SOME RESULTS IN THE THEORY OF PHENOMENOLOGICAL CATEGORIES

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The theory of categories may be used for a mathematical treatment of consciousness, of the phenomenological semantics of mind and of the informational-physical processes of the deep existence and the universe. In this paper are remembered previously introduced notions like phenomenological category, phenomenological structure, phenomenological morphism, phenomenological set, phenomenological functor, autofunctor (phenomenological autofunctor), phenomenological-structural functor, structural-phenomenological functor, structural-phenomenological category.

New notions are introduced such as: phenomenological monoid, fundamental monoid of existence, zeroautofunctor, zeroendomorphism.

Conditions of the extension of the structural theory of categories to phenomenological domains are presented while underlining two types of theories in the structural-phenomenological domains: envelope theories and detailed theories. These theories are types of integrative theories.

1. INTRODUCTION

The classical theory of categories, *a strictly structural theory*, is due in its first years (1945–1970) to Eilenberg, Mac Lane, Grothendieck, Kan, William Lawvere, Tierney and others, followed in the next 30 years by many mathematicians who developed this theory (Marquis 1997).

The applications of the category theory in various domains of science began later but mainly for the structural domains of science.

Working on this paper, I received in April 2001 a message by e-mail from Robert Marty who informed me about his 1992 work, in which he conceived a phenomenological semantics of the human mind based mainly on the theory of categories, introducing some concepts similar to some of the notions introduced by Drăgănescu (2000 a, 2000 b, 2001). In the second section of this paper are examined the phenomenological notions introduced by Robert Marty (1992).

Recently, Kato G., Struppa D. (1999 a, b), Struppa D., Kafatos M., Roy S., Kato G., Amoroso R. (2000) thought to use the classical theory of category to study consciousness, in order to obtain a mathematical theory of consciousness, both for the individual human level and for the consciousness of the universe. They were the first to promote this problem in science and indicated the use of the theory of categories and functors. Although they began to use only the structural theory of category, they looked with interest at phenomenological processes.

Kafatos and Drăgănescu (2001 a, b) considered it necessary – at the IVth Conference for structural-phenomenological modeling, Bucharest, 2000 – to bind

together the structural and the phenomenological in an *integrative science* that might use an *integrative mathematics* to cope with both aspects of reality.

Drăgănescu (2000 a, b; 2001) began to extend the classical (structural) theory of categories for the phenomenological and structural-phenomenological domains. A summary of these first results will be presented in this paper.

Kafatos and Roy (2001) are looking now into the connection between the two above ways of dealing with the consciousness problem and the entire science.

2. PHENOMENOLOGICAL CATEGORIES IN THE SEMANTIC THEORY OF ROBERT MARTY

Robert Marty (Professeur en Sciences de l'Information et de la Communication, Université de Perpignan, France) used the Category theory for the semantics of the natural language (Marty, 1992). He based his theory on the phaneroscopical theory of C.S. Peirce (1931).

Charles Sanders Peirce (1839–1914) is well known as one the main fathers of pragmatism in philosophy, his concepts being expanded by William James and John Dewey. C.S. Peirce was a philosopher and a physicist (he published in 1878 *Photometric researches*, concerning the determination with greater precision of the form of the Milky Way Galaxy, worked on Boolean algebra until 1885, published *Studies in logic* (1883) and other works. *But C.S. Peirce also developed a phenomenology that he called phanerology.*

C.S. Peirce's works in logic were in fact in semiotics (the general theory of signs). He contributed to deductive, mathematical logic, but he paid great attention to the logic of science, which for him was mainly induction.

Peirce appreciated his mainly contribution to philosophy as

> 'his new list of categories analogous to Kant's *a priori* forms of the understanding, which re-reduced from 12 to 3: Quality, Relation and Representation. In his later writings he sometimes called them Quality, Reaction and Mediation; and finally Firstness, Secondness and Thirdness. At first he called them concepts; later, irreducible elements of concepts – the univalent, bivalent and trivalent elements' (NEB 1994).

C.S. Peirce divided the symbols into terms, propositions and arguments (these being abductions – that is forming a hypothesis to explain surprising facts –, inductions, and deductions).

In his phenomenology (phaneroscopy) the phaneron is a *mental phenomenon.* Peirce (in his manuscript 908, *apud* R. Marty) wrote:

> 'Je propose d'utiliser le mot Phanéron comme un nom propre pour dénoter le contenu total d'une conscience […], la somme de tout ce que nous avons à l'esprit, de quelque manière que ce soit, sans regarder sa valeur cognitive.'

In the phaneron, *the relations* among sensations (qualities of feelings, qualities of sentiments) that constitute an expression, for instance, of a seen object

are forming a complex configuration of sensations, some of them primitive, without the possibility of being analyzed. *The 'basic sensations' may only be felt and nothing more*. The phaneroscopic analysis aims to constitute in a formal way the 'structure' of such a group of basic sensations.

The phaneron ('the collective total of all that is in any way or in any sense present to the mind quite regardless of whether it corresponds to any real thing or not', Peirce (1931), *Collected Papers*, 2841) **is synonymous with phenomenon, in the phenomenological way**.

Marty used the phenomenological theory of Peirce to develop a theory of *mental semantic networks*, using also the ideas of semantic networks from artificial intelligence. Of course, the mental semantic networks, following Peirce, are seen only as phenomenological. Such a network is constituted from phenomena (phanerons, phenomenological senses, qualia, feelings), being itself a phenomenon (phaneron, phenomenological sense, qualia, feeling).

The phaneron is a 'feeling' (quality of feeling) or a complex of feelings (supposed to be a structure of feelings). We do not intend here to enter into the details of Marty's theory, but only to underline that Marty (1992) introduced, by using the category theory, notions like **phenomenological structure, phenomenological morphisms, phenomenological category** and **(phenomenological) functors.**

Concerning the **phenomenological structure** this is indeed a delicate and important notion. A structure may be built not only from structural elements. Drăgănescu (1990), for instance, already mentioned:

> 'A concentrated definition of structure is then the following: *organization of elements that can be described by formal methods (mathematical, logical, and linguistic).*
>
> The elements of the structure are, usually, structural elements, but can be also *phenomenological elements* if they enter into the formal character of a structure. The latter case may be met in the case of informatter coupled with orthoenergy, in which case the coupled informatter may be regarded also as being structured.'

A phenomenological element is not a structure in the usual sense of this notion. But it can participate in a structure, in a phenomenological structure.

In Marty's (1992) theory, *the phenomenological structure is a relational structure*. He defines a relational structure of type **n**, after Adamek (1983), as a pair (X, **a**) where X is a set and **a** is an n-adic relation on X (that is, a subset of the cartesian product $X^{\mathbf{n}}$).

The *type* of the relational structure (X, $\{\alpha_i\}_{i\in I}$), where $\{\alpha_i\}_{i\in I}$ is a family of n_i-adic relations, *is* $\{n_i\}_{i\in I}$, where each n_i is a positive integer.

The elements of X are the qualities of feelings caused by external stimuli or by mnemonic reminder. An n_i -tuple of α_i corresponds to a bundle of qualities of feelings linked together by a perceptual judgement, which is a mental semantic network (Marty 1992).

As seen before, the type of the relational structure is given by n. Following Peirce, there are mainly three types of relational structures, called elementary relational structures: types 1, 2 and, 3 (Marty 1992):

'We call 'monads' the elements of relational structures of type 1 (1-tuples); we call 'dyads' the ones of type 2 (2-tuples) and 'triads' the ones of type 3 (3-tuples). Each monad corresponds to a simple 'quality of feeling', each dyad to an existent individual or fact, and each triad to a 'concept, law or something expressible by universal proposition. This is the empirical decomposition of the phaneron into indecomposable elements many a time described by Peirce.'

A relational structure $(X, \{\alpha_i\}_{i\in I}) = (X, \alpha) = (X, \alpha_1, \alpha_2, \alpha_3)$ that is of type $\{1,2,3\}$ on set X with $\alpha_1 = \alpha \cap X$, $\alpha_2 = \alpha \cap X \times X$, $\alpha_3 = \alpha \cap X \times X \times X$ is ***a phenomenological structure*** of type $\{1,2,3\}$ ***if the following conditions are fulfilled*** (Marty 1992):

(i) if $(x_1, x_2, x_3) \in \alpha_3$, then $(x_1, x_2) \in \alpha_2$, $(x_1, x_3) \in \alpha_2$, $(x_2, x_3) \in \alpha_2$;
(ii) if $(x_1, x_2) \in \alpha_2$, then $x_1 \in \alpha_1$ and $x_2 \in \alpha_1$;
(iii) and by combination of (i) and (ii), if $(x_1, x_2, x_3) \in \alpha_3$, then $x_1 \in \alpha_1$ and $x_2 \in \alpha_1$ and $x_3 \in \alpha_1$.

The *objects* $\alpha_3, \alpha_2, \alpha_1$ and the *morphisms* (relations) $R_{3,2}$ defined by condition (i) between α_3 and α_2, $R_{2,1}$ defined by condition (ii) between α_2 and α_1, $R_{3,1}$ defined by condition (iii) between α_3 and α_1 *define a category* called by Marty (1992) $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$. The other known conditions for a category are also fulfilled.

The set X of feelings (phenomenological senses) together with the category $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$ represent the *phenomenological structure* $(X, \alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1)$ associated to an object of the world.

If $(X, \alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1)$ and $(Y, \beta_3 \rightarrow \beta_2 \rightarrow \beta_1)$ are two phenomenological structures, between the categories $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$ and $\beta_3 \rightarrow \beta_2 \rightarrow \beta_1$ there are *functors* that are named by Marty *phenomenological morphisms* (they are morphisms between structures of phenomenological senses).

A category constituted by a family of phenomenological structures provided with corresponding phenomenological morphisms is named by Marty (1992) **'phenomenological category of the objects Pho'.**

We observe that even $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$ or $\beta_3 \rightarrow \beta_2 \rightarrow \beta_1$ are phenomenological categories of which objects are *structures of phenomenological senses* (like α_3 and α_2) or *phenomenological senses* like α_1.

Marty is explaining the interpretation of his definitions and results as follows:

'The phenomenological structures represent the objects of the world (present to the mind), whereas the phenomenological morphisms represent the relations between these objects, that is to say the modes of being.'

Marty is not using explicitly the notion of *phenomenological functor*, but the transformation from $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$ to $\beta_3 \rightarrow \beta_2 \rightarrow \beta_1$, called by him, correctly, functor,

is a phenomenological functor. Also, the transformation from a phenomenological category of the objects A to a phenomenological category of the objects B is also a phenomenological functor.

When the objects of a category are phenomenological senses or structures of phenomenological senses, these categories are phenomenological categories, in the way given by Drăgănescu (2000 a).

The phenomenological category of the type $\alpha_3 \rightarrow \alpha_2 \rightarrow \alpha_1$ may be named *Marty phenomenological category of first type*. And the phenomenological category of the objects Pho may be named *Marty phenomenological category of the second type*.

These Marty categories imply *mental semantic networks* because they were built in such a way to express semantic networks (Marty 1992) and are perceptual judgements, how an object is present to the mind.

Concerning the 'presence to the mind', Marty (1992, note 5) is doing surprisingly a step back from the phenomenological interpretation (only a tactical step?) writing:

> 'This hypothesis is also considerably substantiated by neurophysical considerations. Indeed the 'mental object' is identified by J.P. Changeux (*L'homme neuronal*, Fayard, Paris, 1983) with the physical state created by the electrical and chemical activity of large 'assemblies' of neurons, mathematically described by a graph, discrete, close and autonomous. Nor each neuron is formally equivalent to n-adic relations between the other neurons belonging to the assembly with which it is linked. Therefore, it seems right to consider that this assembly is, formally, connected relational structure.'

If the phenomenological is a relational structure, a dynamic neuronal structure may be relational, but not phenomenological in a true understanding of this term. The phaneron is phenomenological and can not be equal to a neuronal structure. The well known 'explanatory gap' problem between neuronal structure and qualia (phenomenological sense) is showing that in the mind there are two forms of reality, a purely structural one and another phenomenological, the latter being also able to manifest under the form of a structure of phenomenological senses. Only semantic consideration may blur the explanatory gap. Moreover, phenomenological reality may be active in itself, giving birth to intuition and creation phenomena in interaction with the structural reality of the brain. Then, it is needed to introduce, perhaps also in a semantic theory, both strata of the reality of mind which implies structural categories (corresponding to various levels of structures of the brain), phenomenological categories and, perhaps structural-phenomenological categories which embrace the entire reality of mind.

The work of Marty (1992) is a contribution to the theory of phenomenological categories, introducing phenomenological structures for the phenomenological semantics that could be used in developing more detailed theories in which both structural and phenomenological categories may play

together an important role. His treatment of phenomenological network semantics for the human mind may suggest also ideas for the semantic behavior of the deep reality of existence.

3. THE EXTENSION OF THE THEORY OF CATEGORIES TO THE PHENOMENOLOGICAL DOMAINS. PRINCIPLES OF EXTENSION

The extension of the theory of categories and functors to the phenomenological and structural-phenomenological domains was proposed to be guided by two main principles (Drăgănescu 2000a, 2001):

a) to preserve all that is possible from the classical theory of the structural categories and functors;

b) to respect the principle of feasibility, *i.e.* the possibility of physical-informational action or realization in the reality of existence.

The first principle is conservative; the second either introduces constraints to the use of classical notions, or gives the freedom to introduce new notions and aspects in the extended theory.

The extended theory, in the sense presented above, may be much more than a mathematical theory of structures. It may become a foundation for physical-informational theories in general. **The extended theory**, *because it realizes a unification of physical and informational aspects* (as is reality, either philosophically or conceptually supposed) **is an integrative theory of categories** (Kafatos, Drăgănescu 2001 b). It is hoped that two or three great problems of science may benefit from this approach:

– the theory of life, mind and consciousness, either under the form of an *envelope theory* or a *detailed theory*;

– the theory of our universe, either under the form of an envelope theory or a detailed theory, together with the constitution of quanta, space (which might be a type of quanta) and time, explaining the quantum science;

– the theory of deep existence with its Fundamental Consciousness and of its dynamics to give birth to universes.

Concerning the structural and the phenomenological it was observed (Drăgănescu 2000 c):

> 'What is structural? The new answer proposed here is based on the contrast with the phenomenological. All that is not phenomenological, perceived as phenomenological or having phenomenological elements, is structural (1). All that may be described in a formal way, for instance with mathematical models, is structural (2). This is so because the phenomenological in its purest expression is not formal. […]
>
> Sometimes the separation between the structural and the phenomenological is not so sharp. Forinstance, an organization of phenomenological elements forms a structure constituted of phenomenological parts. Such a structure could be treated formally, even with mathematical means.

This may happen with the phenomenological behavior of the deep underlying reality, and therefore a mathematical treatment of this reality is possible. This is very important because the possibilities of science may penetrate into the deepest realms of reality, even if it cannot attain completely the behavior of every phenomenological part or of the phenomenological whole. […]

What is phenomenological? Related to humans it is the experiential and qualia. It is, in general, a sensibility of matter, of a fundamental type of matter (informatter). This sensibility is a physical process and every elementary manifestation of it is also phenomenological information. It is a phenomenological sense. In its own environment (informatter) the generation of phenomenological senses cannot be described formally, it is a non-formal process, although a general frame of tendencies for such phenomena is perhaps present. This property of non-formal processing might explain the phenomena of intuition and creation of the mind and consciousness. Since there are manifestations with a non-formal character and they are not predictable, in front of them science might not completely penetrate the secrets of reality, and, as observed, still this ultimate frontier of knowledge could be surmounted with the means of non-formal processes themselves.'

Concerning the detailed and envelope theories it was also observed (Drăgănescu 2000 c):

'A **detailed theory** of mind and consciousness based on a structural-phenomenological ontological model, which involves also a quantum structural-phenomenological physics, is not yet available, but works for such a detailed theory are in progress (a presentation in Drăgănescu 1999). Nevertheless, there are sufficient elements for trying to continue to build theories that envelop all the physical and informational details, which at last will be necessary to validate an envelope theory. For instance, recognizing the experience and the phenomenological sense as scientific facts, recognizing the coupling between the phenomenological and the structural as necessary facts of reality, also between the phenomenological sense and orthoenergy, recognizing the non-formal information processing in the phenomenological realm and so on, with such elements might be built structural-phenomenological **envelope theories** (by analogy, these are equivalent to macroscopic theories in comparison with microscopic theories) of the generation of a universe, of life, mind and consciousness, even of a Fundamental Consciousness, and on their interactions. It is hoped that the play between *envelope theories* and *detailed theories* will improve both categories of theories toward a better knowledge of reality'.

For the envelope and detailed theories of consciousness, Kafatos and Draganescu (2001 a) have shown:

'For instance, what is essential for the human mind and consciousness is the correspondence between the category of neuronic structures Cstr and the category of phenomenological senses Cphen. This correspondence is assured by two functors, one structural-phenomenological F, and the other phenomenological-structural R. These functors are real physical and informational processes, and in each of these categories there are specific morphisms, structural in Cstr and phenomenological in Cphen. *These elements may be sufficient for an* ***envelope theory.***

For a **detailed theory**, other categories have to be taken into consideration between Cstr and Cphen, like the layers of physical processes proposed by Jibu and Yassue (1995) and Amoroso (1997). Let us consider the layer, proposed by Amoroso, of the coherent quantum waves in the brain which are "connected" to phenomenological senses (having their source in the deep reality). The coherent quantum waves are forming a category that has structural functors, on the one side, in both directions with C_{str} and, on the other side, has functors, in both directions, with Cphen. […]

Hence, if for the **envelope theory,**

Cstr <=> Cphen

where <=> represents the two functors between these categories, then for the detailed theory, descriptions of the form

Cstr <=> Ccoherent quantum waves <=> Cphen

are at least necessary, or perhaps, of the form

Cstr <=> C1str <=>... <=> Ckstr <=> Ccoherent quantum waves <=> Cphen

In the above, C1str, C2str, ..., Ckstr are structural categories of the brain, other than neuronic structures, but intermediary categories (dendritic networks, molecular vibrational fields along protein filaments, perimemebraneous waves, quantum cortical fields – after Jibu and Yassue, 1995) between Cstr and Ccoherent quantum waves.

It seems that we may think about the mathematics of the integrative science as being also an integrative mathematics of the structural and phenomenological processes in nature. It will use perhaps notions like the usual (structural) categories, phenomenological categories, structural-phenomenological categories, functors, both structural-phenomenological and phenomenological-structural, all these being at the same time physical and informational phenomena and processes of reality'.

4. WHAT IS A PHENOMENOLOGICAL CATEGORY?

The *first condition* for a category to be a phenomenological category is for it to be constituted of phenomenological objects:

– phenomenological senses;
– sets of phenomenological senses;
– structures of phenomenological senses;
– phenomenological categories as objects in the main phenomenological category.

The *second condition* is to respect the classical conditions for a category: morphisms (fulfilling associativity and identity axioms) among its objects, composition of morphisms, identity morphism for every object.

It is known that in the structural domain the morphisms among its objects characterize a category. The same may be said perhaps also about the phenomenological categories, although the morphisms, as processes, may be not only structural (formal), but also non-formal. *To get formal and non-formal processes under the same frame is one of the main advantages of the notion of phenomenological category*.

The phenomenological category is not only a mathematical concept. It has a substance, called informatter (Drăgănescu 200 a, b; 2001), because phenomenological senses have to take place in something even if this something is out of space and time. One of the characteristics of informatter is, perhaps, to have a phenomenological topology.

A phenomenological set is a set which has phenomenological elements, and, between these elements there are no morphisms, that is, they are not forming a

category. But a phenomenological set may be an object of a phenomenological category.

The set X from the theory of Marty's phenomenological categories, presented very shortly above, is a phenomenological set.

In Drăgănescu (2000 b, 2001) a fundamental phenomenological set of existence <1> was defined.

What is important for the phenomenological sets is their dynamics. A structural set may have endomorphisms or automorphisms (endomorphisms which are also isomorphisms) and generate a category of endomorphic, respectively automorphic objects.

In the domain of structural mathematics (theory of sets, theory of categories) a single object which is a set may be considered as a category. It is known that a category with exactly one object is called a *monoid* (Lawvere, Schanuel, 1997). The endomorphisms of this only object, M, which may be a set of phenomenological elements, are determining a category of endomorphisms M'. The automorphisms of M are determining a category of automorphisms M".

In principle, we may speak also about a *phenomenological monoid.* **The fundamental phenomenological set of existence <1>** is a ***phenomenological monoid.*** This fundamental monoid of existence is a phenomenological set with 3 elements (Drăgănescu (2000 b, 2001) in which every element has a specific role. The first property of *this* monoid is to be a special entity of deep existence, present 'everywhere', although it may take, in various 'zones' of the deep existence, various forms permitted by its automorphisms.

In Drăgănescu (2001) it was shown that <1> can have only 4 automorphisms. If **a**, **b**, **c**, are the three phenomenological senses of <1>, **a** being in an absolute and permanent position in the set (unity of infraconsciousness of existence), **b** and **c** being either in a 'pole' position (active position), or in a passive position, these automorphisms are shown in Fig. 1. The condition to be an automorphism is to have an endomap only with cycles of length 1,2,3,…. without branches [Lawvere, Schanuel 1997). In Fig.1 there are cycles (loops) of length 1 and 2, and no branch. It may be observed that **a** might be in a cycle with length 2, either with **b** or **c**, in the structural case, but not in the phenomenological <1>. In the structural case of a set with 3 elements the number of automorphisms could be 13 (Drăgănescu 2001), but the feasibility condition for the phenomenological case of <1> reduces this number to 4.

It is interesting to note that <1> has no other endomorphisms that are not automorphisms. In the structural case endomorphisms admit besides cycles (loops) also branches, but this is not feasible for the phenomenological monoid <1>. The phenomenological senses (orthosenses) **b** and **c** cannot have simple branches between them, because they are also permanent phenomenological senses either in pole (active) or passive positions.

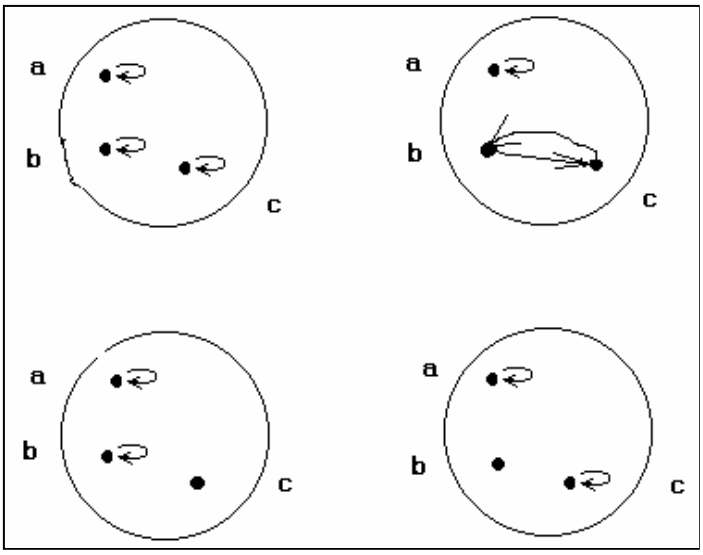


Fig. 1. – The four phenomenological automorphisms of <1>.

The conclusion is that the fundamental phenomenological set of existence has only automorphisms for its dynamics. The application of the automorphisms to <1> is done by a *chronos* (Drăgănescu 2000 b).

The fundamental phenomenological monoid <1> is a category with the only phenomenological object <1>, which is a phenomenological set. Between this category and other categories there are phenomenological functors. In general, between two phenomenological categories functors might be defined (Drăgănescu 2000 a). The particularity of the fundamental phenomenological monoid is that it can create categories (Drăgănescu 2000 b)! Even in the case of a structural monoid, between it as an object, for instance a set, and other mathematical structure under the form of a category, there is a functor that has the quality to preserve some structural characteristics.

But in the phenomenological case there is more. The fundamental monoid <1> is a part of a greater category, the phenomenological category of existence $C_{phe!1!}$. As mentioned before, the fundamental monoid is a special category, which is present 'everywhere' in $C_{phe!1!}$, in every other subcategory of $C_{phe!1!}$.

Between two phenomenological categories, in principle, there are ***phenomenological functors*** (Drăgănescu 2000a) that may be defined in a similar manner as in the structural, classical, theory.

But in this case, the monoid <1> has an **autofunctor (phenomenological autofunctor)** with action between $Cphe_{!1!}$ and $C_{phe!1!}$ to produce the phenomenological category (subcategory) S of a possible universe (Drăgănescu 2000 b). This is not a formal informational process, but a '*non-computable, non-formal, unpredictable*

for an observer from a universe' (Drăgănescu 2000 b). **The phenomenological category S represents the semantic laws, at the phenomenological level, of a universe**. In a previous work one observes (Drăgănescu 2000 b):

'In order to become a real universe, a phenomenological-energetic coupling is necessary between S and the orthoenergy, which gives birth to the *structure* of a universe with its space-time and quanta (perhaps strings).

This coupling is also a process, *i.e*. is a functor F_{SU} from the phenomenological category S to the category U of the structural universe. If the autofunctor F_A is inherent in the nature of deep reality, as was suggested before, the functor F_{SU} is also a property of the deep reality. It may or not intervene, these possibilities (coupling or not coupling) being necessary for an internal play of the phenomenological senses in the deep reality, for a phenomenological processing of its internal information. When F_{SU} is acting, a universe is born. When it is not acting, the former category S disappears or is transformed. The functor F_{SU} is not acting at every generated phenomenological category S. When it does act, due to the coupled orthoenergy, S is maintained together with the structural universe U, in the frame of the structural-phenomenological universe **U.**'

The functor F_{SU} is between a phenomenological category S and a structural category U. It is not a simple phenomenological-structural functor because it involves in its action the deep energy (orthoenergy).

5. THE COMBINATION OF STRUCTURAL AND PHENOMENOLOGICAL PROCESSES

In the above example, the *structural universe* U and the *phenomenological universe* S constitute the structural-phenomenological universe **U,** *i.e*. the **universe** (Drăgănescu 2000 b). The reality of the universe is structural-phenomenological.

This explains why it is necessary to define ***structural-phenomenological categories*** (this is necessary also for the case of mind and consciousness).

In general, the objects of a structural-phenomenological category are pairs of structural and phenomenological objects (A, s), if A and s correspond to each other by a *functorial link*. At the origin of a structural-phenomenological category there are, in such a case, two categories C_{str} and C_{phen} among which there are functorial links.

If C_{str} has the objects A, B, C, ... the corresponding C_{phen} has the objects $FA = s_1$, $FB = s_2$, $FC = s_3$, ... which are phenomenological senses, and F is the functor from C_{str} to C_{phen}.

As was shown in Drăgănescu (2000 a), the resulting structural-phenomenological category is not the product $C_{str} \times C_{phen}$ of the above two categories, but only a subcategory $C'_{str\text{-}phen}$ of this product.

The subcategory $C'_{str\text{-}phen}$ contains a part of the objects of the product category $C_{str} \times C_{phen}$ (for instance, if {A, FA} is an object of $C'_{str\text{-}phen}$, on the contrary {A, FC} is not), contains also all the morphisms of $C_{str} \times C_{phen}$ among the retained possible objects mentioned above, maintains the composition of the

respective morphisms, and the identity morphisms. More, because $C'_{str\text{-}phen}$ contains all the morphisms of C_{str} x C_{phen} among the retained structural-phenomenological objects, it is a *full subcategory* (Bucur, Deleanu, 1968).

Although the product C_{str} x C_{phen} formally seems to be a structural-phenomenological category, this is not true because the condition of feasibility in the real world is not fulfilled. Only the full subcategory $C'_{str\text{-}phen}$ is a structural-phenomenological category.

The universe U is a structural-phenomenological category, the universe is structural-phenomenological, but in some detail it is formed (Drăgănescu 2000 b) by two categories S and U and two functors (or families of functors) H_1 and H_2 between these, *i.e.*

$$U = <S, U, H_1, H_2>$$

where H_1 is a **phenomenological-structural functor** between S and U, and H_2 is a **structural-phenomenological functor** between U and S.

Therefore a structural-phenomenological category contains in a detailed view both a structural-phenomenological functor and a phenomenological-structural functor. This may be very important, for example, for the brain-mind couple. In such a case, S represents the neuronic structure and U the category of phenomenoological senses (qualia). If something happens in U, then the functor H_1 brings changes in S and, reversely, if something happens in S, the functor H_2 brings changes in U (for instance phenomena of intuition and creation). The dynamics of a structural-phenomenological process is better represented by the detailed view of a structural-phenomenological category.

Similar thoughts may apply also to the universe. For the universe, when it is born only as a phenomenological category S, if it is not coupling with orthoenergy, it will vanish (Drăgănescu 2000 a). The disappearance of the phenomenological category S follows the action of something on this category. We call it **zeroautofunctor**, *i.e.* a functor that applied to a category annihilates this category. It acts only when it finds phenomenological senses, outside <1>, not coupled with orthoenergy or, perhaps, not coupled with structures in the case of a mind. It may be said that the *chronos* of the orthosense **a** is also the carrier of the zeroautofunctor of the entire category of existence.

It is interesting to mention that in the structural theory of categories, a *zero morphism* (zero map) is defined (Lawvere, Schanuel 1997). This is a special map between two objects of a category C. If X, Y, Z, W are objects of a category, a zero map, for instance 0_{XY}, composed with any other map, it gives another zero map. If $Y \xrightarrow{g} Z$ is a morphism (map), then (see Fig. 2)

$$g0_{XY} = 0_{XZ}$$

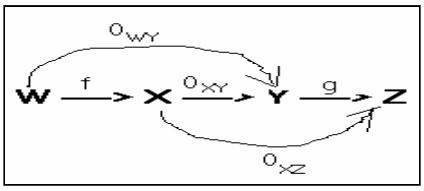
and, if $W \xrightarrow{f} X$ is a morphism, then

$0_{XY}f = 0_{WY}$

and

$g0_{WY} = 0_{WZ}$

Fig. 2. – The signification of zero morphisms.



If we imagine the process of vanishing a category S of phenomenological orthosenses, that is a phenomenological universe which is not coupled with orthoenergy, then on S a zeroautofunctor 0_{af} has to act, which (Fig. 3) is a sum of **zeroendomorphisms.** A *zeroendomorphism*, which is not a zero morphism, taking into account the previous presented definition (the zero morphisms were introduced in the classical theory for linear *structural* categories), is an endomorphism of a phenomenological object which annihilates that object. The fundamental monoid of existence does not have a zeroautofunctor, or a zeroautofunctor does not function for it.

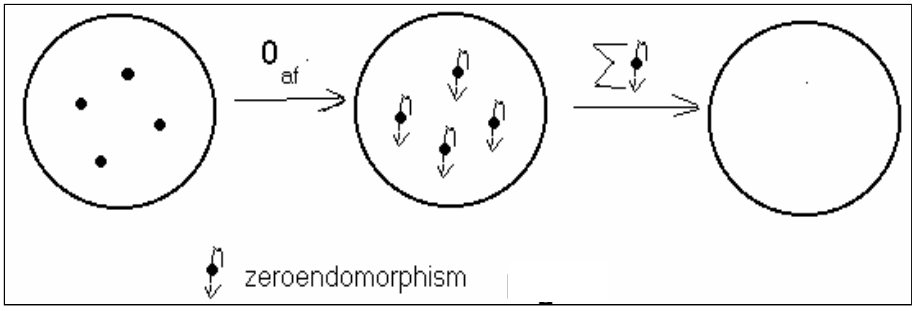


Fig. 3. – The action of a zeroautofunctor and its intermediary zeroendomorphisms.

If one considers a given universe U, which is structural-phenomenological, if something happens in the structural realm U, because of the structural-phenomenological functor H_1, a modification will take place also in the phenomenological part S. If something happens in the phenomenological category S, because of the phenomenological-structural functor H_2, some changes happen in U. But what types of happenings may take place in the phenomenological category of a universe?

Indirectly, we have some proofs that there are happenings that manifest themselves, at least in a part of a universe, for instance in a brain/mind, as intuitions and creations that cannot be explained by structural science. But they

exist. Therefore a phenomenological category connected with a structural one may have its internal workings, and perhaps new types of specific phenomenological morphisms could be defined. But these are question to be explored in the future.

6. FINAL REMARKS

This paper was maintained at the level of fundamental elementary notions of the theory of categories. Extending this theory to the phenomenological domains, new notions were introduced, some similar to those of the classical category theory, others quite new.

Before a real integrative science is established, the extension of the theory of category to the phenomenological domains depends much on the *philosophy of integrative science* accepted by one author or another. For instance, Marty used the phenomenological vision of C.S Peirce. Philosophical suppositions concerning phenomenological processes have common traits and this is normal. As such, it seems that Marty's phenomenological semantics may be taken into account under a more general frame.

The notions introduced by the author of this paper are influenced by his own philosophy (Drăgănescu 1979, 1985) and the common principles agreed by Drăgănescu and Kafatos (1999).

The other line of treating the consciousness problem by the theory of categories, developed by Kato (2001 a, b), uses a higher level of the category theory. Will it associate with an explicit phenomenological treatment?

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