**Kuznetsov V.I.**

# Scientific concepts and their changes

Since 1970-ties, the topic of changes of scientific knowledge has become disputable and fashionable in the philosophy and methodology of science. Any work devoted to this topic may be interpreted as the realization of a certain combination of four major strategies.

The first two strategies are associated with a dichotomy of informal and formal methods used. An example of the informal studies is T.Kunh's *The Structure of Scientific Revolutions* (1963). Examples of the formal studies are J.Sneed's *The Logical Structure of Mathematical Physics* (1971) and *The Structure of Scientific Theories* edited by F.Suppe (1974). It might be well to point out that Sneed and his followers have mainly operated with set-theoretical and category-theoretical methods, while Suppe and his co-authors have favored logical and linguistic methods and tools.

The second two strategies are associated, correspondingly, with a holistic and compositional analysis of scientific knowledge systems. In the former case, the subject of studies is the holistic features and patters of a knowledge system and its history. An example is virtually any book on the history of a particular science. In the latter case, the subject is some component(s) of a knowledge system. M.Jammer's *The Concept of Mass* (1961) is a typical embodiment of this strategy.

From this standpoint, the triplet study of concept changes is some combination of set-theoretical methods and modeling such particular components of a scientific knowledge system as its concepts.

The triplet approach models a scientific concept as three collections of sets associated with three fundamental informative components of a concept [1; 2; 3]. These components are the concept base (the information about objects falling under a concept and about their properties and relations as they are supposed to be), the concept representing part (the information about tools of representing and describing the concept base in a knowledge system) and concept linkage (the information about links between the kinds of information mentioned above).

The concept base is modeled as set of objects subsumed under a concept, sets of various attributes of these objects, sets of various relations between members of the first set, the set of measurable values of quantitative attributes, etc. The concept representing part is modeled as sets of various linguistic structures (including mathematical ones) used for representation of the information about the concept base: letters (symbols), expressions (formulas), texts (mathematical structures). The concept linkage is modeled as sets of various operations and procedures (naming, observation, measurement, computing, interpretation, etc.) of constituting correspondences between the concept base and concept representing part.

In the triplet framework it is possible to propose the ramified classification of concepts, the set-theoretical description of varieties of complex structures of any scientific concept and numerous relations between concepts etc.

If we are not conceptual Platonists and recognize flux and growth of any concept we possess, then there is good reason to believe that the triplet modeling is applicable to study of some aspects of concept changes.

Indeed, according to the triplet model, a certain change of a concept may be studied as 1) adding/removing a new/old set in the three major collections mentioned above; 2) a quantitative and/or qualitative changes of the appropriate sets; 3) introducing/restructuring relations between sets (and between their elements) in these collections; 4) a quantitative and/or qualitative change of the appropriate relation.

The problem is to describe precisely these changes. The triplet modeling will lead to explicating many well-known concept changes (explication, quantification, formalization, mathematization, extension, restriction, etc.) and introducing many before unknown types of changes of concepts. Examples are various kinds of concept alteration, variation, rearrangement, transmutation, permutation, etc. All these concept changes and their patterns have nontrivial interpretation on the real history of the fundamental scientific concepts, especially those from theory of number and elementary particle physics.

It seems to me, that the problem of concept changes is very attractive and promising for ambitious young researchers. Those who are interested in, please, call 553-19-29.

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3. Kuznetsov V. Representing Relations between Physical Concepts // *Communication and Cognition*, 2004, 37: 105-135.