (of choice / action)	responsibility (for action / choice)	
will [Ger. Wille, Rus. воля]	duty [Ger. Pflicht, Rus. долг]	will is the freedom of choice, duty is the responsibility for action
misery [Ger. Elend (Unglück), Rus. беда]	guilt [Ger. Schuld, Rus. вина]	
analysis (deduction)	synthesis (induction)	
knowledge	intuition	
rationality	emotionality	
immanence	transcendence	
practice (empiricism)	theory	
representation (of political unity) [Ger. Repräsentation, Rus.	identity (of political unity) [Ger. Identität, Rus. самоидентификация,	two principles of political form acc. to Carl Schmitt, *Verfassungslehre*

[27] in philosophical sense

		comments
полномочное представительство]	собственное «я»]	*(Constitutional Theory)*, 1927, § 16 „Bourgeois Rechtsstaat and political form“. The ‚assembling‘ operation is here the creation of political unity as a system; the source of its system-constituting concept is the political will of the members of this political unity. A real political unity as a system – dependent on the concrete proportion between ‘representation’ and ‘identity’ – can implement different political systems (state forms): - monarchy / dictatorship, - autocracy (aristocracy / oligarchy), - representative democracy / ochlocracy, - direct democracy (political liberalism) / direct ochlocracy (disintegration of political unity, political chaos). Cf. I. Furgel *Political Systems: Their Roots and Evolvement*, Deutsche Nationalbibliothek (DNB), http://d-nb.info/99768061X, 2009
...	…	

A2) A subgroup of categorial complementarities relating to subjects as systems in their environment. They all can be represented as particular cases of the pair {isolation, identification}:

		comments
isolation (of subject from vicinity)	identification/unification/fusion (of subject with vicinity)	
individualism (competitivity) of subject	collectivism (cooperativity) of subject	
introversion	extraversion	intro: reference point is inside, isolation type: I ≠ world; extra: reference point is outside, identification type: I = world
action	contemplation	actor: an active change of world, isolation type: world ≠ me; contemplator: acceptance of world as it is, identification type: world = me
fright [Ger. Angst]	love	love = opposite_of_inverse[28] (placidity)
hate	placidity[29] [Ger. Gemütsruhe, Rus. безмятежность]	hate = antonym_of_complementary (fright)
hybris [Ger. Hochmut Rus. гордыня]	vanity [Rus. тщеславие]	hybris = antonym_of_complementary (eremitism)
eremitism (as a property of character) [Rus. отшельничество]	humility [Ger. Demut, Rus. смирение]	humility = opposite_of_inverse (vanity)
...	…	

B) Categorial complementarities arising in passing to the limit which causes a change of degree of symmetry (‘second order phase transition’). These complementarities are perceived diachronously relating to the whole life cycle of a system:

		comments
discreteness	continuity	‚continuity’ corresponds to the limiting value of the attribute ‘degree of discreteness’ = 0

[28] operation opposite_of_inverse is equivalent to operation antonym_of_complementary
[29] ataraxia as by Epicureans. Sometimes terms ‚serenity‘ / „Gelassenheit“ / «душевное спокойствие» are used

		comments
asymmetrie / inhomogeneity	absolute symmetry (i.e. with respect to all existing properties) / homogeneity	‘symmetry’ corresponds to the limiting value of the attribute ‘degree of asymmetry’ = 0
being	nonbeing	‚nonbeing’ corresponds to the limiting value of the attribute ‘degree of being’ = 0

C) Categorial complementarities being perceived synchronously as well as diachronously:

		comments
		It is the fundamental complementarity being at the basis of the evolution of nature, of the existence and directedness of time
contingency (indeterminism; the probability of an event/state 0<p<1)	necessity (determinism; the probability of an event/state p = 0 or p = 1)	This pair can be perceived diachronously relating to the whole life cycle of a system as well as synchronously relating to a certain state of a system. Synchronism, for example, is implemented by nature itself: there is a probabilistic transition from one microstate to the next microstate of nature, but these incidental transitions <u>statistically</u> obey a necessary law: the principal of most entropy (of least action), see [7].

5 Glossary

This chapter gives the main terms of the system theory [2] needed for reading this work.

System	any given entity, at which a *relation*, possessing an arbitrarily taken certain *property*, is implemented. Or equivalently: any given entity, at which some *properties*, being in an arbitrarily taken certain *relation*, are implemented.
System-constituting concept[30]	apriori given system-constituting *property* or *relation*; dependent on this, system-constituting concept is *attributive* or *relational* one, resp.
Structural factor[31]	A set of properties and relations that suffices the given system-constituting concept. Structural factor can be relational one (in the case of the attributive concept) and attributive one (in the case of the relational concept).
System substrate[32]	a carrier of relational or attributive structure.

[30] the original term by Uemov: ‘системообразующий концепт’
[31] the original term by Uemov: ‘структурный фактор’
[32] the original term by Uemov: ‘субстрат системы’

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