**SYMMETRY IN PHYSICS: PROPORTION AND HARMONY TO THE TERM OF METALENGUAJE**

**Ruth Castillo**

**Universidad Central de Venezuela**

Revolutionary changes, particularly in physics, require a careful exploration of the way in which concepts depend on the theoretical structure in which they are immerse and how changes, due to the dynamism of physics in that structure, may require a conceptual renewal of our part.

Under this perspective, is necessary conceptual revision since the dynamism of physics imposes the direct study of its theoretical structures, as they have been determined over time[[1]](#footnote-1). In other words, a look at the history of physics allows us to show the transformation or evolution of the notions that support our physical theories. In this way, the reconstruction of the notion of symmetry in each historical period allows us to demonstrate how the advance of science requires a conceptual revision.

Under this point view, we have that the notion of symmetry can have different meanings: Heuristically symmetrical models inspire scientists in the search for satisfactory solutions to different problems. Methodologically, symmetric structures are be used to make theories and laws with precise invariant properties. An important ontological and epistemological question concerns the problem of whether symmetrical structures are only human inventions and projections in nature, or, correspond to a structure of real principles that organizes and determines the world. A description of nature in terms of symmetrical structures and symmetry breaks seems to be the appropriate way to describe the diversity and complexity of reality. Some believe in an ontological reality of symmetrical structures independent of human models and ideas, but from a methodological point of view, the ontological question of symmetry cannot be decide definitively.

The evolution of the notion of symmetry in contemporary terms, as a fundamental category of research to which the usual categories of natural sciences can be logically and mathematically reduced at such: space, time, causality, interaction, matter, force, form, etc...

However, this categorical framework cannot be justified as absolute and necessary (that is as an a priori in the sense of Kant) but as a successful framework and consistent research. In this way, we study three problems:

1) The existence (or not) of the term *symmetry* in antiquity

2) Leibniz's solution in reference to the inertial problem and its repercussions on the evolution of the notion of symmetry

3) The nature of the notion of symmetry in contemporary physics, in other words: symmetry as a metalinguistic term and its use as a principle and argument in physics.

The first problem is study (through the historical journey from the Greeks to the beginning of the Renaissance) the notion symmetry as an implicit characteristic in things and their relation with notions such as equilibrium, indifference, permanence, harmony, proportion, order, beauty and unity. Thus, for the ancient world, symmetry is the quality of the thing. Subsequently, with the advance of mathematics, the notion acquires its own definition and is consider explicitly by means of algebraic expressions. However, in the physical theories remains in an implicit form. This does not mean that there is no evolution within classical physics: incorporation of notions such as equivalence, indiscernibility and congruence will show for the extension of the term in physics. This leads to the second problem: the connection between the notion of symmetry with logical analysis under relations of order and its relationship with Newtonian physics. To answer this question, it is necessary study the ideas of Copernicus, Telesius, Gassendi, Moore, Galileo, Newton, and Leibniz[[2]](#footnote-2).

Subsequently, the advances in algebra, the term bilateral symmetry given by Legendre and the extension in the meaning of the notion of symmetry under relations of order given by Leibniz make possible the explicit consideration of the notion of symmetry within the language of contemporary or current physics. This allow a new transformation of the notion like as a linguistic meta-theoretical requirement in different physical theories such as special relativity, general and quantum mechanics.

This explicit use of symmetry in current physics is show within the algebraic language used in physical theories. The magnitudes are automorphisms that guarantee the invariance or conservation of laws in any reference system. This allows postulating, within the language, two ways of understanding the explicit use of symmetry in physics:

 (1) Assuming that under certain transformations the aspects given in phenomena, systems or laws are unchangeable according to a particular observation (*principles of symmetry*)

 (2) Through the derivation of specific consequences with respect to certain physical situations or phenomena based on their properties of symmetry (*arguments*)[[3]](#footnote-3).

Finally, the following conclusions are derive from the study:

 1) In the absence of the term, ancient and medieval subsumed certain notions to a more general notion, that is: symmetry.

2) Similarly, the moderns (influenced by the ideas about the symmetry notion of the ancients) manage to establish through comparisons between the notions associated with the notion of symmetry a relationship of order or equivalence

3) With the advance of the algebra, the physics leaves aside the search of satisfactory solutions to different problems, and begging the study and elaboration of laws that allow generalizing and giving answers of more precise way. In this sense, symmetry links empirical reality and mathematical structure through language.

This research reveals important repercussions; one of them is to appreciate the fundamental role of the history of science (in particular of physics) in the clarification of fundamental notions within scientific work. The consideration of the history of science is fundamental. A better and clear understanding of our notions in science does not slow down the development of science, but rather provides a better understanding of the world. Notions such as symmetry in physics support the best and successful theories at present, however, the deep understanding of their meaning and their evolution allows the development of later advances in physics.

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1. Cfr. Geymonat, L., *Filosofía y Filosofía de la Ciencia,* Labor, Barcelona, 1970, p. 14 [↑](#footnote-ref-1)
2. Jammer, M., *Conceptos de Espacio,* Grijalbo, México, 1970 [↑](#footnote-ref-2)
3. Cfr. Branding, K., y Castellani, E., *Symetry and Symetry*,…cit.,p. 4 [↑](#footnote-ref-3)