

# INTEGRATIVE SCIENCE: A PATH OF DEVELOPMENT WITH MIHAI DRĂGĂNESCU

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## Prolegomenon

Mihai Drăgănescu, my good friend Mihai, and I met in 1995 in Fairfax, Virginia at George Mason University (GMU). It was when he presented an invited paper on the structural/phenomenological philosophy of science, as a guest of the Computer Science Department and Gheorghe Tecuci. From the very beginning “we hit in off” as we say in English, it was as I was meeting an old and dear friend. We discussed our common interests on the nature of consciousness, concepts about metaphysics and we found an amazing coincidence of ideas. We accepted each other’s developed ideas. Mihai has published an essay in the *Noetic Journal* on my book *The Conscious Universe*. From this point on, the two friends began to publish common papers and eventually our circle became enlarged as we involved other such Sisir Roy, Goro Kato, in our common endeavors.

Daniele Struppa, the mathematician and presently Dean of the College of Art and Science at GMU and I started discussing ideas about category theory. My hunch was that if there was a fundamental language of consciousness, it would have to be mathematical. Daniele responded that the most fundamental mathematical language was category theory. Hence, a new collaboration evolved which included Sisir Roy, Goro Kato and Richard Amoroso. Mihai accepted this idea considering it to be very convenient for describing phenomenological domains and subsequently published a lot of papers, some with myself. Subsequently I visited Bucharest, this beautiful cultured city, several times, where in June 2000, I became an honorary member of

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Academy of Scientists of Romania. Our common interests developed to a grand-unified vision of the future integrative science, which in presently continuing. We published our first e-book *Philosophy of Integrative Science* and another book *Principles of Integrative Science* is under printing. I cherish our common interests and work. But above all, I cherish our deep personal friendship. Collaborations come and go. Friendship is though forever.

Here, I will try to cover some of the common topics developed with Mihai, which I would hope highlight his productivity and deep insight. Parts of these have appeared in our common works.

### **Ontological considerations of integrative science**

The concept of *Integrative Science* was introduced by Kafatos [14,15] at the IVth Conference on Structural-Phenomenological Modeling in Bucharest 2000 as part of his acceptance speech at the Academy of Scientists of Romania and was itself based on a proposed new structural-phenomenological science by Drăgănescu [4,5]. Kafatos and Drăgănescu (2001) collaborated developing this new possible stage of science [1].

It is important to highlight the underlying ontological philosophy of integrative science, which points towards, what we believe, will be the future development of science [3, 4, 5, 19, 20, 12].

Drăgănescu is of course a pioneer in the concepts of phenomenology and structuralism. Integrative science in turn implies both a structural-phenomenological and phenomenological-structural aspect of science. For example, when we study the mind and individual consciousness, the structural-phenomenological aspect predominates, while when we study the deepest levels of existence and Universal or Fundamental Consciousness, it is the phenomenological-structural aspect that predominates.

It is important to emphasize that integrative science as conceived by Drăgănescu and Kafatos is neither just another form of interdisciplinary science, nor form of multidisciplinary science. It contains them both but goes beyond. What is fundamental is the acceptance that *science is the right approach to study nature* but also that nature goes beyond the physical realms or even the mental realms. Integrative science integrates in a “vertical” way, as the phenomenological part involves the deepest levels of existence. Integrative science is a science

of *light*, not just ordinary physical light but the illuminating principle that underlies the Cosmos. Drăgănescu [3] named such a new science, *orthophysics*, especially when he put the emphasis on phenomena at the deepest layers of reality.

Other such as Kondratoff [25] underlined the importance of structural-phenomenological science in our view in the de facto integrative science. After proposing term *integrative science*, many began to use loosely this term replacing interdisciplinary or multidisciplinary with integrative science, which in our view misses the point. Some interdisciplinary or multidisciplinary works might be integrative or not depending on the use of the underlying illuminating of *luciferic* knowledge [8]. Without structural-phenomenological or phenomenological or orthophysic aspects, any science is not really integrative, it is ordinary science.

### Aspects of integrative science

The following bulletined points are perhaps useful for grasping the main ideas and implications of integrative science:

- Phenomenological reality is primary in integrative science (such as all phenomena of experience, quail, in formatter – Drăgănescu' term – Bhom's active information and implicate order etc.) as part of both physical and informational realms.

- It is the phenomenological reality that is most important and likely gives birth to the basic laws of a universe (by "a universe", we accept here the possibility of existence of many universes, operating with their own physical laws, fundamental constants, mathematical descriptions as well as structures and not just the observable universe). The structure of universe, determined by above phenomenological information, takes form by using the deep levels of energy (term the *orthoenergy*, which seems to be similar to the non-created energy of the early Christian theology). Many universes form the Cosmos (adopting the Pythagorean notion of a grand jewel of creation).

- The deepest laws of existence are phenomenological, qualitative, with tendencies, rather than actualities and semantic. They lead not only to many universes but also to the underlying Fundamental Consciousness of Existence (similar to the Vedantinc/Shaiivite *Sat-Chi-Ananda*). This Fundamental Consciousness plays a defining role in all aspects of (fundamental) Existence, i.e., there is no such thing as

existence without Fundamental Consciousness, or vice versa, and we may then say that the two are really aspects of the same Oneness (where we should remember that *Sat* refers to Existence and *Chi* to Fundamental or Universal Consciousness – which is of nature of *Ananda* or Bliss).

- Phenomenological information and orthoenergy are Resources of the deep existence emerging in and out from the *space* of all dimensions (i.e., dimensions, which are most often taken as 4-D space-time continuum of relativistic and quantum physics and at more modern times, the 11-D of standard string theories etc.) of any universe. Integrative science cannot maintain anymore the old concept that space and time are primordial 0 or even the 11 dimensions or any other dimensions for that matter). Even though structural science is moving in this direction, it does not possess the means to evolve further under this new belief system – because by its very nature it cannot. In the frame of integrative science it will perhaps become obvious how this occurs.

- For integrative science it will be natural to start from the whole to study the parts. In traditional structural science, this undertaking is not natural and would be awkward, to say the least, to be undertaken as structural science starts from parts or structure, i.e. individual objects and then builds the whole from bottom-up.

- In the deepest layers of existence, one encounters phenomenological functors, autofunctors, automorphisms and phenomenological-structural functors. They actually correspond to levels of physical and informational reality, not only mathematical objects or just describable by mathematical formalisms.

- In order to proceed with integrative science, an *integrative Mathematics* will have to be developed, i.e., a more fundamental mathematics in which *phenomenological categories, morphism, and functors* will be used together along with the classical structural theory of categories and functors.

- Integrative science combines both physical and biological scientific fields with information related to the most *delicate* (and deeper domains) of reality.

- In the new integrative physics, phenomenological information is an essential aspect and implies, not only energy and structures as in the presently existing structural physics but qualitative information as perhaps may be encountered in state of sleep where some senses of time still exists.

- Structural science *has arrived at the frontier of a deep Reality*, which is outside its own domain of physical space and time and has therefore opened the doors of a realm of reality where phenomenological processes become predominant (e.g., the concept of non-locality of the 3<sup>rd</sup> kind proposed by [20]). This underlying level of reality is the source of all phenomenological existence, and also is the source of the deep or underlying energy used and formed by phenomenological information into space, time, string, membranes, elementary particles etc. integrative science is expected to explain the underlying sources and the formation of the quantum world.

- Life itself is an integrative process. Current structural biology will evolve into an integrative biology. Neuroscience will evolve into integrative neuroscience.

- As such, the brain is a physical and at the same time an informational integrative device.

- Integrative science will be the only hope to understand the nature of life, mind and consciousness. It may be the only hope for future generation, for the survival of the planet.

- The philosophy of science will be the ultimate *philosophy of integrative science*.

- We appreciate that the greatest problems of today's (structural) science are related to consciousness. Only integrative science will be able to address this issue. Any other means of present-day science (although it may provide hints) will ultimately be a band-aid cure.

- *Fundamental Consciousness is the overall and underlying integrative process in the entire Cosmos.*

- The future human *society of consciousness*, that we believe will follow the present-day society of information and knowledge (and we may add dualistic), will be possible only when a well-developed integrative science occurs. This will bring new levels of deep knowledge on the nature of life, brain, mind, consciousness and Fundamental Consciousness itself.

- In approaching the issue of Fundamental Consciousness, the new integrative science will include statements and insight of perennial philosophies from both East and the West [18, 29].

Drăgănescu and Kafatos [12] proposed the following set of foundational principles:

- Principle of **complementarity** is a foundational principle of existence.
- Nature of existence is both physical and informational.
- Ontological principle of self-organization is a fundamental principle.
- Fundamental Consciousness of Existence is a foundational principle.
- Our own universe generated from the deep reality is non-local.
- Our own universe is quantum-phenomenological.
- The objects with life, mind and consciousness in a universe are structural-phenomenological.

Guided from quantum theory one can perhaps extend the list of the above principles to include additional candidates as:

- Correspondence.
- Light in the “glue” of the universe.

We concluded here that foundational principles may be needed to begin to understand the all-pervasive phenomenon of consciousness. These principles operate *beyond or below* the physical universe and as such are meta-mathematical or pre-mathematical in the sense that mathematical used to describe the physical universe emerge from them.

### **The Mathematics Of Integrative Science**

Integrative mathematics will be based, as pointed above, on the extension of classical theory of categories and functors to the phenomenological domains of underlying reality, akin to the Implicate order of Bohm. The classical theory of categories was developed mainly for structural domains, especially for mathematics and for the foundation of mathematics and was already used for applications in informatics (Căzănescu, 2001) and other domains. A new idea was also to use the classical theory of categories and functors for a theory of consciousness and Fundamental consciousness.

Kato and Struppa [23, 24], Struppa, Kafatos, Roy and Kato [29], Drăgănescu [9, 10, 11], Kato [21, 22] developed works that demonstrate the feasibility of using categories in the integrative science.

Kafatos and Roy are looking into connection between non-locality, structural-phenomenological regimes and the new notions of functors comprising phenomenological domains. Kafatos [16] observed:

“At the Planck length or below it, there is no structure in the usual sense. As such, the regime can be considered purely phenomenological and rather than characterized by linear time and specific time scales that operate at specific processes/events, we should have some concept of generalized time and no events in the usual sense, hence a phenomenological approach. At the other extreme, beyond the Hubble radius, we again, have no structure in the usual sense (no possibility of observe structure) and one should then assume a purely phenomenological realm with generalized time. *It is curious then that at both the very large and the very small we have phenomenological levels of existence.* In between, at the human/macros regime, we should have structural realm. In moving towards the middle levels, from purely phenomenological at both the very large and the very small, to purely structural, we should encounter levels of structural-phenomenological. These regimes are where large uncertainties from the observational problem and constraints that are tied to “constants” such as Planck’s constant or the Hubble radius. Even at the human level, there is an important level where structural-phenomenological realm exists, namely collective brain processes at the interface between physical neuron processes and the functioning of the mind. There should then be similar constraints on observations and some characteristic “constant(s)” that are applicable. We don’t know what they may be but the neuroscientists might have some ideas. We suspect the applicable timescales are at the  $\sim 1/10$  Hz level, which is characteristic of EKG frequencies, much larger than individual neuron processes where  $<10$  ms timescale apply.

All these ideas can be mapped to category theory and its functors. In Drăgănescu’s view, perhaps, the functors are the mathematical formalism of describing the existence of constraints (physical “constants”) which allow the structural and phenomenological sense.” Until now, *the theory of categories was a generalized mathematical theory of structures*: One should remember that “Category theory is a general mathematical theory of structures and systems of structures” [28].

The new theory of categories proposed for the integrative science is not just a science of structures. The new theory of categories, as proposed by Drăgănescu, that we may term the integrative theory of categories and functors, is a physical and informational theory with mathematical background. It is dealing with forms of phenomenological reality that are not structures.

The *extension* of category theory to the phenomenological domains has philosophical origins, surpassing the philosophical interpretations of the classical structural theory of categories. The new category theory of categories and functors becomes a new ontological theory of existence or underlying reality.

Classical categories correspond to physical or informational structures described by the present day science. For instance, in the brain, the neuronal system is a category, but other physical strata may intervene as well, like dendritic networks, molecular vibrational fields along protein filaments, perimembraneous waves and quantum cortical fields [13]. All these are also categories and between them are functors which represent physical and informational processes. We noted [17]:

Cneuronic  $\Leftrightarrow$  C1str ....  $\Leftrightarrow$  Ckstr  $\Leftrightarrow$  Ccoherent quantum waves

where  $\Leftrightarrow$  represents two functors (both ways) between these categories. The categories C1str..... Ckstr represent the various intermediary structural data of the brain. The functors between them are maps between such categories. For the brain/mind very important is also the category of qualia (experiences) which is a phenomenological category. Now, what is a phenomenological category? According to Drăgănescu [11]:

The *first condition* for a category to be phenomenological category is to be constituted by phenomenological objects: phenomenological senses; sets of phenomenological senses; structures of phenomenological senses; phenomenological categories as objects in 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, and identity morphism for every object.

It is known that in the structural domain what characterize a category are the morphisms among its objects. The same may be said perhaps and 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”.*

For phenomenological categories in connection with structural categories functors were defined such as:



(i) only for phenomenological categories: phenomenological functors, phenomenological autofunctors, and zero autofunctor;  
 (ii) for the connection between phenomenological and structural categories: phenomenological-structural functors. For the human mind and consciousness, it is essential to define correspondence between the category of neuronal structures Cneuronic and the category of phenomenological senses (qualia, experience) Cphen. This correspondence is assured by two functors, one structural-phenomenological F, and the other phenomenological-structural  $\Phi$ . 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. Hence,

$$\text{Cstr} \Leftrightarrow \text{Cphen}$$

And the brain/mind may be seen, in the most general terms, as a 4-uple

$$\text{Mind/Brain} = \langle \text{Cstr}, \text{Cphen}, F, \Phi \rangle$$

The explanatory gap of the mind is filled with the above two functors. The above formulae are showing the phenomenological processes are dependent but not strictly dependent on the structural part, and can influence the structural part by processes of specific phenomenological nature, as it happens in intuition and creation manifestations of the human mind. Therefore Cphen has also its own dynamics, in interaction with the entire deep phenomenological reality, where such objects like the fundamental monoid of existence, types of autofunctors and zero autofunctors are acting [9, 11].

It is possible to come up with the concept of generalizes time based on category theory. This “time” does yield ordinary 4-dimensional Minkowski time when projected to the categories which correspond to physical entities. Yet, it also allows an immutable, non-ordinary (in the sense of flowing) sense of time. If indeed this is the case, it would point to a fundamental connection of levels of consciousness with levels of time.

### **The Universal Diagrams**

To illustrate how integrative science may be operating in specific circumstance, we present here a *top-down and bottom-up* approach: A series of *Universal Diagrams* (UD) have been

constructed which reveal deep underlying wholeness. These can be constructed by placing various physical quantities of many different objects in the universe on common, multidimensional plots. 2-D diagrams have been constructed involving the mass, size, luminous output, surface temperature and entropy radiated away of different objects in the universe. These diagrams originally constructed for astronomical objects as far back as 1986 [19] have been revised and extended to all scales including biological entities, industrial and man-made objects etc. two of these 2-D diagrams are shown here (Figure 1, size versus mass; Figure 2, entropy radiated versus mass). The diagrams show continuity among different classes of objects and can even be used to find *likely* regions where to-date undiscovered objects could be located are (such as supersuperclusters, large planets etc.). The overall appearance of the UDs does not change as more objects are introduced, rather the specifics of smaller regions become more refined. Over smaller regions, different power laws can be found to fit the data, while more *global* relationships can be found that approximately fit many different classes of objects (such as an approximately linear relationship between entropy radiated away and mass). It is found that black holes provide boundaries in the UDs and often cut across the main relationships in these diagrams. The values of the constants (and their ratios) and the laws of physics are determining the overall relationships and as such the diagrams *must* be related to the ratios (2) and (3), although it is not totally clear at present if additional principles may or may not be required.

There are large scale *correlations* revealed in these diagrams among different dimensions (other than space and time examined above) or parameters which extended beyond the quantum or cosmological realms to realms such as living organisms etc. it follows that non-*locality* in the sense of global multidimensional correlations is revealed by the UDs to be a *foundational principle* of the structure of the cosmos along with *complementarity* [19, 20].

### Final Remarks

Seeing that structural science as the dominant science practiced today, which was extended in this century from the physical realms to the informational domains (structural information of the genome

(AND), structural neurobiology, artificial intelligence, artificial life, molecular computing, quantum computing etc.), Kafatos [14] expressed the “need of phenomenological approaches to understand the vast realm of experiential, mental components of human and *universal experience*”.

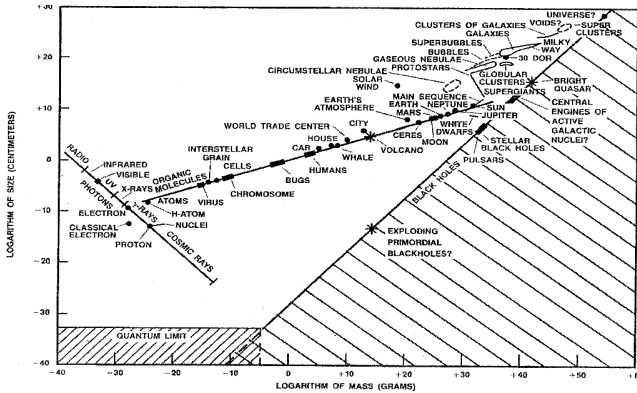


Figure 1

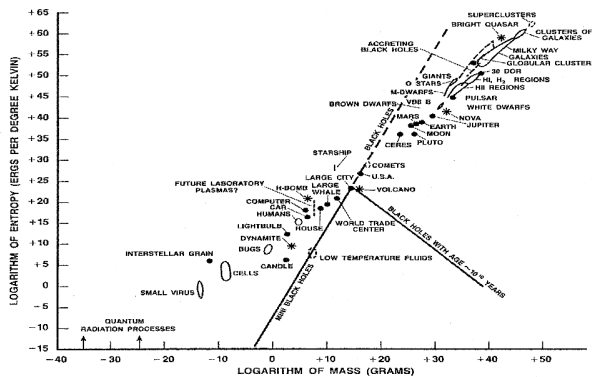


Figure 2

Kafatos [14] also defined four levels of reality corresponding to four stages of human experience:

- Structural -> waking state/physical
- Structural-phenomenological -> dream state Phenomenological
- > deep sleep state/causal
- Deep reality -> supercausal

It is the last level that is the ground of all, where deep reality of the Universe becomes identical to deep (inner) reality of being.

The universal “experience” mentioned above is related to the Fundamental Consciousness of Existence which was postulated as a foundational principle [15, 6, 7, 12, 19, 20]. *The phenomenological part of reality is as important as the structural part, if not more important.*

If the concepts and ideas developed here for integrative science will prove valuable, then the integrative science may lead, assuming that the integrative mathematics will succeed, to integrative model of reality itself.

These models will have an architectural character. The notion of architecture refers either to an organization, or to a set of functions. In the first case an organizational architecture, in the second case, a functional architecture. The full architecture is both organizational and functional. The concept of architecture of integrative models has to be explored, and this concept may prove important for the way in which such models are conceived and realized [25, 27]. In order to develop such models, intuition and inductive reasoning may prove very useful [25, 26, 2].

We believe that we are approaching the dawn of integrative science.

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