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Scientific Representations and the Dynamics of Descriptive Imaginary*

Abstract: One of the most interesting philosophical aspects regarding the scientific discourse refers to the understanding of the relation between scientific theories and the characteristics of nature they describe. A closer look at the structural features of the scientific discourse could reveal the complex image of a continuously evolving science that is trying to reveal the most significant characteristics of reality, describing them by the use of scientific representations. Our intention is to observe the complex mixture between the qualitative and quantitative aspects of scientific concepts and the very refined dynamics of scientific representations, a process we are going to analyse using the concept of "descriptive imaginary".

Key words: scientific representation, descriptive imaginary, scientific discourse.

1. Introduction

Modern science represents one of the most important cultural activities that influence a lot many aspects of human existence, including the evolution of mentalities. However, there is a feature of the scientific discourse with important consequences at cultural level, which interests us a lot, that is the non-historical character of the scientific discourse, at least in universities and high schools. More precisely, this means avoiding the historical details of conceptual evolutions when a scientific theory is presented to the students.

On one hand, this non-historical character of the scientific discourse has some important advantages, as regarding the communication efficiency. Of course, it is much more convenient to avoid the huge amount of historical details when one has to transmit information about a knowledge system in a short period.

On the other hand, there are some undesirable consequences of the fact that historical evolution of scientific theories is less discussed. The view about an important component of scientific discourse, the scientific representations, is

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not a very accurate one, especially as regards their nature. 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).

Because the dynamics of these representations is ignored, they are considered also *complete* descriptions. Therefore, the scientific values cultivated by the scientist in designing scientific theories are mixed sometimes in the contemporary popular culture with religious and moral values. Thus, for many people the success of science became legendary and its authority has no limits, even in the moral area of human existence. Philip Kitcher observes :

> "Legend celebrated scientists, as well as science. The noble goals of science have something to do with the attainment of truth. Here, however, there were differences among the versions of Legend. Some thought in ambitious terms: 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)

Most of the people have no direct access to the understanding of the significance of scientific theories but through technology. Technological approach of science is an indirect one and creates quite often the illusion of complete stability and efficacy of scientific descriptions of nature capacities.

Of course, technology represents the major and the most visible result of scientific inquiry that legitimates the descriptive relation between science and nature. However, much of the theoretical evolving struggle in science does not appear at all in the evolution of technology. Moreover, if a certain technology uses some capacities of nature this does not mean that scientific theories used to create that specific technology represent a complete description of those capacities of nature.

For example, the construction of the atomic bomb is not an argument for considering the models of atom used in this process as being complete descriptions of the atomic physical structures. Since 1945, those models evolved continuously, but the construction of the hydrogen bomb, which took place later, reflects only a small part of this evolution.

All the aspects mentioned above are consequences of the fact that common people are not used to pay enough attention to the evolving process of scientific concepts, which always have a historical evolution and sometimes a cultural background that reveal their true ontological nature and their descriptive character, with its virtues and limits. In addition, perhaps more important, the provisory and dynamic character of scientific truth can be revealed by investigating the dynamics of scientific discourse, the evolution of scientific theories and scientific concepts.

2. Descriptive imaginary and modern science

Because the dynamics of scientific discourse is a complex subject, we are going to introduce some conceptual instruments that could help us to understand better the ontological status of scientific concepts, which are interrelated inside of a scientific theory.

We use to oppose quite often the words "imaginary" and "real" in everyday language. It is very convenient to suppose that it is possible to make a very sharp distinction between "real things" and "imaginary things", even thaw human knowledge raises from a combination of these two categories at the conjunction of human imagination and human cognition with that part of the physical real detectable by our senses.

Western culture is quite suspicious regarding any imaginative excess, especially in the moments when imaginary interposes between human consciousness and the physical world. Those situations are usually associated with psychopathology. This circumspection could be explained by the long time in which Western civilization struggled to eliminate mythical imaginary from the dialogue of human consciousness with nature. In a way, this process was similar with the dissolution of the charm of mythical explanation regarding the world.

Some of the greatest cultures in the world, others than the western one, missed the opportunity of inventing modern science just because "they hesitated to make a sharp distinction among real world and imaginary worlds." (Nakamura, 1997 : 12). Indian culture is a good example in this respect. One can easily conclude that, in order to give constructive powers to human imagination in the knowledge making process, a great culture has to admit the fictional nature of the conceptual products of human imagination. The distinction between imaginary (as a noun) and real (as a noun, also) represents the first step towards the recognition of the constructive and epistemological function of imaginary. This is equivalent with admitting that descriptive fictions have a provisory and explanatory nature with regard to their part in the scientific discourse.

For a long time, the European culture has been characterized by a great competition between mythological descriptions of the physical world and logical-structural descriptions of the same physical world. At the end of the XVII-th century, the logical-structural descriptions, based on logical-structural fictions, prevailed upon mythological descriptions. They proved to be more efficient, so – finally – descriptive imaginary prevailed in this culture upon mythological imaginary.

One of the most distinctive features of descriptive imaginary is represented by its *intentional rationality*. The descriptive fictions are the products of the use of human reasoning in the limits of rationality. Human imagination is not used in science in a very free manner, but rather in a selective way. The conceptual products of it have to meet a very tough criterion. They

have to fit one to the others in such a way that the result, the scientific theory, should have internal coherence. Moreover, the image of reality created by the theory must be a testable and a believable one.

Therefore, among other pragmatic criteria, the one of the *concatenation of descriptive representations* is the most important. It demands that each concept with descriptive function within the framework of a scientific theory must fit in the conceptual puzzle of that theory in such a way that leaves no dark places in the description of the real phenomenon. The concept must be logically linked to other central concepts of the theory in order to assure a minimum efficiency for the scientific description, therefore the concept is shaped in accordance with the whole theory. This feature distinguishes the scientific discourse in comparison with other types of discourse, like the artistic one or the religious one. For example, electromagnetic induction has to be understood in such a way that fits with other important concepts in electromagnetism like field or energy.

However, human mind is forced sometimes to go beyond the limits of classical logics in order to be able to properly represent the real. This is the case for some important scientific hypotheses like quantum hypotheses of Planck, the relativistic hypotheses of Einstein or the hypotheses of complementarity developed by Niels Bohr, the last one being adopted "in order to avoid difficulties like the Schrödinger`s cat paradox". (Cushing, 2000 : 326)

3. Fictional nature of scientific representations

The reason for the complexity of scientific representations dynamics is the specific relation between fictional products of human thinking and what we are used to call objective physical reality. Scientific theories can be seen as complex systems of such fictional products of human thinking with descriptive features toward physical reality. Especially "contemporary theories in physics create a whole explicative world of concepts" (Cao, 1997 : 14) called "scientific reality" involved in a very complex relationship with "objective physical reality". That is why we are going to rename those two concepts. We will call "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" and for us it will represent the natural environment whose properties and capacities can be partially described by the human thinking using conceptual structures called *descriptive scientific representations* and *descriptive laws of nature*. Human thinking generates 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 recent struggles in the unification of contemporary physical theories are so 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. Nevertheless, this type of description can never become a definitive one, because the relation among human thinking, scientific reality and physical real is an evolving one.

After all, the development of modern science determined an evolution of scientific representations. At the beginning of human rational inquiries upon nature these representations were mainly qualitative-sensitive. In contemporary science they became predominantly conventional-structural. As one can easily observe comparing, for example, classical mechanics with quantum mechanics, their *visuality* (their capacity of helping the scientist to visualise physical processes) changed and became, little by little, a conventional-structural one.

This giving up of sensory intuition simultaneously with a translation towards mathematical abstraction in the historical development of scientific discourse revealed another important aspect concerning scientific representations. Theirs ontological status in the discourse depends on the distinction drawn between the objective physical process and its reflection in the scientist mind. Sometimes, this status is not very easy to be clarified, giving the fact that nowadays not only the discovery of regularities in nature, but also "the creation through scientific means of phenomenon, processes and substances that do not exist in that form in nature became quite an ordinary thing". (Hottois, 2004 : 85)

Descriptive fictions are products of human imagination, but in the course of scientific theories development they are treated *as if* they were in perfect conformity with the characteristics of nature they describe. Actually, we consider scientific representations as being descriptive fictions produced by the so-called descriptive imaginary that characterizes each scientist as member of a scientific community. In doing that statement, we do not adhere completely to the *fictionalism* of Hans Vaihinger, most of all because we consider the descriptive fictions as being linked in a particular way to empirical data about the physical world. More specifically, the process of shaping theirs features depends on some empirical data about physical world, especially because they are made to describe this world. Nevertheless, as fictions, they are produced by the use of human imaginative faculty and as part of scientific descriptions of the physical processes, they are assumed as being relevant regarding some features of real objects they represent.

They are invested with what we call *ontological-descriptive truthfulness*, thus becoming the bricks of scientific discourse. However, their status is a provisory one. They are going to be tested as concerns the correctness of their descriptive orientation or descriptive intentionality. By this expression, we want to underline the fact that no descriptive effort regarding the features of physical world was ever conceived without assuming from the beginning a criteria of selecting the most important features of a physical system from those considered as negligible.

As a result, every scientific model of a physical system is characterized by epistemological intentionality and the scientific representations that form it

are descriptive oriented, associating deeper significance to some features of the physical system than to others. Of course, this selection or hierarchy of features is not completely arbitrary, rather being influenced by empirical data and by some tradition in conceptualzing the physical world that characterizes the descriptive imaginary of that scientific community, some sort of inertial effect that orients the primary descriptive intentionality of that community. For example, scientists are more inclined to admit the fictional nature of obsolete scientific concepts, like *ether*, than the fictional nature of nowadays-scientific concepts, like *quarks*. However, in our opinion, these aspects are more related with some conceptual history than with anthropological issues.

This kind of *provisory ontological status* inside of scientific discourse allows the scientist to develop complex reasoning systems based on these descriptive fictions and to test the predictions of such systems as regard the testable behaviour of physical systems. Some of these fictions are shaped in such a way during the process on confrontation with experimental results that allows them to remain valuable descriptive "prototypes" of real objects. Others become obsolete and tend to lose the competition for the status of truthful descriptions, as was the case with the concept of ether.

No matter how successful some of these descriptive concepts are, their fictional origin must be emphasized for their real nature to be well understood. Their truthfulness is essentially a *provisory* one and in time, their shape or properties could be changed or, in a more drastic case, they could be entirely replaced by other concepts.

4. Conclusions

From our point of view, the most important aspect of scientific representations regards their evolution. Actually, this is what differentiates them from other types of representations. Scientific representations evolve and are replaced one by another based on some specific criteria, very different from those that play an important role in other fields like art or religion. Of course, scientific representations have a lot in common with other types of representations. Therefore, in some respects, a general theory on representation can be used quite efficient in describing them. But we think it is important to pay attention to the tendency of such an inquiry to assert the idea that science is just another type of discourse (among others) about physical world (comparable with religion, art or politics) in which scientific representations play a communicative role. The selection of scientific representations obeys some specific rules; therefore, in our opinion their ontological profile is very different from those of other types of representations. Although their communicative role is deeply linked by the states of mind they are associated with, their nature is a very complex one beyond this aspect and should be discussed in connection with other problems like the one of scientific realism, for example.

One of the most competent specialists in the problem of physical realism, Bernard D'Espagnat, describes briefly the recent evolutions :

> "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)

Beyond these aspects, the dynamics of scientific representations is highly influenced by their mixed configuration. In our view, each one of them has a public part and a private part. Although 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, the private part of them must not be neglected. It plays a very important role in the process of manipulating representations by different individuals. In the language used by Gottlob Frege, 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.

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