Chapter 5

HYPERSTRUCTURAL BRANCH OF HADRONIC MECHANICS AND ITS ISODUAL

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5.1 Introduction

In this author's opinion, the biggest scientific imbalance of the 20-th century has been the treatment of biological systems (herein denoting DNA, cells, organisms, etc.) via the mathematics, physics and chemistry developed for inanimate matter, such as that of classical and quantum mechanics.

The imbalance is due to the fact that conventional mathematics and related formulations are inapplicable for the treatment of biological systems for various reasons.

To begin, biological events, such as the growth of an organism, are irreversible. Therefore, any treatment of biological systems via reversible mathematics, physical and chemical formulations can indeed receive temporary academic acceptance, but cannot pass the test of time.

Quantum mechanics is ideally suited for the treatment of the structure of the hydrogen atom or of crystals, namely systems that are fully reversible. These systems are represented by quantum mechanics as being ageless. Recall also that quantum mechanics is unable to treat deformations because of incompatibilities with basic formulations, such as the group of rotations.

Therefore, *the rigorous application of quantum mechanics to biological structures implies that all organisms from cells to humans are perfectly reversible, rigid and eternal.*

Even after achieving the invariant formulation of irreversibility outlined in the preceding section, it is easy to see that the underlying genomathematics remains insufficient for in depth treatment of biological systems.

Recent studies conducted by Illert [56] have pointed out that the *shape* of sea shells can certainly be represented via conventional mathematics, such as the Euclidean geometry.

However, the latter is inapplicable for a representation of the *growth in time* of sea shells. Computer simulations have shown that the imposition to sea shell growth of conventional geometric axioms (e.g., those of the Euclidean or Riemannian geometries) causes the lack of proper growth, as expected, because said geometries are strictly reversible, while the growth of sea shells is strictly irreversible.

The same studies by Illert [56] have indicated the need of a mathematics that is not only structurally irreversible, but also *multi-dimensional.* As an example, Illert achieved a satisfactory representation of sea shells via the *doubling of the Euclidean reference axes,* namely, a geometry which appears to be six-dimensional.

A basic problem in accepting such a view is the lack of compatibility with our sensory perception. When holding sea shells in our hands, we can fully perceive their shape as well as their growth with our three Eustachian tubes.

In particular, our senses are fully capable of perceiving deviations from the Euclidean space, as well as the possible presence of curvature.

These occurrences pose a rather challenging problem, the achievement of a representation of the complexity of biological systems via the *most general possible mathematics* that is:

(1) is structurally irreversible (as in the preceding section);
(2) can represent deformations;
(3) is invariant under the time evolution;
(4) is multi-dimensional; and, last but not least,
(5) is compatible with our sensory perception.

A search in the mathematical literature revealed that a mathematics verifying all the above five requirements did not exist and had to be constructed from the main features of biological systems.

As an example, in their current formulations *hyperstructures* (see Ref. [96] lack a well defined left and right unit even under their *weak equalities*, they are not structurally irreversible, and they lack invariance. Consequently, they are not suitable for applications in biology.

After numerous trials and errors, a yet broader mathematics verifying the above five conditions was identified by Santilli in Ref. [14] (see also Refs. [13,47] monograph [57]; it is today known under the name of *Santilli hypermathematics;* and it is characterized by the following *hyperunits* here expressed for the lifting of the Euclidean unit

$$I = Diag.(1,1,1) \rightarrow \hat{I}^{>}(t,x,v,\psi,\partial_x\psi,...) = Diag.(\hat{I}_1^{>},\hat{I}_2^{>},\hat{I}_3^{>}) =$$

$$= Diag.\Big[(\hat{I}^>_{11}, \hat{I}^>_{12}, ..., \hat{I}^>_{1m}), (\hat{I}^>_{21}, \hat{I}^>_{22}, ..., \hat{I}^>_{2m}),$$

$$(\hat{I}^>_{31}, \hat{I}^>_{32}, ..., \hat{I}^>_{3m})\Big], \qquad (3.6.82a)$$

$$I = Diag.(1, 1, ..., 1) \rightarrow {}^<\hat{I}(t, x, v, \psi, ...) = Diag.({}^<\hat{I}_1, {}^<\hat{I}_2, {}^<\hat{I}_3) =$$

$$= Diag.\Big[({}^<\hat{I}_{11}, {}^<\hat{I}_{12}, ..., {}^<\hat{I}_{1m}), ({}^<\hat{I}_{21}, {}^<\hat{I}_{22}, ..., {}^<\hat{I}_{2m}),$$

$$({}^<\hat{I}_{31}, {}^<\hat{I}_{32}, ..., {}^<\hat{I}_{3m})\Big], \qquad (3.6.82b)$$

with corresponding *ordered hyperproducts to the right and to the left*

$$A > B = A \times \hat{T}^> \times B, A < B = A \times^< \hat{T} \times B, \qquad (3.6.83a)$$

$$\hat{I}^> > A = A > \hat{I}^> = A, \quad {}^<\hat{I} < AA <^< \hat{I} = A, \qquad (3.6.83b)$$

$$\hat{I}^> = ({}^<\hat{I})^\dagger = 1/\hat{T}^>, \qquad (3.6.83c)$$

the only difference with genoforms is that hyperproduct are now multivalued, where all operations are ordinary (and not weak as in conventional hyperstructures).

As one can see, the above mathematics *is not 3m-dimensional, but rather it is 3-dimensional and m-multi-valued.*

Such a feature permits the increase of the reference axes, e.g., for $m = 2$ we have six axes as used by Illert [56], while achieving compatibility with our sensory perception because at the abstract, realization-free level hypermathematics characterized by hyperunit is indeed 3-dimensional.

The various branches of hypermathematics (hypernumbers, hyperspaces, hyperalgebras, etc.) can be constructed via mere compatibility arguments with the selected hyperunit (see monograph [57] for brevity).

A main difference of hypermathematics with the preceding formulations is that in the latter the product of two numbers is indeed generalized but single-valued, e.g., $2 > 3 = 346$.

By comparison, in hypermathematics the product of two numbers yields, by conception, a *set of values,* e.g.,

$$2 > 3 = (12, 341, 891, ...). \qquad (3.6.84)$$

Such a feature appears to be necessary for the representation of biological systems because the association of two atoms in a DNA (mathematically representable with the hypermultiplication) can yield an organ with an extremely large variety of atoms.

This feature serves to indicate that the biological world has a complexity simply beyond our imagination, and that studies of biological problems conducted in the 20-th century, such as attempting an understanding the DNA code via numbers dating back to biblical times, are manifestly insufficient.

The *isodual hypermathematics* can be constructed via the use of isoduality. The following intriguing and far reaching aspect emerges in biology. Until now we have strictly used isodual theories for the sole representation of antimatter.

As shown in the qupted literature, the complexity of biological systems is such to require the use of both hyperformulations and their isodual for consistent and quantitative representations, as it is the case of bifurcations.

In turn, the above occurrence implies that the intrinsic time of biological structure, here referred to as *hyperbiotime,* is expected to be of a complexity beyond our comprehension because not only multivalued, but also inclusive of all four directions of time.

In conclusion, the achievement of invariant representations of biological structures and their behavior can be one of the most productive frontiers of science with far reaching implications for other branches, including mathematics, physics and chemistry.

As an illustration, the achievement of a mathematically consistent representation of the non-Newtonian propulsion of sap in trees up to big heights will automatically provide a model of *geometric propulsion,* namely propulsion caused via the alteration of the local geometry without any external applied force.