

PRODUCTS OF PHENOMENOLOGICAL CATEGORIES AND PRODUCTS OF PHENOMENOLOGICAL FUNCTORS

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In this paper it is shown that the product of categories and the product of functors may be extended from the structural to the phenomenological domains. For the phenomenological domains the products of functors applies both to functors and autofunctors. Examples of such products representing feasible physical and informational processes are given in the case of the generation of a phenomenological universe in the deep existence (orthoexistence).

It is also shown that for the dynamics of the deep existence some types of orthosenses previously defined by the author might be replaced in a natural way by autofunctors and functors acting in the deep existence on the main orthosenses that represent the deep phenomenological information.

1. INTRODUCTION

1. In the domain of classical structural categories one defines [1], [2], [3]:

- the product of categories;
- the product of objects in a category;
- the fibered products of objects in a category;
- products of functors;

In this note one examines the extension of the product of categories and the product of functors for phenomenological categories. In [4], [5] the product between a structural category and a phenomenological category was used for building a structural-phenomenological category. From feasibility considerations it was shown that only a subproduct (a part) of the product might form a structural-phenomenological category and not the entire product.

The fibered product of two objects in a phenomenological category is not considered in this note. The product of objects in a phenomenological category will be examined in another paper.

2. THE PRODUCT OF CATEGORIES

The definition of the product of two or more categories from the structural realm may be extended directly to the phenomenological categories *because the products involve objects of two or more categories, independently of their nature.*

In a phenomenological category the objects are phenomenological [4].

Therefore, both for structural and phenomenological categories is valid the classical definition of the product of categories. The product of two or more categories C_1, C_2, \dots is *the category product* [2]

$$\prod C_i = C_1 \times C_2 \times \dots \times C_n \quad (1)$$

where $i \in I$ and $I = 1, 2, \dots, n$.

The objects of the product category are all the *families* of the form

$$(Y_j)_{j \in J} = (X_1, X_2, \dots, X_n) \quad (2)$$

where X_1 is an object of C_1 , X_2 an object of C_2 , etc.

In the case of two categories, C_1 having the objects A1, B2 and C_2 having three objects A2, B2, D2, the product category $C_1 \times C_2$ will be as shown in Fig. 1.

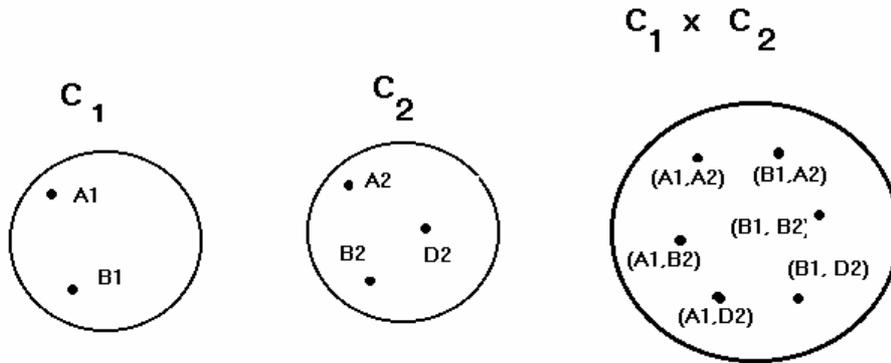


Fig. 1

The category $C_1 \times C_2$ has 6 objects of six families of objects, every family having two objects.

In general, if r is the number of objects of C_1 , s is the number of objects of C_2 and t is the number of objects of C_3 etc, the number of objects of $C_1 \times C_2 \times C_3 \dots$ will be

$$J = r \times s \times t \times \dots \quad (3)$$

The morphisms of the product category are products of morphisms of categories C_i .

The morphism from the object (A1, A2) to the object (B1, B2) in Fig. 1 will be

$$(A1, A2) \rightarrow (B1, B2) = (A1 \rightarrow B1) \times (A2 \rightarrow B2) = (A1 \rightarrow B1, A2 \rightarrow B2) \quad (4)$$

i.e. the product of the two morphisms $(A1 \rightarrow B1)$ and $(A2 \rightarrow B2)$ or the couple of two morphisms.

In Fig. 2 are shown two categories C_1 and C_2 , each with two objects and one morphism.

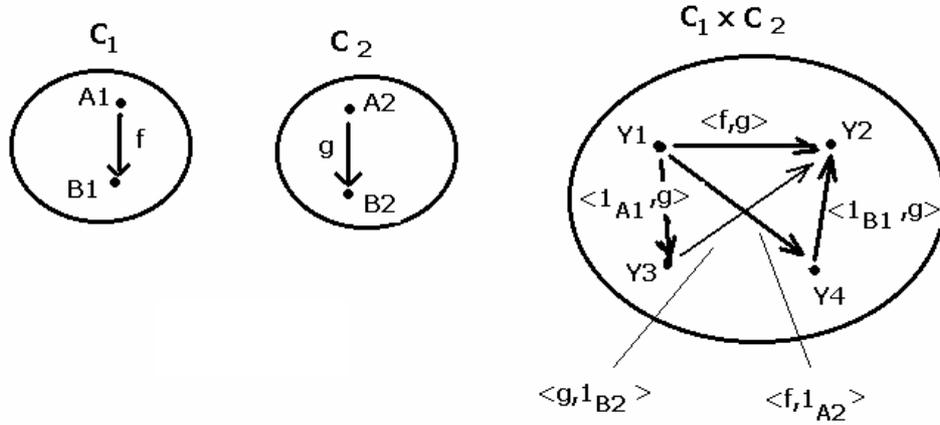


Fig. 2

The product category $C_1 \times C_2$ has four objects,

$$Y1=(A1, A2); Y2=(B1, B2); Y3=(A1, B2); Y4=(A1, B2) \quad (5)$$

and the following morphisms,

$$Y1 \rightarrow Y2 = f \times g = \langle f, g \rangle \quad (6a)$$

$$Y1 \rightarrow Y4 = f \times 1_{A2} = \langle f, 1_{A2} \rangle \quad (6b)$$

$$Y1 \rightarrow Y3 = 1_{A1} \times g = \langle 1_{A1}, g \rangle \quad (6c)$$

$$Y2 \rightarrow Y4 = 1_{B1} \times 0 = 0 \quad (6d)$$

$$Y2 \rightarrow Y3 = 0 \times 1_{B2} = 0 \quad (6e)$$

$$Y2 \rightarrow Y1 = 0 \times 0 = 0 \quad (6f)$$

$$Y3 \rightarrow Y4 = f \times 0 = 0 \quad (6g)$$

$$Y3 \rightarrow Y2 = f \times 1_{B2} = \langle f, 1_{B2} \rangle \quad (6h)$$

$$Y3 \rightarrow Y1 = 1_{A1} \times 0 = 0 \quad (6i)$$

$$Y4 \rightarrow Y1 = 0 \times 1_{A2} = 0 \quad (6j)$$

$$Y4 \rightarrow Y2 = 1_{B1} \times g = \langle 1_{B1}, g \rangle \quad (6k)$$

$$Y4 \rightarrow Y3 = 0 \times g = 0 \quad (6l)$$

It may be seen that in the category $C_1 \times C_2$ there are only five morphisms, from a total of possible 12 morphisms, because in C_1 and C_2 arrows are leaving only from $A1$ and $A2$. Evidently, 1_{A1} and 1_{A2} are identity morphisms and 0 is a zero morphism. Because $Y2 = (B1, B2)$ and in C_1 and C_2 no arrow is leaving from $B1$ and $B2$ respectively, then no arrow is leaving from $Y2$ in $C_1 \times C_2$. The nodes $Y1$

and Y_2 have three links and the nodes Y_3 and Y_4 have two links. From Y_1 all arrows are leaving, for Y_2 all arrows are arriving. For the nodes Y_3 and Y_4 one arrow is arriving and one arrow is leaving.

If C_1 has also an arrow (morphism) from B_1 to A_1 , as in Fig. 3, then the number of morphisms in $C_1 \times C_2$ increase from 5 to 8 from a possible of 12 (this may be easily proofed as in the previous case. It may be observed that adding a new link (inverse link) in C_1 the number of links increased with 3 in this case. The product of two simple categories gives a very reach category in links, producing a complex network of morphisms.

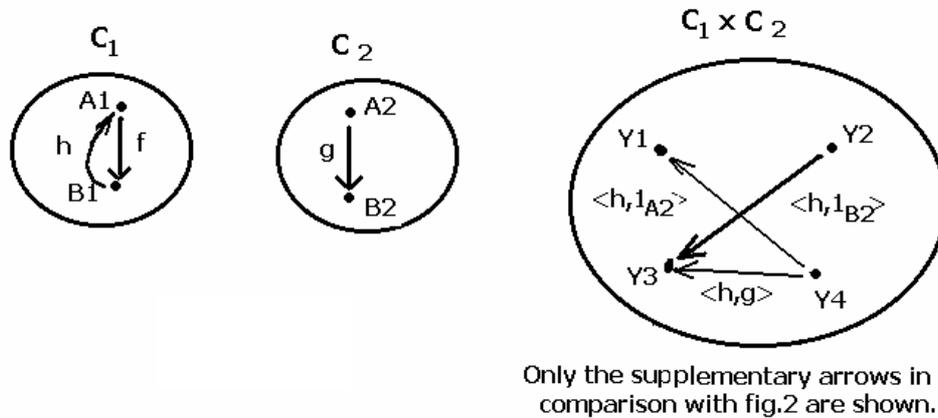


Fig. 3

It may be shown that for the product category all the other conditions for a category are fulfilled [2].

3. UNIVERSES AND MINDS

Which is the meaning of the product of two or more phenomenological categories?

Let us take into consideration two phenomenological categories $C_{p_{he1}}$ and $C_{p_{he2}}$, the objects of each category being phenomenological senses. The product combines all these phenomenological senses in pairs, every pair being a *complex* of two phenomenological senses. This might be indeed feasible from an informational-physical point of view.

For instance, when the phenomenological category of a universe $C_{p_{he.univ}}$ is born, it might happen to be composed of a subcategory of the topological phenomenological senses of a future space in the structural universe, of a subcategory with a family of some specific phenomenological senses, of another

subcategory with another family of other phenomenological senses, etc. The product of these phenomenological subcategories completes the final phenomenological category of a universe.

The *product could be a natural phenomenon* to produce objects with complex phenomenological senses, every object being, perhaps, the phenomenological core of an elementary particle, at a convenient level of elementarity.

In [6] were defined five main types of phenomenological categories. Four of these (the phenomenological category of the entire existence, the phenomenological category of a universe, the phenomenological category of the Fundamental Consciousness and the free phenomenological category) depend *primarily* on phenomena in orthoexistence (deep reality). The fifth type, the phenomenological category of the mind, depends primarily on the constitution of a living *structure* in a universe, *i.e.* the constitution of a living body or a brain in a universe. The phenomenological part of the mind is as important as the structural part, if not more important, but the mind is not constituted first in the phenomenological realm, and then is coupled to a body.

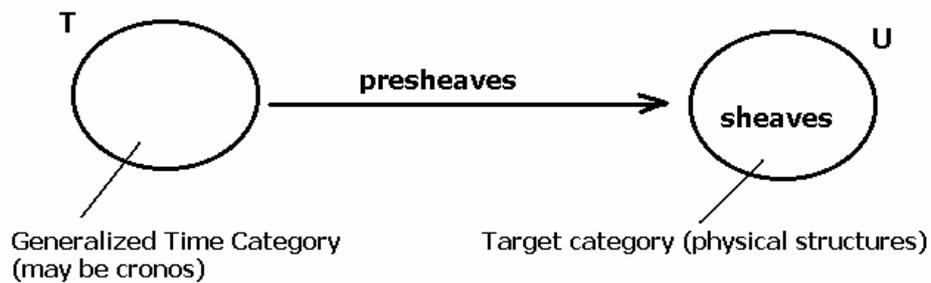
The mind is structural-phenomenological. The structural and phenomenological parts are complementary, not dualistic as Eccles [7] and others proposed. For Eccles the mind is a separate entity, in interaction with the brain made of matter-energy, the mind (soul, self-consciousness, self) being created by God and coupled by God with a brain [8], [9]. Eccles did a big advance in the scientific thinking of the XXth century showing that the structural science is incomplete and insufficient to explain mind and consciousness. The same idea about the structural science, not only for describing mind and consciousness, but the entire reality was expressed by myself independently in 1985 [18] and in following papers and books.

Mind is formed by a secondary step in the phenomenological realm, after the first step of a formation of a body (brain) in the structural realm. On the contrary, the universe begins in the phenomenological realm, and only as a second step becomes also a structure. The science of the integrative universe and the science of the integrative mind have many common features, by using the same ingredients, but will have also important differences.

The point of departure of a universe are phenomenological phenomena in orthoexistence in the rhythm of ‘cronos’ (the cosmic tact, without duration and arrow of evolution, but ordering in a way, the dynamics of processes in orthoexistence [10]), or the ‘phenomenological clock’. This may be considered a rudiment of time, a *pre-time* [11]. In such a case, a theory of the physical structural reality of the universe might have a simplified form beginning with a category of pre-time (generalized time-category), from which functions under the form of presheaves are going to (creating) physical structures in a target structural category formed by a product of a family of categories (Kato theory [12]). For Kato the same procedure may be followed both for the physical universe and the mind

(consciousness), as may be seen from the works [12]. I presented in [13] some comments on Kato theory. For the physics of a universe the things are simplified because if we admit the pre-time as a phenomenological cronos, all the other intermediary phenomenological processes are overlooked, the presheaves leading directly to a final target, a structural category (Fig. 4a).

a)



b)

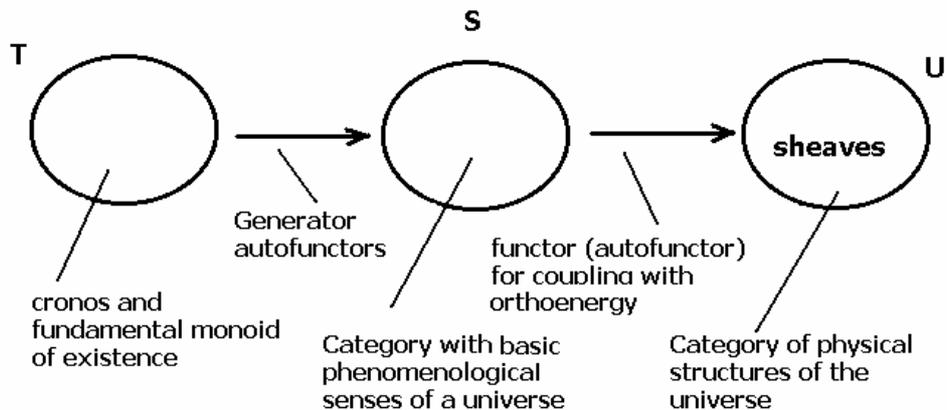


Fig. 4

In Fig. 4b is shown after [14] a some more detailed process in which are taken into account the fundamental phenomenological senses of existence (the fundamental phenomenological monoid of existence [14], [15], [5], the generation of the category of the phenomenological senses of the universe, and after coupling with orthoenergy, the constitution of the structural part of the universe. The integrative universe (the real universe) is formed both by the two categories S and U in Fig. 4b.

Where is the time of the universe in the above schemes? This is not yet clear. As is known from physics (structural physics) the arrow of time appears, it seems,

when there are great ensembles of particles (or elementary entities); more exactly, the arrow of time could be an affair of the community of elementary entities, *i.e.* might be the result of the network properties of these communities [16]. These might become an important component of the proposed integrative science [17].

Concerning the mind, it seems not to be so sure that the point of departure is the generalized time, or pre-time (or cronos), excepting the case that the process from T to U is extended, in a way, further to the phenomenological category of mind M as shown in Fig. 5, where all the detailed processes of Fig. 5a are concentrated in the synthetic scheme of Fig. 5b. Fig. 5b is similar to Fig. 4a for a universe. It may be observed that the category of mind or of the community of minds M is structural-phenomenological, the phenomenological part having a peculiar dynamics [6].

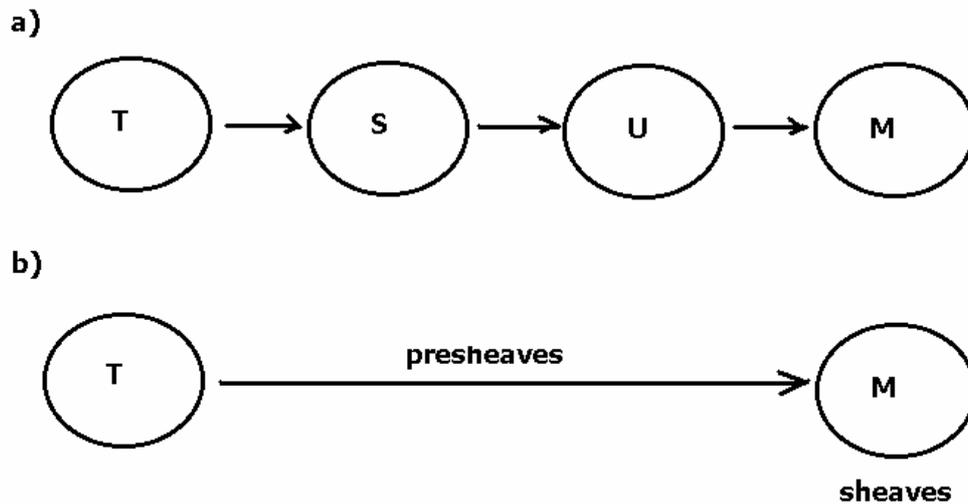


Fig. 5

4. CLASSES OF ORTHOSENSES

In [18], [19] were defined and systematized the following orthosenses in the deep existence, that are important for the birth of a universe:

* *The fundamental orthosense <to exist>* (infraconsciousness of existence, fundamental experience of informatter), noted with <1>, that has three components, as shown in Fig. 6.

In [14], to the orthosense <to exist from itself > is associated an autofunctor F_A which is a physical informaterial functor that generates families of orthosenses (phenomenological categories) for building a universe and, perhaps, the Fundamental Consciousness of Existence.

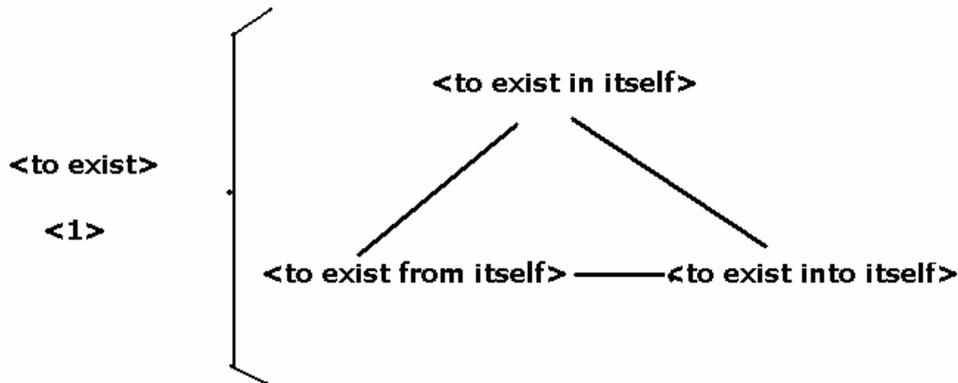


Fig. 6

In [15] it is shown that $\langle 1 \rangle$ is a fundamental phenomenological set of existence. In [5] it was observed that $\langle 1 \rangle$ is also a category, with one object, the fundamental set of existence with three elements. This category was named the fundamental monoid of existence [15].

Because functors are acting among categories, the point of departure (the domain) of the autofunctor F_A is the monoidal category $\langle 1 \rangle$. F_A is associated with the orthosense $\langle \text{to exist from itself} \rangle$.

Are there also other phenomenological autofunctors? The answer may be yes, because the autofunctors seem necessary for the selfdynamics of the processes in orthoexistence.

*** **Basic fundamental orthosenses**, derived from the fundamental orthosenses, in general by autofunctors.

In the tact of the cronos [20], two great types of *basic phenomenological orthosenses* [18], F_A may generate [19]:

- ➔ topological orthosenses [21];
- ➔ movement orthosenses.

The movement orthosenses may be [18], [19],

- of interaction (charge orthosenses);
- of coupling/decoupling with orthoenergy;
- of division.

All these movement orthosenses were proposed in the beginning of the years 1980's taking into account only elementary particles, y compris quarks, but not the strings or superstrings. In the latter case a revision of the families of orthosenses, especially of interaction orthosenses, seems to be necessary, but it will not be done here. Our interest in this paper is to show the role of phenomenological functors and especially of the products of phenomenological categories in the phenomenological realms.

5. THE GENERATION OF A PHENOMENOLOGICAL UNIVERSE

We shall consider now the generation of a universe. The autofunctor F_A generates first (Fig. 7) the phenomenological category of a universe [14].

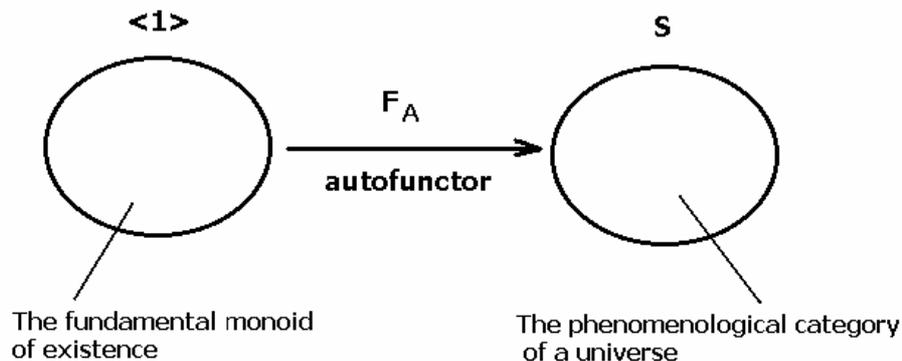


Fig. 7

In detail, from $\langle 1 \rangle$ to S , there are some intermediary stages. First, at a tact of a cronos, by fluctuation of informatter are generated the topological orthosenses of the universe and the family of charge (interaction) orthosenses of that universe. To these processes (Fig. 8) correspond: an autofunctor $F_{A'}$ which may BE modeled as a set of functors;

F_{A0} – that generates the phenomenological category $\langle \text{otop} \rangle$ with the topological phenomenological orthosense of that universe;

$F_{A1}, F_{A2}, \dots, F_{An}$ – that generate the phenomenological categories $\langle \text{os1} \rangle, \langle \text{os2} \rangle, \dots, \langle \text{osn} \rangle$ each of them having a charge (interaction) orthosense.

At the following tact of the cronos, the autofunctor F_{div} produces a division of these orthosenses. The orthosense $\langle \text{otop} \rangle$ is divided by $F_{\text{div}0}$ (Fig. 8) giving the phenomenological category $\langle \text{otop} \rangle_{\text{div}}$. *This is not a process of multiplication* of the category $\langle \text{otop} \rangle$ with itself for a great number of times, because in the category $\langle \text{otop} \rangle_{\text{div}}$ are generated morphisms among the topological orthosenses which introduces some order for the orthosenses to be able to form later an ordered structural space of n dimensions. On this depends the actual number n of dimensions, as the possibility to form a future 3 dimensional structural space, complemented with a $n-3$ subjacent space, or of any possible configuration of the n dimensions.

The morphisms created among the objects of $\langle \text{otop} \rangle_{\text{div}}$ are assuring the ordered neighborhoods of the orthophysical points (or cells) of the space and finally of the quanta of the structural space. These morphisms will be named *neighboring morphisms* and they represent, in this model, physical and informational realities. This type of morphism may be added to those already considered in a previous paper [22].

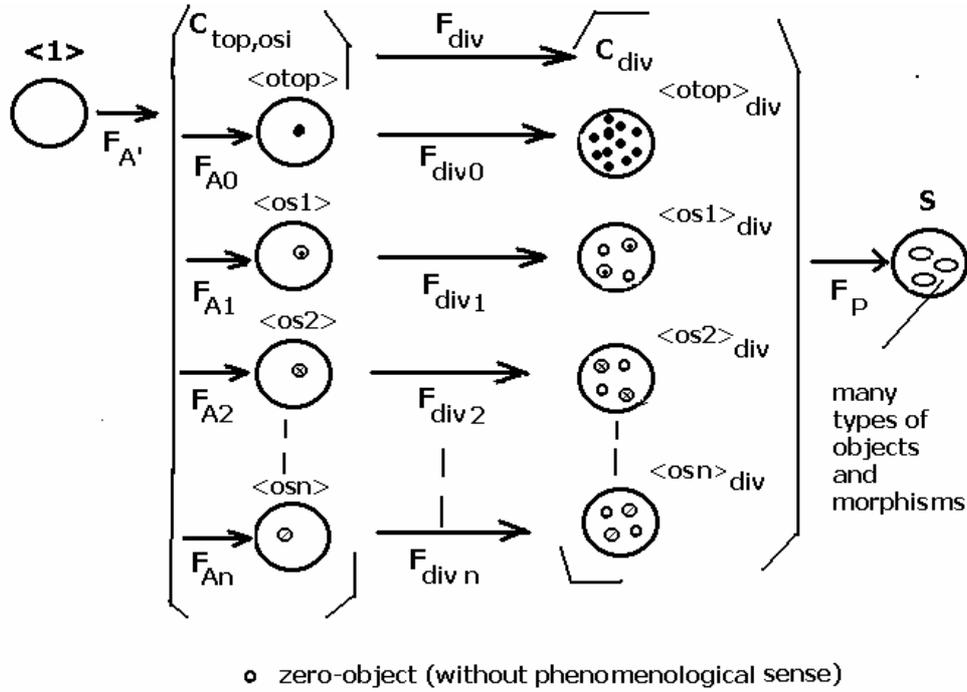


Fig. 8

It may be seen that the autofunctor F_{div0} , and consequently F_{div} , which has many components (Fig. 8) are rich autofunctors.

In part 3 of this paper were mentioned the orthosenses of division as a class of movement orthosenses. They are indeed necessary in the model of orthoexistence introduced in [18] – year 1985 – because at that moment the theory of categories for phenomenological processes was not used. Only later – year 2000 – the possibility was realized to use the concepts of phenomenological categories.

When the theory of categories and functors are used, by extension, to the phenomenological domain, one may renounce to the class of orthosenses of division, because these may be replaced by division autofunctors.

The new model presented in this paper does not consider necessary the orthosenses of division. Still these had the role to signal the phenomena of division of orthosenses that is better represented now by autofunctors as shown before. The autofunctors become an important ingredient of orthoexistence.

The autofunctor F_{div} (Fig. 8), besides F_{div0} discussed above, has also the components F_{div1} , F_{div2} , ..., F_{divn} , each of these components being an autofunctor.

The effect of an autofunctor F_{divj} , where $j = 1, 2, \dots, n$ is to generate a number of identical orthosenses of type j , a number of phenomenological zero-objects (Fig. 8), and corresponding morphisms. This is necessary, as it will be seen for the final

constitution of the phenomenological category S of a universe. A phenomenological zero-object is a cell (point) of informatter without any topological or charge (interaction orthosense). There is no category of only zero-objects, such objects are only in the categories $\langle os1 \rangle_{div}$, $\langle os2 \rangle_{div}$, ..., $\langle osn \rangle_{div}$. Still the zero-object has the general orthosense $\langle 1 \rangle$ which is preset, by definition, in all informatter, in all points (cells). The phenomenological zero-object has no orthosense except the orthosense $\langle 1 \rangle$.

In fact, a category $\langle osi \rangle$ has two types of objects, one orthosense, named also $\langle osi \rangle$, and the zero-object which is also the orthosense $\langle 1 \rangle$. The division applies to both these orthosenses, and that is why $\langle osi \rangle_{div}$ has many orthosenses of both types (Fig. 8).

The $\langle osi \rangle_{div}$ category has perhaps morphisms among all $\langle osi \rangle$ orthosenses (for instance if to such an orthosense corresponds in the structural an electric charge, these will interact). The morphisms of $\langle osi \rangle$ will be *morphisms of interactions* among the same type of orthosenses, after the type of charge they represent in the structural realm.

The next step of F_A is the production of S (Fig. 7). *This may be obtained by the product of the phenomenological categories (Fig. 8),*

$$\langle otop \rangle_{div} \times \langle os1 \rangle_{div} \times \langle os2 \rangle_{div} \times \dots \times \langle osn \rangle_{div} = S \quad (7)$$

The product (7) of those phenomenological categories corresponds to a feasible process of generation of the phenomenological category of a universe. This is represented by F_P (Fig. 8) applied to the categories $C_0 = \langle otop \rangle_{div}$, $C_i = \langle osi \rangle_{div}$, $i=1, 2, \dots, n$. Then

$$F_P (C_0, C_1, C_2, \dots, C_n) = C_0 \times C_1 \times C_2 \times \dots \times C_n = S \quad (8)$$

Because F_P listen to a tact of the cronos, it is also an autofunctor. Then

$$F_A = F_P \times F_{div} \times F_A' \quad (9)$$

i.e. the general autofunctor F_A is the product of three autofunctors. Concerning the autofunctors I already observed: *“The essence of an autofunctor for a phenomenological category is to give birth to a physical and informational process, which is non-computable, non-formal, unpredictable from an observer from an universe”* [14, p. 204].

Most of the objects of S are of the form shown in Fig. 9a comprising only topological orthosenses and becoming later *quanta of space*.

In Fig. 9b, 9c, 9d, etc. there are objects of S with only one interaction orthosense and a topological orthosense. Other objects are shown in fig.9e and 9f with two interaction orthosenses and a topological orthosense etc. These will become later *quanta of matter*, positioned in space corresponding to their topological orthosenses.

The morphisms among the objects of S are determined by the morphisms in the categories participating at the product (see part 2 of this paper).

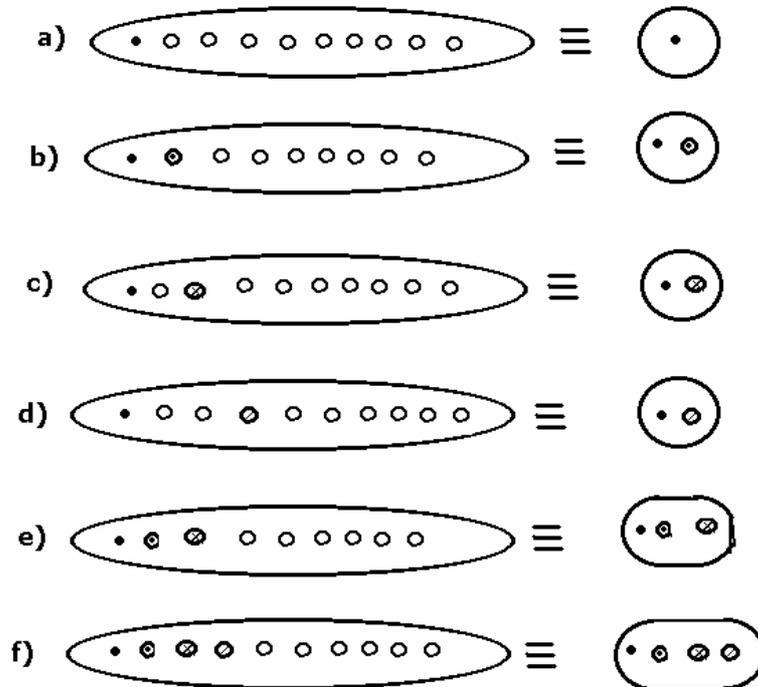


Fig. 9

6. THE GENERATION OF THE STRUCTURAL UNIVERSE

The following step in the generation of a universe is the coupling with orthoenergy [18], [19], [14]. In [14] it was considered (Fig. 10) that the coupling is realized by a functor (F_{SU}) for which two possibilities were envisaged: "a) the component <to exist into itself> of <1> is acting the functor F_{SU} expressing the potential tendency to receive senses from the development of a real universe; b) the functor F_{SU} is controlled by the Fundamental Consciousness of existence who may decide if it is the case to apply or not this functor in a specific case of a generated phenomenological category [14, p. 203].

In any case, F_{SU} is associated with <1> and in [14, p. 19] I observed: "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".

F_{SU} does not generate something new, it only couple existing elements. For this reason it is not an autofunctor.

In order for a universe to constitute alive structures [18] it is necessary for informatter to take part to such structures without being coupled to the orthoenergy. For this, F_{SU} couples all the informaterial cells of S that have interaction orthosenses

(charge orthosenses) with orthoenergy, *but not all the informaterial cells that have only topological phenomenological orthosenses*. Perhaps, an amount of cells with topological phenomenological orthosenses are coupled and the rest is not coupled. It may happen that the amount of not-coupled cells to vary from 0 to 100%, depending of a random quality of F_{SU} .

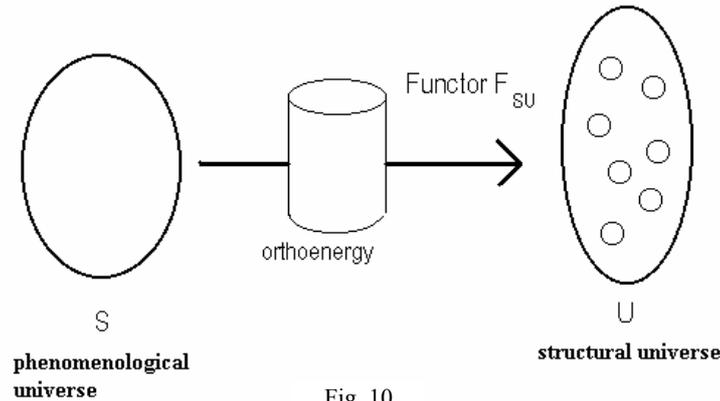


Fig. 10

These non-coupled cells are like quanta of space without carrying energy, only phenomenological information.

It may be seen that the *coupling orthosense* introduced previously [18], [19] and presented in part 4 of this paper is not necessary, as were not necessary the orthosenses of division, *in the case of using the theory of phenomenological categories*, for the same reasons advanced in the previous case.

The problem of decoupling orthosenses will not be examined here. In [5] a zero-autofunctor was introduced that may vanish a phenomenological category S *before* coupling with orthoenergy, but was not examined the possible decoupling of a couple $\langle S, U \rangle$.

7. CONCLUSIONS

The dynamics of $\langle 1 \rangle$ is given by its automorphisms [15]. Excepting the identity map, $\langle 1 \rangle$ has a number of possible automorphisms, each of them setting in function one of the autofunctors and functors associated with $\langle 1 \rangle$, like $F_{A'}$, F_{div} , F_P , F_{SU} and others. These automorphisms and functors enter into function at successive tacts of cronos.

In this paper it was shown that the product of categories and the product of functors may ended be extended from the structural realm to the phenomenological domain, where new functors were defined, namely the autofunctors, and also the product of autofunctors.

If one combines Fig. 8 with Fig. 10 one obtains a sequence of functors shown in Fig. 11.

The last two categories in Fig. 11 are forming the structural-phenomenological universe U [14].

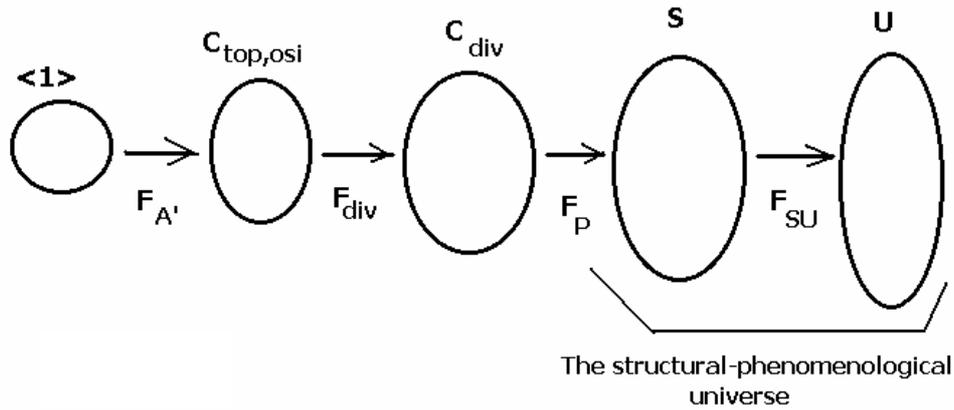


Fig. 11

$F_{A'}$, F_{div} , F_P are acting in sequence, each in a tact of the cronos. After the first tact $F_{A'}$ is acting no more, it is not more present in the process. The same is valid for F_{div} and F_P . Only the categories S and U remain to form the real, integrative universe U . Some preliminary considerations on U are presented in [14]. Once established, S and U remain in permanent interaction (Fig. 12).

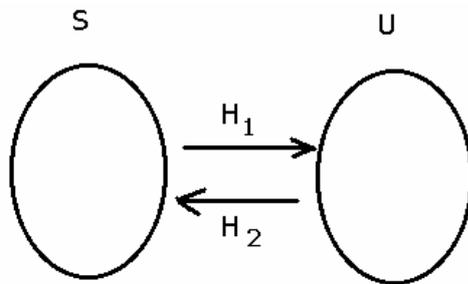


Fig. 12

$$U = \langle S, U, H_1, H_2 \rangle$$

We will observe that the product of the categories S and U , one phenomenological, the other structural gives, under certain conditions [4], a structural-phenomenological category U , defined in principle in [4], of which objects are formed by both phenomenological and structural objects of S and U , but only those objects under the effects of F_{SU} and related by H_1 and H_2 (Fig. 12). The study of an existing integrative universe is a problem to be studied further carefully.

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- [20] From [19, p. 78]: “Without a deep cronos could not be a fundamental framework of any change, without cronos would not exist a reason for the time, and also for causality. [...] Cronos is the primordial agent of change, it is the first agent of discontinuity in the continuity and unity of informatter, it is a fundamental physical process, inherent to the deep matter”.
- [21] From [19, p. 79]: “The informatter is a physical ingredient that has a specific continuous quality, it is a unity due to the fact that if we imagine it divided in parts, every part is neighboring any other part due to a special topological quality of the orthosense <to exist>. When the orthosense <to exist from itself> produces new topological orthosenses, besides that of the unity mentioned before, these new topological orthosense distribute themselves in various 'parts' of informatter.[...] That is why a process of fluctuation produces in some way in informatter a phenomenon of cells formation, every part (cell) of informatter having an ensemble of topological and movement orthosenses. [...] Every orthoexistential cell will organize itself topologically with neighbors corresponding to their topological orthosenses. One of these orthosenses corresponds to the organizations of the usual space of our universe with three dimensions. But may be produced and other topological organizations if there are also other topological orthosenses. We shall name the space that might manifest, due to such topological orthosenses, as *subjacent spaces* to the usual space. The before mentioned topological organizations must not be understood *in a space*, but as generators of spaces, among which also the usual space. Informatter is not a space but a more subtle reality in which are generated a family of spaces”.
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