Pretopology, Quanta of Space and the Fundamental Phenomenological Information of the Universe

Mihai DRĂGĂNESCU[1] and Sisir ROY[2,3]*

[1]*Research Institute for Artificial Intelligence of the Romanian Academy*
[2]*Physics and Applied Mathematics Unit, Indian Statistical Institute, Calcutta, India*
[3]*School of Computational Sciences and Center for Earth Observing and Space Research, George Mason University, Fairfax, VA 22030-4400, U.S.A.*
**E-mail address: sisir@isical.ac.in*

Abstract. The birth of a universe is described as having two main stages: a) a phenomenological informational process that generates the fundamental phenomenological information of the universe; b) an informational—energetic process which produces the structural universe. It is shown that the laws of the universe have a semantic origin, producing a cellular universe, both at the phenomenological and structural levels.

1. Introduction

The origin of the matter constituting this world is an important but difficult problem. It is often discussed that a birth of the cosmos followed the big bang about 16 billion years ago. But, in the big bang theory it is assumed that the matter existed from the beginning and the origin of this matter is not asked. It is a big challenge to constitute a logic to explain the origin. Since we have no experimental evidence for it, the only motivations would be the simpleness and the common sense of physics. In the main text of this paper several new concepts are introduced to construct the theory, such as "monoid", "orthoenergy" and "cronos". They are proposed so that they assure the origin of existence and diversity of the matter.

The recent developments (ISHAM, 1995) in our understanding of matter and their implications for contemporary research in foundations of physical laws raise new interest to study the role of information theory for the description of physical processes in the universe. The unification of various forces in nature demands that all the forces become similar at high energies if supersymmetry is true. In fact, this kind of standard theory of unification makes sense if electrons and quarks are considered as fundamental i.e., without assigning any structures to them. The charge and mass of these particles cannot be deduced from any form of microscopic considerations. If electrons and quarks are assumed to be composite, this unification fails. LAUGHLIN and PINES (2000) emphasized that these

quantities can not be deduced from the "Theory of Everything" even if it exists. It follows that electrons, quarks or strings are particles without having structures and appear as first particles after the quanta of space (as Planck unit). Still they have content, because they are material particles. We can not speak about the interior of an electron or a quark. To the electron or to the quark corresponds a phenomenological cell (a phenomenological cell is an object of phenomenological nature) in the phenomenological category of the universe (a phenomenological category is a category of which objects are phenomenological—DRĂGĂNESCU, 2000), in a realm of reality without space, and the cell is carrying a specific phenomenological information for the electron, respectively for the quark, coming from the fundamental phenomenological information of a specific universe. The phenomenological information is a sense, like the mental sense, or qualia, or experience, being quite different from the digital information—see DRĂGĂNESCU (2001a), the Section 'Structural and Phenomenological'.

The phenomenological information was defined in the years 1984–1985 (DRĂGĂNESCU, 1984a, 1984b, 1985; LAUGHLIN and PINES, 2000) following a previous ontological model of existence of one of the authors (DRĂGĂNESCU, 1979). The phenomenological information or the phenomenological sense, in itself, is a phenomenon outside the field of structural science. The science of today which does not take into account phenomenological processes, this structural science is insufficient and incomplete, a general principle established by many authors, like John Eccles, David Bohm, Drăgănescu and Kafatos and many others—see DRĂGĂNESCU and KAFATOS (1999). But the phenomenological senses as elements, when they interact are forming a structure, a phenomenological structure (DRĂGĂNESCU, 2001). Still and all, this structure has not, in most cases, a systemic formal behavior, because in phenomenological realms, when the phenomenological information is not coupled with orthoenergy (orthoenergy is the deep energy, which is different from the energy in the universe, but it is the source of it (DRĂGĂNESCU, 1984), non-formal processes may take place which generate new phenomenological senses (information). This may happen when a new universe is born or in the usual activity of minds. In such cases, the phenomenological structures defined above are not submitted to the structural science. This is one more reason why the structural science is insufficient and incomplete (DRĂGĂNESCU, 2000).

The plan of this paper is as follows: We start with the possible unified theory of physical forces in nature and discuss the role of phenomenological information in building up such a theory in Sec. 2. Then, in Sec. 3, we discuss the phenomenological information at different levels of hierarchy of the existence in the universe. The birth of universe and the concept of fundamental phenomenological information is studied in Sec. 4. This sheds new light on the issue of pretopology, pregeometry at the fundamental level i.e., Planck scale of the physical universe.

2. Unification of Forces and Theory of Everything

There exists various type of forces in nature, like, gravitational, electromagnetic, weak and strong forces. Many attempts have been made to find a unification of all these forces. If we start with an object in our everyday life and make it smaller and smaller, we will reach at the atoms, electrons, protons, neutrons and quarks etc. The question is whether

we can build up all the material objects starting from fundamental objects like electrons and quarks. However, the underlying motivation is to find a set of equations capable of describing all phenomena in nature. This is known as the **Theory of everything or Ultimate theory of the Universe** (LAUGHLIN and PINES, 2000).

In supersymmetric extension of standard theory of elementary particles, it has been proposed that electrons and quarks are considered as fundamental objects without any internal structures. Here, the unification of forces fail if electrons and quanta are considered as composite particles.

Again, the attempts to incorporate gravity into quantum mechanical framework, leads us to a new search for deeper understanding of the nature. It is believed that superstring theory might provide this understanding. Strings are considered as one-dimensional filament like objects, vibrating to and fro. The elementary ingredients of the universe are not now point like objects but one dimensional filaments. On the average, strings are of the size of Planck length. Strings are considered as fabric of space-time like a piece of material out of which the universe is tailored. This may give rise to new possibility to understand the space-time at small scales. But as ordinary piece of fabric is the end of product of raw material, string theory does not suggest an answer to the question: **What is there before the string?** However, ultimately, the strings constitute the elementary particles, the atoms and, hence all the matter in the universe. So, at the level of string i.e., **at Planck scale (~10^{-33} cm), is the world really incomprehensible?** At the level of quanta of space-time i.e., at Planck scale, the string appears. The most challenging question arises whether it is possible to formulate an effective theory where not only the mass and charge of the electron and quark can be calculated but also the space-time and rules of quantum theory? At this point, we have a different approach. We propose that Planck cell corresponds to a phenomenological cell in the phenomenological category of the universe, in a realm of reality without space and the cell is carrying a specific phenomenological information for strings or for mass and the charge of electron and quark, coming from the fundamental phenomenological information of a specific universe. It is amazing to note that BOTTA-CANTCHEFF (1998) tried to define the concept of space-time in relation to the "phenomenology" of the physical interactions. However, this approach is still in infancy and needs careful analysis.

3. The Place of Phenomenological Information

The ontological frame of the phenomenological information was presented previously (DRĂGĂNESCU, 2003) in a synthetic manner as shown in Figs. 1, 2 and 3.

In Fig. 1, are presented the main four levels of existence. The first two levels constitute the orthoexistence (the deepest underlying zone of the existence).

In Fig. 2 are shown the elements that generate a phenomenological category, for instance of a universe. The dynamic of the primordial information together with the action of the cronos (the frame of change in the phenomenological domain of the deep reality, a tact without duration, the source of time in a universe—see DRĂGĂNESCU and KAFATOS, 1999) are working together to produce the phenomenological information (orthosenses) of a universe or for other entities. The phenomenological information is playing an important role at all levels. The physics of today dealing with the universe neglects the

　　　　　　　　　M. DRĂGĂNESCU and S. ROY

First level:　　　　Orthoenergy,

　　　　　　　　　　Primordial information(informatter),

　　　　　　　　　　Cronos,

　　　　　　　　　　Fundamental Consciousness

Second level:　　　Phenomenological categories
　　　　　　　　　　(Clusters of orthosenses)

Third level:　　　　　Universes

quanta (of space and particles)
time, arrow of time
energy, information,
bodies and minds

Fourth level:　　Group, community and social networks

Fig. 1. Levels of existence of the structural-phenomenological model.

First level:

Primordial information(informatter),　　Cronos,

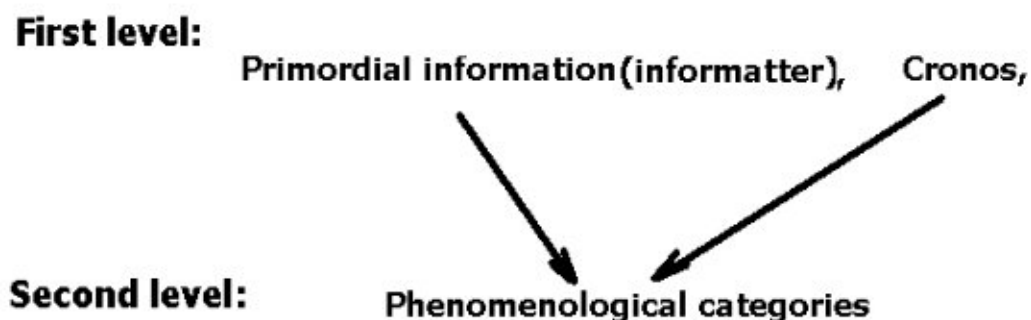**Second level:**　　Phenomenological categories

Fig. 2. The generation of phenomenological categories of the second level, from primordial elements of the first level.

phenomenological information. In Fig. 3 it is shown, how, by the coupling of the phenomenological information of the universe with orthoenergy, a complete structural-phenomenological universe may be born.

　　The fourth level (Fig. 1) of group, community and social networks is an unequivocal and a new level to be taken into consideration by science. This level embraces network phenomena of the second and third main levels of existence mentioned above. An
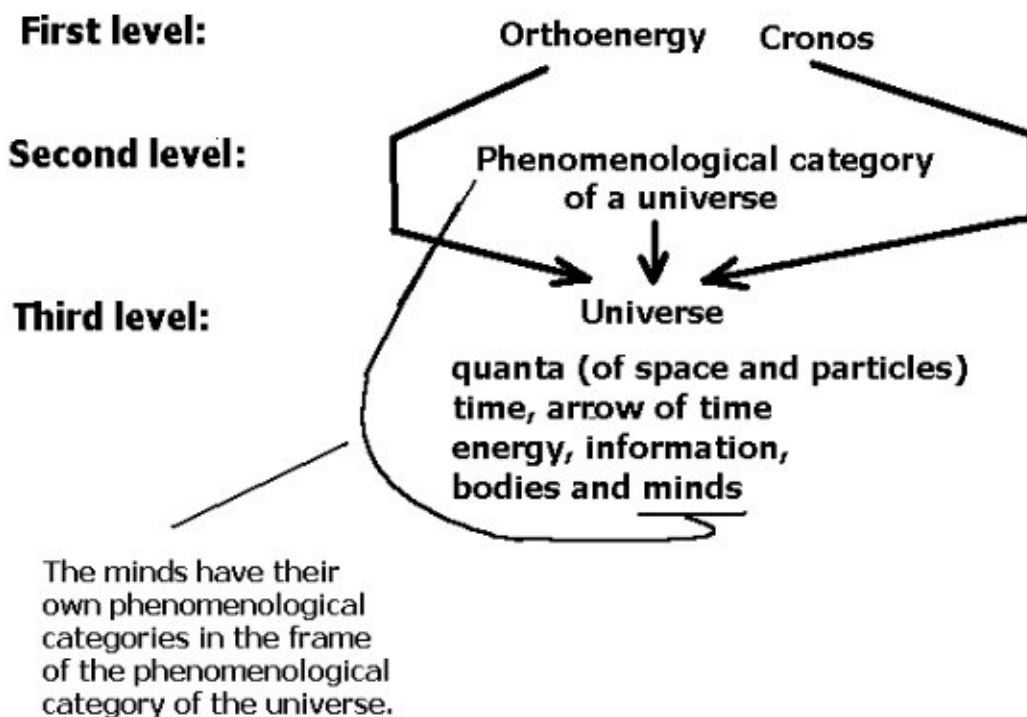
First level: Orthoenergy   Cronos

Second level: Phenomenological category
                                      of a universe

Third level: Universe

quanta (of space and particles)
time, arrow of time
energy, information,
bodies and minds

The minds have their
own phenomenological
categories in the frame
of the phenomenological
category of the universe.

Fig. 3. The generation of a universe (third level) from the elements of the first and second levels.

integrative science has to consider network phenomena (DRĂGĂNESCU and KAFATOS, 2003) both at the phenomenological and structural-phenomenological levels, and not only at structural level (DRĂGĂNESCU, 2003).

4. The Birth of a Universe

We shall now consider the generation of a universe. The autofunctor (the autofunctor is a special type of frunctor acting only in phenomenological domains to generate phenomenological objects—DRĂGĂNESCU, 2001b) F_A first generates (Fig. 4) from the fundamental monoid of existence (the monoid of existence contains the primordial phenomenological information of existence—DRĂGĂNESCU, 2001b) the phenomenological category of a universe.

The following big step in the generation of a universe is the coupling with orthoenergy. That coupling is realized (Fig. 5) by a functor F_{SU}. 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.
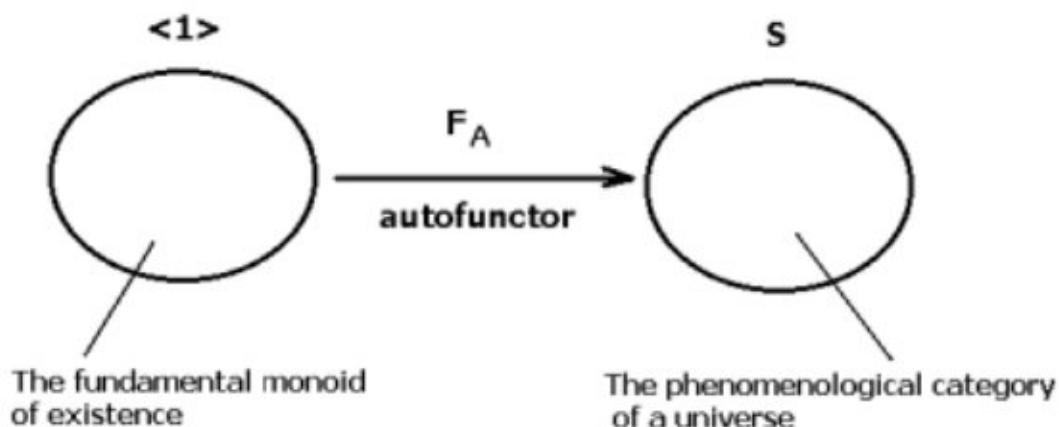
Fig. 4. The generation of the phenomenological category of a universe from the fundamental monoid of existence.
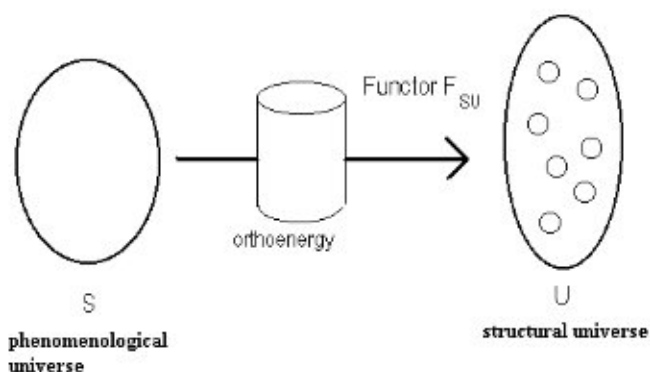

Fig. 5. The generation of the structural universe from the phenomenological universe and orthoenergy.

In detail, from <1> to S, there are some intermediary stages (DRĂGĂNESCU, 2002a) as shown in Fig. 6.

The autofunctor F_A from Fig. 4 is the product of the autofunctors $F_{A'}$, F_{div} and F_P from Fig. 6:

$$F_A = F_P \times F_{div} \times F_{A'}. \tag{1}$$

Here, $F_{A'}$, 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 and no more present in the process. The same type of behavior under the cronos is valid also for F_{div} and F_P.
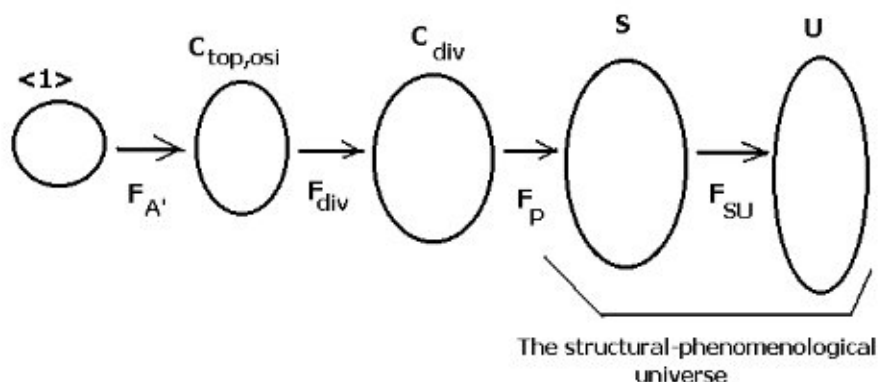
Fig. 6. The detailed stages of the generation of a universe (structural-phenomenological) from the fundamental monoid of existence.

$F_{A'}$ generates a number of fundamental phenomenological orthosenses (senses depending only of deep reality processes),

$$<otop, os_1, os_2, ..., os_n> \tag{2}$$

each of which are forming, a phenomenological category with one object, the respective phenomenological sense (phenomenological information). The first of these, otop (one observes that when otop is alone it is written <otop>, otherwise, like in (2) when it is mentioned in a group with many elements the parantheses < > embraces all of them; the parantheses < > mean that the content is an orthosense or are orthosenses), is the phenomenological topological information, that will determine the arrangement, as neighborhoods, of the final phenomenological cells—(objects) of the phenomenological category of the universe. The other orthosenses determine specific properties for various types of interaction among the same cells mentioned above. Every $os_1, os_2, ..., os_n$ is an orthosense (a sense of the deep reality), like the orthosense corresponding to the electric charge, or the orthosenses corresponding to other charges from the theory of elementary particles.

F_{div}, as it was observed (DRĂGĂNESCU, 2002a), produces a division of the orthosenses of (2). "The orthosense <otop> is divided by F_{div0} (a component of F_{div}) giving the phenomenological category <otop>$_{div}$. *This is not a process of multiplication* of the category <otop> with itself for a great number of times, because in the category <otop>$_{div}$ 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 an $n-3$ subjacent space, or of any possible configuration of the n dimensions.

The morphisms created among the objects of <otop>$_{div}$ are assuring the ordered neighborhoods of the orthophysical points (or cells) of the space and finally of the quanta
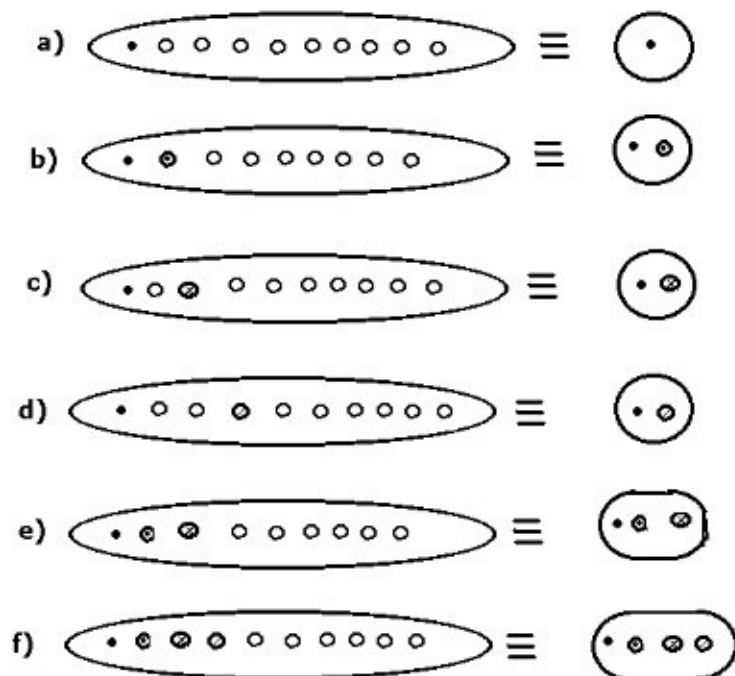
Fig. 7. Types of objects of the phenomenological universe S.

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" (DRĂGĂNESCU, 2002b).

The autofunctor F_{div} produces the phenomenological categories

$$<otop>_{div}, <os_1>_{div}, <os_2>_{div} ... <os_n>_{div} \qquad (3)$$

where

- $<otop>_{div}$ is a category which has a multitude of objects (phenomenological cells) <otop> which represent the phenomenological information of the future structural space of the universe, and
- $<os_j>_{div}$ is a phenomenological category, which has two types of objects, a multitude of phenomenological senses of interaction $<os_j>$ and a multitude of zero-objects and corresponding morphisms.

"The autofunctor F_{div}, 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 $j = 1, 2, ..., n$ is to generate a number of identical orthosenses of type j, and a number of phenomenological zero-objects (Fig. 7),
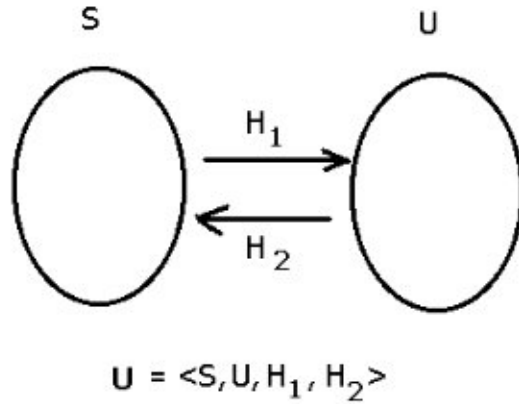
Fig. 8. The functors H_1 and H_2 between the phenomenological universe and the structural universe.

and corresponding morphisms. This is necessary 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 $<os_1>_{div}$, $<os_2>_{div}$, ..., $<os_n>_{div}$. Still the zero-object has the general orthosense $<1>$ which is preset, by definition, in all informatter, in all points (cells). The phenomenological zero-object has no orthosense except the orthosense $<1>$. The phenomenological zero-object as defined above has no orthosense, excepting the fact that being a part of the deep reality still has, as any part of this reality, the fundamental monoid, noted with $<1>$. (For details on phenomenological zero-objects: DRĂGĂNESCU, 2001c, d.)

In fact, a category $<os_j>$ has two types of objects, one orthosense, named also $<os_j>$, and the zero-object which has the complex orthosense $<1>$. The division applies to both these orthosenses, and that is why $<os_j>_{div}$ has many orthosenses of both types.

The $<os_j>_{div}$ category has perhaps morphisms among all $<os_j>$ orthosenses (for instance if to such an orthosense corresponds in the structural realm an electric charge, these will interact). The morphisms of $<os_j>$ will be *morphisms of interactions* among the same type of orthosenses, after the type of charge they represent in the structural realm" (DRĂGĂNESCU, 2002a).

All these $<otop>$ and $<os_j>$ categories are forming together a category C_{div} of which objects are of course categories.

At last, the autofunctor F_P (Fig. 6) was shown (DRĂGĂNESCU, 2002a) to produce the product of phenomenological categories of C_{div}. Then,

$$S = \Sigma C_{div}. \tag{4}$$

This is the fundamental phenomenological information S of a universe at its birth. *This is a phenomenological category.* The objects of this category represent the phenomenological information content of every quantum of the universe (of space and matter). The morphisms

of it represent the neighborhood arrangements, the interactions, changes of neighborhood and the transformations of the phenomenological objects in interactions. It may be observed that the stages 1 to 4 in Fig. 6 correspond to the first and second levels of Fig. 1. This may be seen also from Fig. 2. The stages 4 and 5 in Fig. 6 correspond to the third level in Figs. 1 and 3. In Fig. 6 stages 1 to 4 are necessary because they represent an internal process, not so simple, for obtaining level 2 from level 1 in Fig. 1.

Most of the objects of S are of the form shown in Fig. 7. Those objects with the content of the type of Fig. 7a have only topological orthosenses and become *quanta of space*. And further: "In Figs. 7b, 7c, 7d etc. there are objects of S with only one interaction orthosense and a topological orthosense. Other objects are shown in Figs. 7e and 7f with two interaction orthosenses and a topological orthosense etc. These will become later *quanta of matter*, positioned in space mainly 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 Drăgănescu (2002a)).

Only the categories S and U remain to form the real, integrative universe **U**. Some preliminary considerations on **U** are presented in (Drăgănescu, 2001b). Once established, S and U remain in permanent interaction (Fig. 8).

We will observe that the product of the categories S and U, one phenomenological, the other structural gives, under certain conditions (Drăgănescu, 2000), a structural-phenomenological category **U**, defined in principle in (Drăgănescu, 2000), of which objects are formed both phenomenological and structural objects of S and U, but only those objects under the effects of F_{SU} and related by the functors H_1 and H_2 (Fig. 8).

5. Conclusions

The fundamental phenomenological information S of a universe at its birth, $S = \Pi C_{div}$, represents the result of a phenomenological process in which an important role played the autofunctors F_A, F_{div}, F_P. As it was observed previously (Drăgănescu, 2001b), "*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 for an observer from a universe*".

The autofunctors are phenomenological informational commands of <1>, acting in the tact of cronos **R**. The cronos is a 'permanent' presence in the activity of S. If in the universe there are minds, their phenomenological categories $\sum C_{phemind}$ are part of the phenomenological information of the universe. It remains to take into account the possible phenomenological influence of the Fundamental Consciousness, which is also a phenomenological information. Then *the phenomenological information of the universe* may be

$$S_{phenomenological.univ} = \{<1>, \mathbf{R}, F_A, F_{div}, F_P, S = \Pi C_{div}, \mathbf{Z}, \sum C_{phemind}\}. \qquad (5)$$

Where, **Z** is the Fundamental Consciousness (or the part implicated in the universe). The Fundamental Consciousness was supposed to exist having a root in the fundamental monoid of existence, who has a form of infraconsciousness, 'to exist', that may become an entire consciousness of existence (Drăgănescu and Kafatos, 1999).

$S_{phenomenological.univ}$ represents all the phenomenological information of a universe, and this is not a category, although it contains categories like $S = \Pi C_{div}$ and $\sum C_{phemind}$, and may be **Z**.

It remains to study the networks that are formed by self-organizations or by organization, or by organization due to subcategories of $\sum C_{phemind}$, in the frame of (4) or (5).

The phenomenological categories are categories with phenomenological information. The phenomenological information is always a semantic information. The fundamental phenomenological information of a universe (4) is a semantic information. The phenomenological information of the universe (5) is also a semantic information.

The laws of a phenomenological universe without minds (a mind is understood as a structural-phenomenological object in a universe, and as such any living being is seen as a mind) and without the influence of **Z** are contained in (4) and they are of semantic nature.

The semantic nature of these laws becomes the physical structural laws of the universe, after the coupling with orthoenergy, as shown before.

The semantics of the phenomenological information is a semantics of meaning (sense, phenomenological sense) (DRĂGĂNESCU, 1984a, 1984b, 1985). This is different from the semantics of signification of reference and context (DRĂGĂNESCU, 1984a, 1984b, 1985) which does not imply the meaning (as a phenomenological information), but only the structures of information, as it is case of artificial intelligence, and also of the structural information of the brain.

It may be observed that the fundamental phenomenological information of the universe contains cells (phenomenological objects of the category S), which become quanta of space and matter of the structural universe. If nothing happens from the part of $\sum C_{phemind}$ and **Z**, the structural universe might be seen as a cellular automaton. But the sources of the structural universe are in the phenomenological information and this may be corroborated with the efforts to describe reality under the Planck scale, where the usual mathematics fails and efforts are done to find new mathematical ways (ROY, 2003).

REFERENCES

BOTTA-CANTCHEFF, M. (1998) *The "Phenomenological" Space-Time and Quantization*, http://xxx.lanl.gov/abs/gr-qc/9804084

DRĂGĂNESCU, M. (1979) *Profunzimile lumii materiale* (*The depths of the material world*), Bucharest, translation in English, *The Depth of Existence* (1997), on the Web: http://www.racai.ro/books/doe

DRĂGĂNESCU, M. (1984a) *Cu privire la sens și semnificație: înapoi la Frege* (concerning the notions of sense and signification: back to Frege), in the volume of the author, *Stiința si Civilizație* (*Science and Civilization*), București, Editura Științifică și Enciclopedică, pp. 201–220.

DRĂGĂNESCU, M. (1984b) Information, heuristics, creation, in *Artificial Intelligence and Information; Control Systems of Robots* (ed. I. Plander), pp. 24–25, Elsevier Science Publishers, North Holland.

DRĂGĂNESCU, M. (1985) *Ortofizica* (*Orthophysics*), București, Editura Științifică și Enciclopedică, pp. 371–432.

DRĂGĂNESCU, M. (2000) Categories and functors for structural-phenomenological modeling, *Proceedings of the Romanian Academy*, Series A, Vol. 1, No. 2, pp. 111–115, also at http://www.racai.ro/~dragam

DRĂGĂNESCU, M. (2001a) The frontiers of science and self-organization, *Revue Roumaine de philosophie*, Tome **45**, No. 1–2, 3–19, also at http://www.racai.ro/~dragam

DRĂGĂNESCU, M. (2001b) Autofunctors and their meaning, *Proceedings of the Romanian Academy*, Series A, Vol. 1. No. 1–2, pp. 45–48, also at http://www.racai.ro/~dragam

Drăgănescu, M. (2001c) Automorphisms in the phenomenological domains, *Proceedings of the Romanian Academy*, Series A, Vol. 2, No. 1, pp. 201–205, also at http://www.racai.ro/~dragam

Drăgănescu, M. (2001d) Some results in the theory of phenomenological categories, communication at *The Vth Conference on Structural-Phenomenological Modeling; Categories and Functors for Modeling Reality; Inductive Reasoning*, Romanian Academy, Bucharest, June 14–15, 2001; NOESIS, XXV, pp. 9–23.

Drăgănescu, M. (2002a) Products of phenomenological categories and products of phenomenological functors, research report, Institute of Research for Artificial Intelligence of the Romanian Academy, November 15, to be printed, preprint at http://www.racai.ro/~dragam

Drăgănescu, M. (2002b) Neighborhoods in and among phenomenolgical categories, *Proceedings of the Romanian Academy*, Series A, Vol. 3, No. 3, pp. 105–109.

Drăgănescu, M. (2003) The sources of complementarity between mind and body, *The Noetic Journal*, **4**, No. 1, 33–44.

Drăgănescu, M. and Kafatos, M. (1999) Generalized foundational principles in the philosophy of science, *The Noetic Journal*, **2**, No. 4, Oct., 341–350; republished in *Science and the Primacy of Consciousness, Intimation of a 21st Century Revolution* (2002) (eds. L. A. Richard *et al.*), Chapter 9, pp. 86–98, The Noetic Press, Orinda.

Drăgănescu, M. and Kafatos, M. (2003) *Community and Social Factors for the Integrative Science*, e-preprint http://www.racai.ro/~dragam

Isham, C. J. (1995) *Structural Issues in Quantum Gravity*, http://XXX.lanl.gov/abs/gr-qc/95/0063

Laughlin, R. B. and Pines, D. (2000) The theory of everything, *Procd. Nat. Acad. of Sc., USA*, **97**, 28–31.

Roy, S. (2003) Planck scale physics, pregeometry and the notion of time, in *The Nature of Time: Geometry, Physics and Perception* (eds. R. Buccheri *et al.*), pp. 341–351, Kluwer Academic Publishers, Netherlands.