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Scientific mythology and the dynamics of scientific concepts*

Abstract: The relation between the dynamics of scientific imaginary and the popular understanding of scientific theories is a very complex one, especially in case of contemporary postmodern society. The present work aims to analyze this relation using the concept of descriptive imaginary as investigation tool. The main purpose of the paper will be to underline the most important moments in the evolution of modern physics that boosted the development of a parallel scientific mythology quite influential on the social imaginary evolution.

Keywords: scientific representation, social imaginary, scientific discourse.

The present work aims, at first, to clarify the specific way in which scientific concepts evolve, heavily influencing the dynamics of scientific imaginary. Second, we will try to characterize the way in which the development of scientific theories in natural sciences influences the so-called scientific mythology used by the general public in describing the world. As one can easily notice, the role played by imaginary in these processes is bivalent, from real constructive contribution (Fauconnier and Turner 2002, 15) to the development of scientific theories up to the pseudo-scientific imaginary inflation characteristic for what we will call "scientific mythology".

In order to emphasize the specificity of scientific imaginary we will analyze briefly the evolution of natural sciences, namely physics, from its historical beginning. Even though Aristotelian physics is not considered any more as scientific in the modern sense of the word, it still represents an important moment in the development of western scientific thinking. What strikes the modern reader of Aristotelian physics, what strike Thomas Kuhn for example, was the radical different attitude towards nature. For instance, no matter how logically rigorous, Aristotelian natural science excluded the very possibility of experiment. Thus, the measurement did not play any role in the

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argumentation about natural phenomena. The only scientific method of investigation remained the observation accompanied by imaginary explanatory scenarios. This way, common sense played an important part in the genesis of the descriptions proposed.

On one hand, this led to a quite good correspondence of Aristotelian descriptions to the sensorial image of reality. On the other hand, developing a descriptive discourse in this manner did not help Aristotle to prevent the perpetuation of mistakes, as regards the causal understanding of natural phenomena. Even though Aristotle rejected the idea that scientific discourse could have a fictional component, his intention being that of describing "real" things, in this respect, one could say that, on one hand, Aristotelian scientific discourse did not have rigorous pragmatic criteria of selecting the descriptive fictions used in the effort of making generalizations about the characteristics of physical world and, on the other hand, that his endeavor suffered too much from cultural influences. Ironically, we will find almost the same lack of pragmatic criteria, at the level of general public in postmodern society, as regards the selection of descriptive fictions used this time in understanding some of the implications of contemporary scientific theories. As we will see in the last part of the present paper, such a phenomenon contributed to the perpetuation of the so-called "scientific mythology", together with some recent trends in postmodern culture.

As to scientific observation, no matter how systematic was it in times of ancient Greek astronomy development, the first remarkable progress occurred when this activity became intentionally oriented in tandem with experimentation and measurement. For such a combination to be possible, it was necessary to surpass the ancient Greek reluctance towards the possibility of mathematical description of the terrestrial world. And such a mutation was initiated by Galileo, who combined carefully the experimental scenario with formal calculus in the effort of investigating rigorously the properties of the physical world beyond any intuition or common sense.

The change induced in the discourse of natural sciences was spectacular in multiple ways, for such a transformation determined the putting on of some restrictions in the selection of descriptive fictions used in such a discourse. Later, as a result of such a process, pragmatic criteria for selecting descriptive fictions involved in the development of scientific theories were introduced. Starting from that point, the correspondence of the scientific discourse with the real world was not any more tributary to sensorial image of the world. Moreover, the counter-intuitive properties of the physical world were experimentally revealed and the very use of systematic observation changed, being influenced by the introduction of experimental scenario. Thus, scientific observation became intentionally oriented and complementary to experimental method. For such important changes to happen, it was necessary to modify the way in which the possibility of knowledge was conceived, which also influenced the contribution of imaginative faculty within scientific discourse.

The possibility of experiment occurred in the context of an epistemological optimism regarding the interaction between the human mind and the structures of nature. The ancient Greeks hesitated to consider the experimental scenario as a positive form of intervention regarding the effort of unveiling the characteristics of nature that could disturb further the already complicated properties of natural structures, whereas Galileo saw such a possibility as a form of investigating the hidden properties of physical systems. However, scientific discourse was already conceived by Aristotle as dealing with the relations among objects rather than with the objects themselves.

Unsurprisingly, the very use of descriptive fictions in scientific discourse changed dramatically when Galileo made the assumption of the mathematical character of natural structures. There is here a profound ontological transition regarding the relation between the mathematical component of descriptions in natural sciences and the physical structures they aim to describe. A physical law expressed by an equation was seen in Galileo physics as a powerful form of generalization that reflects some profound characteristics of the real world. Thus, mathematically structured representation of the world, an essentially quantitative one, replaced gradually the sensory representation, less efficient and profound in reflecting the features of natural structures. Moreover, at the level of scientific reasoning, the tandem experiment-mathematical physical law determined the development of a tandem between two main forms of reasoning: deductive reasoning-inductive reasoning, because experimental scenario implies the investigation of particular cases, while the obtaining of a physical law implies the effort of generalization.

This way, descriptive fictions used in a provisory manner in the process of developing the experimental scenario, especially in assuming a descriptive working hypothesis that makes the experimental effort to be intentionally oriented, were severely selected using much more clearly pragmatic criteria. Those of them with a positive role in establishing the provisory explanatory scenario that made possible the experiment gained epistemic descriptive authority by experimental confirmation of the scenario. The others were declared useless fictional components of the provisory description and soon were abandoned in favor of the others. In terms of investigative efforts, Galileo physics became even more imaginative than Aristotle physics, but the use of imagination was epistemologically restricted in the manner described above.

The main purpose of the natural science was to clarify the relations among objects, but the argumentation in favor of a specific explanatory scenario was rich now in factual arguments and in formal arguments as well, namely in experimental data and in mathematically expressed interpretation of those data. It is the case of the experiment with balls rolling on an inclined plan in order to emphasize the influence of gravitational acceleration on the process of falling down of an object in gravitational field. The experimental scenario is the expressions of an intensive imaginative effort aiming to underline the possibility of decompose the movement of a falling down object into a horizontal falling and a vertical falling. This way, the time necessary to an object to fall down from a certain height can be measured more precisely.

The whole experimental arrangement involves some sort of "discursive schematization" in terms of description. Within such schematization are ignored certain aspects that characterize the whole process in favor of others. The description is intentionally oriented towards isolating those key features of the phenomenon underlined by the working hypothesis. But sometimes the measurements or the experiment itself could become sources of surprises and this aspect, unique in the Galileo physics in comparison with the Aristotle one, proves that in this case the working hypothesis and the discursive schematization involved in experimental scenario are not definitive, nor the description of the phenomenon. Thus, the provisory character of the descriptive fictions involved in the scientific discourse became obvious, together with the dynamics of their evolution.

An important step forward in terms of the refinement of pragmatic criteria in selecting descriptive fictions involved in scientific discourse was made by Newtonian physics. The direction was the same with that opened by Galileo, but the mathematical component of scientific discourse became richer and boosted the systemic character of the entire descriptive effort to a superior degree of rigor. In the same time, the diversity of described phenomena increased significantly. Newton was an admirer of Euclid geometry; therefore the visual component of the scientific discourse promoted by him is very well represented. Almost all the demonstrations developed in his mechanics have a geometrical character. However, beyond this aspect, the efficiency of his descriptions is tributary to the development of mathematical abstract tools, namely the infinitesimal calculus. As a consequence, one can say that philosophical hesitations of ancient Greek philosophers of nature regarding the possibility of investigating terrestrial world using mathematical instruments were finally abandoned. Subtle parameters that characterize physical processes, like momentary velocity, could be successfully defined using derivative calculus (Cartwright 1994, 85), the direct consequence of this fact being the unification of the physical principles used in picturing the image of terrestrial and celestial reality. For the first time, the idea of a universal natural science became formally sustainable and Newton proved its viability by explaining some terrestrial phenomena, like tides, in terms of gravitational influence of the Moon.

But gravity was not the single universal element analyzed by the new physics; light itself represented an important topic of this sort, and Newtonian optics also benefited from the development of the modern scientific method that combined visual scenarios with abstract mathematical tools. In this case imagination played also an important part and the geometrical rigor of experimental arrangements became mandatory. In this respect, light bending represents a good example of phenomenon that became explainable by geometrical means, the concept of refraction angle being used for unveiling some profound features of light.

In the case of Newton one could easily observe the amplitude of the process related to descriptive fictions selection. From a biographical point of view, such a process proved to be really painful, especially if we are taking into account the amount of time dedicated by Newton to Alchemy experiments. The fact that he eventually abandoned such a form of investigation regarding nature properties tells us something about the triumph in his case of pragmatic criteria in investing with epistemic authority only those descriptive fictions that led to successful experimental scenarios (Verlet 1993, 45).

Another significant moment in the evolution of scientific imaginary was the formalization of Electromagnetism by James Clark Maxwell. The empirical component of the scientific discourse was provided by Faraday experiments regarding the magnetic effect of electric current. The case of electromagnetism is a very special one in terms of scientific representations dynamics. First, it is a case of strong complementary evolution of mathematical formalism on one hand and conceptual development on the other hand. The quantitative aspect of theory had a major contribution to the evolution of the qualitative aspect. The unification of electrical field with magnetic field into one single phenomenon described by the concept of electromagnetism was expressed by the famous set of Maxwell equations.

What is really intriguing about the role of imagination in the development of scientific discourse in this case, is that the road towards the concept of *electromagnetic field* was paved with spectacular visual representations of *ether* as background for the manifestation of electromagnetic field. Actually, Maxwell used several provisory visual representations of ether, the transmission of interactions through such a continuous isotropic medium being conceived in terms of mechanical systems. At first glance, the idea that Maxwell equations are describing the propagation of a perturbation through some sort of *mechanical ether* could seem shocking, given the huge influence Maxwell equations had in the development of electromagnetic wave theory (Cushing 2000, 72). However, from a historical point of view, things become easily explainable, if we are taking into account the huge prestige of Newtonian mechanics in the moment of Maxwell contributions.

Actually, the case of Maxwell is representative also for the relation between the private and the public part of descriptive representations. The starting points for Maxwell were the intuitions and the experiments of Faraday who, in his turn, used visual representations in describing magnetic field lines. What is really interesting here is not only the evolution of the representations used by Maxwell, but most of all the relation between the visual component of the theory and the analytical one. In spite the fact that the concept of ether was finally removed from contemporary scientific discourse, the mathematical formalism behind it, namely the Maxwell equations, remained a useful descriptive tool with great applicability. In fact, we are witnessing an ontological transition from a descriptive fictional framework that provided the qualitative background for the crystallization of the quantitative description of the phenomenon, towards a situation in which the fictional framework disappeared only to leave the quantitative description to be interpreted within another conceptual framework. Nowadays, for example, the electron-positron field would be considered as replacing the ontological function of classical *ether* in the description of nature.

In terms of descriptive imaginary dynamics, Maxwell historical moment announces a distinct tendency of contemporary scientific discourse: the relative autonomy of the mathematical formalism as part of the general description of the physical world. This tendency will become more and more obvious in other major theories of contemporary physics.

First, in case of General Relativity, the geometrical description of gravity will survive to some fundamental changes in the ontology assumed by Einstein; the most spectacular one was the giving up of the so-called "Mach Principle" that placed the matter at the origin of gravitational field (Cao 1997, 185). One could argue that geometrical description of gravity gained in this case a relative autonomy within the whole theory.

Second, in case of Quantum Mechanics, the autonomy of mathematical formalism became so strong, that it induced two distinct tendencies. On one part, the formalism became compatible with a wide range of interpretations, associated with different types of ontology. On the other part, the physical significance of the mathematical component of scientific discourse became intermittent, without affecting the authority of the theory. For example, the symbol Ψ, used for designating Schrödinger wave function, can be associated to some physical meaning only in some precise formal conditions of its occurrence, namely in the form of $|\Psi|^2$. Otherwise, in spite of its importance within formalism, it has no physical meaning. Thus, the formal component of physical discourse gains partial autonomy in comparison with other components of the same discourse.

Coming back to the moment of Relativity, in terms of descriptive imaginary evolution, we can observe that Einstein, in comparison with other great scientists that made significant progresses in the direction of relativity principle like Poincare or Lorentz, dared to question two descriptive representations inherited from Newton and Maxwell: the concept of *absolute space* and the concept of *ether.* Starting from Michelson-Morley experiment, Einstein began to search for an explanatory strategy able to describe "the electrodynamics of moving objects" without the concept of *ether.* The introduction of a modified relation between space and time which individualize relativistic physics in comparison with the classical one is a result of giving up the *ether* as explanatory tool by Einstein.

The spectacular relativistic descriptive imaginary impresses not only by its geometrical character, but also by the combination between visual and pure analytical elements, as it is the case with tensor calculus. In the same time, relativistic physics, most of all General Relativity, had a major influence on contemporary cosmology, whose reverberations on general public view about universe are significant. Beyond the technical aspects of relativistic cosmology, the idea of a limited, dynamic and expanding universe became popular, even if not always well understood. Actually, it arises from the Schwartzschild solution of the gravitational field equation developed by Einstein. Of course, the empirical confirmation of the theory, made by Hubble, was essential in establishing the epistemic authority of relativistic set of descriptive representations. But the theory created an explanatory context that oriented the astronomical observations and helped in data interpretation.

As to Quantum Mechanics, it contributed also in multiple ways in shaping the social imaginary about reality although in his case the misunderstanding of some basic concepts was even more severe. Of course, in 1905 when Max Planck introduced his quantum hypothesis the idea looked awkward even for trained physicists of Academy, but after 1930 when Copenhagen School led by Niels Borh began to develop the Quantum Theory and to apply its principles in understanding the atom structure and in explaining the Periodic Table of Elements, the new theory started to change dramatically the image about physical reality.

Especially the epistemological consequences of the Uncertainty Principle stated by Werner Heisenberg changed the manner of imagining the relation between subject and object. An important aspect regarding the misunderstanding of Quantum Theory principles by the general public regards the objective character of the theory. In spite of its difficult relation with realism, at least in its epistemological form, Quantum Theory remains an objective theory (D'Espagnat 1990, 94). But the multitude of interpretations associated with its formalism favored sometimes the fallacious understanding of the scientific discourse in its case.

On one hand, the general public had the tendency to assume the idea of a subjective relation among mental states and the properties of physical reality. A lot of pseudo-scientific domains started to be justified and explained in a "quantum" manner. Severe misunderstanding of some quantum concepts like "distance interaction" associated with Bell and Aspect experiments might be responsible for that situation.

Another possible cause could be the fact that sometimes the language used by physicists when trying to express verbally some results of quantum theory was not so philosophically rigorous. This lack of rigor was exploited by some authors in the context of postmodern philosophy and led to a spectacular but dangerous form of pseudo-scientific discourse in philosophical jargon having a misleading influence on general public, especially because it was promoted by some cultural elite. The situation became so annoying that determined some physicists to protest, the most well-known example in this sense being the Sokal affair (Wheen 2004, 99).

In such a world dominated by informational networks (Castells 1996, 21), the mythologies, namely the clusters of convictions regarding the structure of reality, are less regional and highly influenced by the scientific discourse

(Smith 2007, 229). The explanation is that nowadays the scientific discourse is the most prestigious form of discourse that intends to establish a rigorous descriptive knowledge about the world. The construal of the notion of "reality" is heavily influenced by the implications of contemporary natural science theories. Of course, the claim of universal authority as regards the description of reality (Deutsch 2006, 99) opposes sometimes religion and science, for example. But in contemporary postmodern society the syncretism of different types of ontology is quite often accepted and promoted. The modern of a single, unitary and rational description of reality has been abandoned especially because of the lack of enthusiasm in considering the scientific description as the source of solutions for problematic postmodern reality, mainly in its cultural aspects. The fact is that, in spite of this situation, the connection between cultural shaping of reality in postmodern society and the scientific discourse about reality remains quite strong, especially because the huge social influence of scientific theories through theirs technological applications. Therefore, science cannot be ignored in postmodern society as descriptive authority concerning the concept of *reality.*

Generally speaking, contemporary mythologies are in fact mixtures of scientific and non-scientific concepts that underlie a general perspective upon reality, a perspective embraced by large categories of people. In fact, any veritable scientific theory can become part of scientific mythology if the dynamic character of scientific representations and scientific concepts involved in it is ignored. This way, the theory loses its scientific character because, in Popperian terms, it is not any more recognized as falsifiable, becoming only a cluster of dogmatic statements regarding the structure of reality. As a consequence, we could ask how many of us are taking the most influential physical theories of the moment, like General Relativity or Quantum Mechanics, as live authentically dynamic scientific theories about the properties of physical real and how many of us are tempted to use them in a dogmatic way for configuring their reality as image about the physical real?

What seems to us really dangerous in this respect is the fact that many manuals used for teaching natural sciences reveal very few aspects regarding the dynamics of scientific representation, because of the non-historical perspective assumed. Thus, some pupils and students tend to adopt a static perspective in what regards contemporary science, ignoring the historical evolution and the morphological dynamics of scientific theories which is a basic feature that characterizes the scientific truth. This leads to a fallacious axiological understanding of the specificity of scientific discourse with deep consequences. Among them, we could mention the unjustified extension of scientific moral neutrality on different sensitive cultural issues.

In conclusion, we could say that, quite often the popular scientific mythology is inflationary and is mixing different types of discourse like the religious, philosophical, artistic and scientific discourse. What we consider to be characteristic for postmodern society is the multitude of directions in which scientific imaginary is used for enhancing scientific, but also pseudo-scientific manners of conceiving reality.

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