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Change and Stability in the Dynamics of Scientific Representations**

Abstract. Knowing the dynamics of scientific representations in contemporary natural sciences is a controversial subject, we intend to analyze the problem in a specific manner, focusing on the problem of the stability of descriptive representations in time. Fully aware of the importance of historical dynamics of scientific representations for the development of scientific theories, we will try to emphasize some specific features that influence the evolution of representations in natural sciences.

Keywords: descriptive imaginary, scientific theories, scientific representations, truth.

1. Introduction

The dynamics of scientific representations is a phenomenon that is worthy to be investigated, mainly because in the present information society science can be seen as a major form of culture, actually a privileged one. Science has huge power in establishing social and even cultural standards, at least in western countries. But quite often science becomes a sort of myth for common people and scientific representations are seen as definitive descriptions of the capacities of nature (Cartwright 1994, 141). Often the dynamics of these representations is ignored; therefore they are sometimes considered complete descriptions. One of the possible causes for this state of facts lays in the scientific values cultivated by scientist in designing scientific theories, which are mixed in the contemporary popular culture with religious and moral values. In fact,

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** **Acknowledgement:** This paper was made within The Knowledge Based Society Project supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU ID 56815.

for many people the success of science became legendary and its authority has no limits, even in the moral area of human existence.

The main problem we are interested in, as far as the present paper is concerned, refers to establishing whether or not one can talk about genuine stability in the group of descriptive representations used by the theories of modern natural science. Furthermore, the problem refers also to a possible coexistence between such stability and the continuous evolution of descriptive representations in time. Namely, we intend to emphasize what could be considered stable in the discourse of modern natural science and what kind of elements continuously change without affecting the stability of the general endeavor.

2. Stability and Scientific Truth

The idea of stability in science, although quite controversial today, is deeply linked to the concept of scientific truth, which was understood differently in various periods of time, starting with the ancient Greek and up to the contemporary trends in philosophy of science. The classical theory of science, inspired by the Greek Geometry, conceived the scientific truth as something clear, sure and perennial from the moment it was established, such a point of view being adopted in the case of pure theoretical sciences and in the case of natural sciences as well. The main source for truth in Ancient Greek natural sciences was the thorough observation of nature, giving the fact that, at that time, the ideas of experimentation and mathematical description of experience were not accepted, as far as the terrestrial world was concerned. The main reason for that was the famous separation introduced by the Greek philosophers between the cosmic world and the so-called sub-lunar world. Only the mysteries of the cosmic world were considered suitable for mathematical treatment, while the terrestrial world was considered too irregular and unpredictable for such a method.

One should not be very much intrigued today by such an idea, taking into consideration the fact that infinitesimal and integral calculus were not developed at that time, and consequentially the differential equations were not among the mathematical tools of those preoccupied with understanding nature. Without these theoretical means the efficient description of terrestrial physical system was almost impossible and this aspect was quickly understood by the developers of modern natural science, each of them contributing in the field of mathematical concepts development before attaining real progress in the investigation of the physical properties of objects. Archimedes did this way, followed by Galileo, Pascal and Newton as well.

However, the progress made by Galileo and Newton involved significant changes not only at the level of mathematical tools or at the level of general descriptive attitude towards nature regarding mainly the Pythagorean idea of unveiling the "mathematical structures" embedded in natural systems, but also as regards the discovery of some strong criteria regarding the selection of viable descriptive representations (Stewart 1999, 127). Such criteria were put into evidence by the experimental scenario introduced by Galileo and one could consider this step as a crucial one in what regards the maturation of experimental method as the basis tool for producing more and more realistic descriptions in natural science. It may be considered even a unique step and in fact a crucial stage of an irreversible epistemological process of maturation for natural science discourse, giving the fact that from that moment alone one could really talk about modern Physics in contrast with previous much less convincing attempts of understanding rationally the properties of nature.

In any case, modernity involved also not only some degree of strictness in applying pragmatic criteria for selecting descriptive representations, favoring in the same time the development of what we call *descriptive imaginary*, but also a strong rejection of error in science, regarded as an unfortunate event from an epistemological point of view. It took a long time for the theorists of scientific endeavor to evolve from the position of rejecting scientific error as a veritable obstacle for the general struggle of unveiling the scientific truth about physical real towards the more refined position of treating scientific error as a necessary step in the economy of scientific progress in science that sometimes involves the effort of constructing semantically what we use to call *scientific truth*.

The complex ontological mutations involved in this process are too subtle to be analyzed in the present paper, but for the moment we can observe that such transitions involved significant changes in what regards the idea of change in the history of science. Change became a somehow natural characteristic of scientific endeavor, a permanent one and not one caused forcefully by regrettable and embarrassing occurrence of error throughout the entire process of describing the most important features of nature by use of scientific theories. However, the idea of general, holistic and somehow ultimate scientific truth remained for some scientists and for some philosophers of science as a mere unconscious and idealistic striving (Novacu and Novac 1996, 73).

As one of the best specialists in the history and philosophy of science, Philip Kitcher remarked once that "ultimately science aims at discovering the truth, the whole truth, and nothing but the truth about the world. Others preferred to be more modest, viewing science as directed at discovering truth about those aspects of nature that impinge most directly upon us, those that we can observe (and, perhaps, hope to control). On either construal, discovery of truth was valued both for its own sake and for the power that discovery would confer upon us" (Kitcher 1995, 3).

3. Descriptive representations and their dynamics

Looking carefully to the way in which scientific concepts and scientific representations evolve historically allows us to remark the surprising level of complexity that characterizes this process (Tian Yu Cao 1997, 59). Such complexity of scientific representations dynamics can be explained due to the complex relation between fictional products of human thinking and what we are used to call objective physical reality. From this perspective, scientific theories can be seen as complex systems of fictional products of human thinking with descriptive features toward physical reality.

Most of all, the contemporary theories in physics create a whole explicative world of concepts usually called "scientific reality" and involved in a very complex relationship with the so-called "objective physical reality".

As far as the present paper is concerned, we are going to rename those two concepts. We choose to call the "scientific reality" just "reality" and we will consider it as being a sort of coherent image of "objective physical reality". As to this last one, we will call it "real". From our point of view, it will represent the natural environment whose properties and capacities can be partially described by the human thinking, using in this process of description conceptual structures called *descriptive scientific representations* and *descriptive laws of nature*. Following our strategy of conceptual assignation, we can affirm that, throughout the entire history of modern natural science, human thinking struggled to generate the scientific *reality* as an image, or a coherent description of the accessible part of the physical *real*.

The major problem of the relationship between scientific reality and physical real is represented by the fact that scientific reality is not unique, nor the set of premises used in its construction. That is why the recent struggles in the unification of contemporary physical theories, in the form of string theory for example, can be appreciated as very important. They represent a last step in a historical evolution of basic scientific descriptive concepts in natural sciences towards a final and coherent description of the capacities and human understandable features of nature.

In one of his works, Bernard D'Espagnat describes briefly this effort. "Because scientific knowledge has a kind of certainty – at least a relative one – which distinguishes it from conjecture pure and simple, anyone who deems the thesis of physical realism to be well-founded should expect physics to produce increasingly general theories and should also expect these not to be enduringly in conflict one another. In each field there should therefore remain just one such general theory, once the short-lived period of trial and error is over and it should be possible to formulate these general theories as descriptions of reality. This latter condition can also be expressed by saying that the general theories in question must be capable of being stated in terms of strong objectivity" (D' Espagnat 1990, 115). Of course, for the moment, any unification theory is merely a theoretical construct, very far from direct experimental validation. Nevertheless, this type of description could never become a definitive one, because the relation among human thinking, scientific reality and physical real is a continuously evolving one.

Beyond all of these, as we already remarked in some of other works of ours, the dynamics of scientific representations is highly influenced by theirs mixed configuration. Each one of them has a public part and a private part. The raise of a scientific theory and the acceptance of its validity inside of a specific scientific community have to do primarily with the public part of scientific representations, but the private part of them must not be neglected.

It plays a very important part in the process of manipulating representations by different individuals. We can say that, beyond the sense associated to a specific scientific representation in scientific community, each individual attributes a specific significance to that representation, which allows him to manipulate it better in his own mind.

One of those who noticed this conflict between the public and objective part of scientific discourse and the private, qualitative and sometimes intuitive part of it was Gerald Holton, in his book *Thematic Origins*, in which he stated that the understanding of this dynamics can be obtained only through an historical inquiry upon the evolution of natural sciences.

That is why we consider the adopting of new historical strategies in investigating natural sciences as being one of the most important improvements. Of course, these strategies should keep a thin equilibrium between historical approach and technical approach. And this has a lot to do with the informational selection dilemma. What is historically essential and what is technically essential from a wide range of concepts and evolving theories? In fact, quite often the history of a discipline cannot be very well understood from the perspective of the present.

4. Conclusions

Beyond all these sorts of difficulties, we believe that the benefits of the historical approach of scientific theories make it worthy. The understanding of the dynamics of scientific representations could help researchers to become aware about the limits and the possibilities of scientific knowledge. They could understand better the complex interaction among human thinking, scientific reality and physical real. In this way contemporary human beings will integrate better science among other types of cultural activities which are vital for the well-being of humankind. A better understanding of the dynamics of scientific representations would emphasize supplementary the fact that almost everything in the scientific discourse is changing. However, the problem is how this discourse is able to maintain epistemological "contact" with the structure of physical real.

At first glance, one could be tempted to argue that, giving the fact that everything changes through the historical evolution of scientific theories, there is no ontologically "privileged" entity within scientific discourse whose epistemic authority remains unmodified in time.

As a consequence, the problem of realism in science becomes suddenly not so relevant for the fictional dynamics of scientific discourse. No matter how "realist" the scientists are, they will change eventually their explanatory tools in time, replacing them with better ones.

However, on the other hand, concepts from certain classes remain more stable in time than others. For example, no matter how many new scientific theories aroused in the contemporary period, the so-called "physical constants" did not disappeared, on the contrary, became more numerous. The only change some of them suffered was at the level of measurement approximation.

Therefore, we are forced to conclude that there is some stability in the scientific discourse of natural sciences. As long as such a discourse is capable to emphasize some essential features of physical real, it can evolve, but only within the limits imposed by the pragmatic criteria that assure the correspondence with empirical data obtained experimentally. No matter how strange could sound this, change and stability coexists in the historical development of scientific discourse.

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