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Descriptive Imaginary Mutations that Made Possible the Birth of Modern Natural Sciences*

Abstract: The birth of modern natural sciences was a complex process, still able to heat debates among philosophers and historians of science as regards its true causes and stages. While discussing this issue, the present paper intends to analyze briefly some of the most important mutations that took place at the level of descriptive imaginary and favored the rise of the new methodological attitude of scientists towards natural phenomena. The starting point of our endeavor will be the famous controversy between Karl Popper and Thomas Kuhn regarding the nature of scientific progress, but we will be interested mainly in a better understanding of the specific role played by scientific imagination in the process of developing two very different types of scientific discourse about nature: the Aristotelian one and the Galilean one. Our aim will be in this regard that of emphasizing the unique features of the comparison between the two mentioned authors, in order to clarify whether or not the history of Modern Physics has an asymmetrical character which should be taken into consideration in any philosophical investigation of scientific progress.

Keywords: scientific imagination, scientific revolution, scientific knowledge

1. Introduction

The birth of modern natural sciences was a spectacular and complex process that still raises some questions and debates, some of them involving the adoption of different points of view regarding the progress in science. The specific profile of the discourse of natural sciences is

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directly linked to this problem. This is because one cannot understand the birth of modern natural science and the mutations it brought about without understanding the elements that define the discourse of natural sciences, its specific relation with the things it is talking about, on one hand, and its relation with its specific publics, on the other.

Among the controversies regarding this subject, one of the most well-known is that between Thomas Kuhn and Karl Popper. In fact, their dispute was not focused on the birth of modern natural sciences, but on the way in which progress takes place in this field (Deutsch 2006, 450). In direct relation with scientific progress, Popper argues in favor of his critical realism, while Kuhn is advocating in favor of his historical turn in philosophy of science, introducing the famous concepts of paradigm and scientific revolution (Kuhn 1996, 43). But the way philosophers of science see the scientific progress in natural sciences sheds light on the birth of natural sciences as well, because that very moment of the beginning can be considered as the one when such a progress took place for the first time.

2. A historical comparison

The starting point for Thomas Kuhn in developing the concept of paradigm was a historical comparison. Such a comparison forced Kuhn to become aware of his limits in understanding old texts of natural philosophy. More precisely, he became aware about his difficulties in accepting the general view about nature developed in Aristotelian Physics, which in fact prevented him from understanding the meaning and the purpose of Aristotle's endeavor in terms of describing and explaining natural phenomena. After repeated efforts, he discovered that the most important barrier in understanding Aristotelian Physics was represented by his knowledge of modern Physics (Marcum 2005, 30).

Thus, the influence of the cultural and historical context in which a descriptive and explanatory scientific endeavor in natural sciences takes place became for him a crucial factor. If one intends to compare two very different periods of time dominated by distinct sets of concepts and principles of understanding nature, the difficulties become obvious and, in terms of Thomas Kuhn's theory, even insurmountable; hence, the concept of incommensurability. From the entire Kuhnian doctrine, this aspect was by far one of the most contested, raising numerous controversies, Popper himself responding in a critical manner, especially in his work about "the myth of the context" (Popper 1998, 55).

Today both conceptions of Popper and Kuhn are considered influential. On one hand, the positive role of error in the evolution of scientific theories is accepted, while, on the other hand, the cursive and somehow gradual nature of scientific progress seems to be from time to time disturbed by revolutionary, or – at least – heated episodes that oppose for a while important personalities and their influence throughout important scientific communities. The problem in this regard seems to be the chronological proximity of paradigms that succeed one another. This aspect influences considerably the amount of notions and concepts which are transferred between them and, from this perspective, the comparison between Modern Physics and the Aristotelian one seems to be quite an extreme case, especially if one takes into account the huge period of time that separates them.

In fact, it seems almost impossible to find another similar example in the history of modern science, as far as the chronological distance between paradigms is concerned. That is why, as we are going to see, there are a few elements that entitle us to consider the history of modern science as profoundly asymmetrical in that of being fundamentally triggered by the introduction of experimental method, which in fact changed the role of imaginative faculty in its epistemological relation with nature. Among the precursors of this method we can mention Archimedes, as well as some of the English mathematicians of thirteen and fourteen century that theorized the method (Eastwood 1992, 84-99).

As far as he is concerned, we can consider that Archimedes effectively "materialized the Geometry", linking the properties of terrestrial matter with geometrical properties. Beyond engineering calculus, his contribution is remarkable in so far that he developed a veritable method of "material reasoning" in geometry, imagining geometrical figures as being material and deducing their geometric properties from the physical ones by applying on them physical principles like the center of gravity principle and the lever principle (Luria 1958, 97). From a pure mathematical point of view, this method was regarded, by Archimedes himself among others, as an intermediary or provisory one, the results obtained by its application being furthermore demonstrated using the classical deduction method, in order to be well-accepted. In fact, Archimedes continued in this regard the contributions of Eudoxus and Euclid.

But this somehow awkward application of physics to geometry represents, from a philosophical point of view, one of the first moments when human imaginative faculty linked the principles of natural sciences with mathematical reasoning, although reversing the order, by comparison with modern times. It may be only one single ancient philosopher and mathematician, apart from Archimedes, that used concepts of mechanics in geometry for demonstrating its theory of proportions: the Greek Archytas, whose contributions were used by Euclid himself. In any case, the episode mentioned above allowed Archimedes to develop a pretty rigorous and successful Statics. On their turn, centuries after that moment, Oxford mathematicians of the thirteenth century theorized the experimental method in science, without applying it effectively (Eastwood 1992, 84-99).

Returning to our main subject, one has to take notice of the fact that, in his later works, Kuhn himself refined his initial position on the problem of paradigms' incommensurability. However, giving the fact that he started his work about scientific paradigms from this historical comparison between Aristotle and Galileo, we intend to reevaluate this episode from a distinct point of view based on the specific use of imaginative function in scientific investigation, a perspective quite distinct from that adopted in the remarkably detailed studies of Alexandre Koyré about this episode, which inspired Kuhn initially (Kuhn 1996, VIII).

3. Aristotle's view about natural science

Speaking of Aristotle, his ideas about physical movement cannot be understood separately from his conception about universe as an organism, dominated by Aristotelian causality and having the Earth in the center. He avoids treating the physical movement (Aristotel, 1966, 201a, 57) with mathematical tools, favoring in this regard its teleological metaphysics and opposing to other pre-Socratic philosophical schools influenced by Pythagoras, Parmenides, Empedocles, Anaxagoras or Democritus (Ross 1998, 82).

In fact, his general attitude regarding mathematics can be seen as rather skeptical, at least with regard to the possibility of mathematics to reveal the fundamental characteristics of the terrestrial world. In this respect, his philosophical position is distinct from that of genuine Platonism, especially if we compare him to the direction of development adopted by the Platonic School led by Speusippos, immediately after the death of Plato (Ross 1998, 14).

For explaining this attitude towards mathematics, one should not forget the well-known discrepancy between the astronomical part of the

Aristotelian universe and the terrestrial part (Ross 1998, 95). Regarding the change and the evolution of terrestrial phenomena, extremely important for Aristotle was the transformation of potentiality in reality. Anything beyond the orbit of the Moon was considered by Aristotle a possible subject for mathematical investigation, while the terrestrial world, placed below Moon's orbit, was considered by him too irregular to be investigated with mathematical tools. In this respect, we can easily observe the contrast between his position and that of Galileo, who considered mathematics as being a privileged language for understanding the whole nature, whose characteristics became observable due to the use of telescope and microscope. As far as the terrestrial movement is concerned, the position of Aristotle was dominated by his conception regarding, on one hand, the four causes – especially the final cause – and, on the other hand, the four elements: earth, air, fire and water. In analogy with living entities, non-living objects have their own nature, their own tendency and their own purpose. As a consequence, it is natural for an object made of fire to rise up and for an object made of earth to descend.

Since these should be the natural movements of different kinds of terrestrial objects, it is natural for the earth to look for the center of the universe, hence to be placed in the center of the universe and to have a spherical shape, given the fact that circle is the most stable of all geometrical shapes, all the composing parts of the earth having the same tendency to move towards the center. Because the heavens and their specific element, the ether, can be observed as being unchangeable, the characteristic movement of all celestial entities should be also circular. It is noticeable at this point the logical justification of the celestial entities trajectory, instead of an observational one (Ross 1998, 93).

Apart from that, the case of ether as descriptive concept exemplifies very well the substitutive function of imagination products in Aristotelian natural sciences. The undetected ether, mixed imaginatively with the real heaven, represents a significant example in this respect. The mixture between testable concepts and purely imaginary ones was so strong, that the ether was inherited by Newton, played an important role in Maxwell's work regarding the concept of electromagnetic field and remained a significant descriptive tool for Poincaré, Lorentz and other modern scientists, Einstein being in fact the first one who dared to give up on it as a descriptive tool.

In spite of his dedication to the systematic and detailed observation of nature combined with his preoccupation for the correspondence truth criterion, Aristotle failed to find a clear and efficient method for distinguishing pure fictional elements of scientific discourse from those with real epistemic authority. The main reason for that was, of course, the lack of experiment as investigative instrument within the scientific endeavor of unveiling the most important characteristics of physical systems. Apart from that, Aristotelian theory about movement is perfectly coherent, but limited in explaining the behavior of the external world.

Coming back to the movement of different terrestrial objects, we can observe that, for Aristotle, each one of these has the natural tendency of transforming its potentiality in actuality by going towards its own purpose, in accordance with the elements it is made of. According to a *teleonomic* Aristotelian principle, each object follows its natural purpose with tenacity, in a similar manner to living entities (Aristotel 1966, 199 a, 52); thus, the perspective upon universe developed on the ground of this principle was an organicist one. Any terrestrial movement has an external agent; for example, the efficiency in movement for an object made of earth increases together with its closeness to the earth, its natural element. Because the external cause of any linear terrestrial movement is related to one of the four elements, it is impossible to conceive the presence of vacuum, which excludes the possibility of natural movement. This kind of a priori reasoning could not favor a realistic and efficient approach of natural phenomena and became, unfortunately, a quite difficult obstacle throughout medieval period for any attempt of developing further investigations in natural sciences (Cushing 2000, 33).

The use of logics in understanding the physical world is a process with certain specificity in the case of Aristotle. A good example in this respect is the use of material point when discussing the problem of physical corps divisibility. In his work entitled *De generatione et coruptione*, Aristotle opposed his position to the atomist positions in this regard (Joachim 1922, XIII). He partially accepted the divisibility of all parts of a physical body, but in the same time rejected the simultaneity of such divisibility, due to the fact that a physical body for him consisted of an infinite number of points. This positioning is grounded on the fact that physical points inherit the non-dimensional character of mathematical points. Later on, Newton himself would include the concept of material and non-dimensional point in his reasoning about the mechanical properties of physical bodies, inheriting this concept from Aristotle together with other concepts like absolute space and the concept of ether.

However, in the case of Aristotle, the lack of experiment prevented the prevalence of experimental correspondence to reality over the coherence criteria of scientific discourse. The consequence was the substitutive role of logical speculations over the facts, up to the point of negative conceptual interfering within the effort of investigating the true causes of phenomena. By contrast, in the case of Modern Physics the preeminence adequacy with experimental data over the discursive coherence is omnipresent, for instance in the case of quantum hypothesis adopted by Max Planck.

In fact, as far as the Modern Physics is concerned, the experiment represents not only a component of the methodological attitude towards nature, but also an important reference point for the scientific discourse, which in fact plays the part of an epistemic selection criterion regarding the adequacy of different scientific concepts to the physical real. Thus, depending on their profile in accordance to this criterion, descriptive representations used within scientific discourse can be split into two major categories: those with a logical-mathematical background, having a rather difficult relation to experience and those with an empirical background, having a strong relation with experience and sometimes receiving the logical-mathematical integration later on. There might be also a third category of discursive entities used in descriptive scenarios: that of physical constants, which depend directly on measurement units, being in fact not genuine descriptive representations, but rather fundamental operational components of descriptive scenarios.

4. Galileo's view about natural science

It is hard to overestimate the importance of Galileo's contributions as regards the emergence of the modern way of understanding nature (Koyré 1997, 73). In works like *Sidereus Nuncius, Dialogues Concerning Two Chief World Systems* or *Dialogues Concerning Two New Sciences* he literally changed the methodology of building the scientific descriptions in natural sciences and reshaped the image of the Universe for a remarkably diversified public (Koestler 1995, 286).

As regards the motion, Galileo started his researches with the problem of explaining the trajectory of a projectile, which constituted for him an important subject for over forty years. He supposed the trajectory was a parable and he tried to demonstrate that each point on the trajectory would have the properties of a point situated on a parable (Galilei 1961, 343). In time, another guiding idea for him was that such a parabolic shape of a projectile's trajectory would be given by the overlapping phenomenon between its falling down movement and its movement towards the initial throwing direction. This idea led him to deduce the law of throwing heavy objects from the law of free falling. The parable condition for the trajectory of a projectile was satisfied only in the situation when the space was proportional with the square time (Cushing 2000, 97). But another important discovery helped Galileo make real progress in understanding the movement of projectiles (Galilei 1961, 338): he observed the isochronisms of pendulum oscillations and the link between this aspect and the falling of a body on an inclined plane. Such a discovery was favored by his researches conducted in Padua, when he observed the fact that the reduction of the angle of the inclined plane reduces the velocity of falling for the body on the plane.

He discovered experimentally the law of free falling and the law of falling on the inclined plane (Galilei 1961, 282), but the main difficulty for him was to demonstrate mathematically these laws, together with the equality between two ratios: the ratio between the time of falling on the inclined plane and the time of free falling from the height of the inclined plane, on one hand, and the ratio between the length of the inclined plane and the height of the inclined plane, on another hand. Furthermore, the mathematical demonstration of the isochronisms of pendulum oscillations posed him significant difficulties (Marian 1961, 25).

All these difficulties determined him to adopt a working hypothesis according to which the speed of a heavy object in its free falling increases proportionally with the growth of the distance covered by the object from the beginning of its movement. From this point, he engaged in fallacious reasoning (Marian 1961, 24) and stated that, in the case of the free falling, the ratio between the covered spaces is equal with the ratio between the corresponding square times. Another consequence raised from the working hypothesis was that a thrown up body crosses decreasingly through the same speeds as in the period of its falling down movement, which in fact convinced furthermore Galileo about the rightfulness of his working hypothesis.

At this point the situation of Galileo's scientific discourse is special, because the imaginative contribution in this case maintains an apparent correlation with experience, which for the moment justifies quite satisfactorily the enthusiasm and the trust of Galileo in his hypothesis. And maybe for the first time in the history of Western Thought the eligibility of scientific descriptions depended on the correspondence criterion so directly. As we are going to see, the correspondence criterion became more and more important throughout the historical development of Physics, while the combination between this criterion and the criterion of mathematical coherence became the mark of natural sciences discourse, representing at the same time a lucrative limit for the imaginative function and its idealization effort within the descriptive and explanatory endeavor of natural sciences.

Soon, the enthusiasm of Galileo was replaced by disappointment, because one of the consequences deduced from his working hypothesis proved to be in deep contradiction with experimental data. The claim that the speed of a thrown body should be a genuinely instantaneous movement turned out to be in deep contradiction with experience, but also with the starting hypothesis. The claim was deduced from the hypothesis that the speed of a falling body is proportional with the covered space; thus, given the fact that the body gained a specific speed after covering a certain amount of space, it would gain a double speed after covering a double space. But the second space, which is double, was covered in the same amount of time as the first space. Given the fact that, in the case of the second space, the first half of it has to be crossed before the second half, there are obvious difficulties in finding the amount of time necessary for crossing over the second half of the second space. This way, the falling down of bodies would become an instantaneous movement, which is absurd (Marian 1961, 24).

Around 1609, Galileo replaced his working hypothesis with one that admitted the proportionality between the speed and time in the case of a falling body. According to this new hypothesis, in case of two successive downfalls of the same body, if the time of the second downfall is double in comparison with the time of the first downfall, the speed gained at the end of the second downfall would be double in comparison with the speed gained at the end of the first downfall. Starting from here, with the use of graphical representations, he deduced that in the case of this movement the space is proportional with the square time (Marian 1961, 25). A good correspondence of this theoretical result with experimental data assured Galileo of the fact that the free falling of a body is a uniformly accelerated movement. Starting from here, Galileo corrected all the consequences deduced initially from his first hypothesis adopted in 1604, creating in this way his modern theory of dynamics. In the center of this theory was the idea that the arch of a circle was the trajectory of a falling body covered in the shortest amount of time. In the same time, Galileo took into consideration the possibility of applying the laws of free down falling in the case of falling on an inclined plane, especially the principle according to which the speed gained by a falling body on different inclined planes remains the same, no matter the inclination of the planes, provided that the height of all inclined planes remains the same. Based on these researches, Galileo started to investigate the problem of composing movements in the case of thrown bodies, in order to determine their trajectory. He explained this movement as resulting from the combination of two movements: a uniform one and a uniformly accelerated one (Cushing 2000, 91).

As far as the problem of composed motion is concerned, Galileo was familiar with an ancient treatise entitled *Problems of Mechanics,* which was attributed to Aristotle, while the real author might be the ancient Pythagorean philosopher, mathematician and astronomer Archytas (428-347 BC), who may be considered a pioneer in studying geometry by the use of mechanical concepts. The mentioned treatise presented a study of composed motion as a combination of two similar motions, but Galileo made further investigations in the direction of understanding the case of the motion resulted from the combination of two different motions: a uniform one and a uniformly accelerated one (Galilei 1961, 175). Ancient Greeks already demonstrated the fact that the trajectory of a point influenced by two movements whose velocities are not in a constant ratio one to each other cannot be a straight line, but the contribution of Galileo is essential in that of using real, natural movements which are present in nature, for understanding the movement of a thrown object, while the Greeks used imaginary movements. And this is the crucial element that distinguishes the work of Galileo, because in his case the imaginative faculty is used within the limits of rationality, its products having a complementary and not a substitutive function in relation with experience. Furthermore, the physical experiment can be seen as the expression of a projective intentionality deeply originated in the imaginative faculties of a scientist. At the same time, experimental data became a reference element for the process of descriptive representations selection which gradually turned into a new and extremely powerful epistemic criterion in what regards the modern natural sciences discourse.

Thus, one can consider the transition from Aristotelian natural science to Galilean natural science as involving a fundamental mutation in what regards the function of imagination within scientific reasoning, as far as the production of descriptive and explanatory scenarios is concerned.

Of course, other important mutations took place in times of Newton, Faraday, Maxwell, Poincaré, Einstein, Bohr and others, which contributed to the maturation of natural sciences discourse, but the fact is that its genuine modernity has been consecrated by the combination between measurement, experimental scenario and mathematical demonstration initiated by Galileo, theorized by thirteen century Oxford mathematicians like Roger Bacon and later on by empiricists like Francis Bacon or David Hume and rationalists like René Descartes.

5. Final considerations

At the end of our short investigation, we could return to the starting problem regarding those fundamental mutations that contributed decisively to the emergence of modern natural sciences, to the maturation of their discourse about fundamental features of natural phenomena. First of all, we must emphasize the fact that in the course of this paper we were less interested in the question of personal merits of different scientific personalities in what regards the changes we are discussing. It is less important for our discussion if the mutations that distinguish the Galilean Physics from the Aristotelian one happened due to the extraordinary originality of Galileo on one hand, or could be linked, on the other hand, to a long tradition of more or less speculative thinking about the problem of movement, which started from Antiquity with Pythagoras, Archytas, Archimedes, then with Aristotle and Ptolemy, continued with Roman authors like Lucretius that spread the Aristotelian ideas throughout the Western cultural space up to Renaissance period and finished with Oxford School of mathematics in the thirteenth and fourteenth century, that in its turn developed a theory about the role of mathematics in understanding the mentioned problem (Roux 2010, 319-337) before the new wave of thinkers represented by Copernicus, Kepler and Galileo made the final step towards a modern understanding of the problems.

Of course, the Kuhnian idea about a scientific revolution would be favored more by a sudden change in the architecture of the scientific discourse (Hoyningen-Huene 2006, 119-131), but even in the case of gradual accumulations that triggered out a fundamental epistemological mutation of the discourse of natural sciences the idea of the so-called "Copernican Revolution" (Kuhn 1998, 8) can be maintained. The crucial question is whether or not some fundamental changes took place and what would be the most important ones, especially in what regards the role of imagination within scientific discourse.

For the first time, in the case of Galilean scientific discourse the concept of verifiable truthfulness gains importance, most of all because the statements about the fundamental features of natural systems can be obtained by isolating and rigorously observing those features through experimental endeavor, while at the same time the manner they are quantitatively expressed could be mathematically demonstrated and verified by anybody. Moreover, the role of human imagination changes fundamentally within scientific discourse, from a substitutive function as regards the relation with experience, that epistemologically exposed the discourse to risky confusions between real and fictional elements, to a complementary function. Pragmatic criteria that individualize the descriptive imaginary (Chiriac 2011, 162-168) play a fundamental role in this second case, when the imaginative faculty of human mind is severely limited in terms of influence, all its "productions" being in fact tested through a mechanism of successive conventional assumptions and verifiable predictions whose maturation will take place in times of Newton.

Several conclusions can be drawn from the comparison between Aristotle's way of thinking and Galileo's way of thinking in what regards the discourse of natural sciences. In the case of Aristotle, beyond his own theory about imagination (Védrine 1990, 36), the products of the imaginative function represent sometimes a substitute of the experience. This substitutive role of imagination within scientific discourse, together with Aristotle's philosophical positioning in the problem of movement exposed Aristotle to a weak relation with experience. In fact, he was an adversary of atomism and Parmenides positioning regarding motion, while at the same time the scientific experiment was not at all a possible investigative strategy for him, especially in what concerns the effort of unveiling the properties of nature.

In the case of Galileo, imagination becomes a complementary tool in comparison with experience, allowing even the designing of the experiment as an intentionally oriented projective strategy of isolating certain causes with a presupposed important role within the studied phenomenon (conventionally considered as such at the beginning of the experimental scenario). Galileo combines this particular function of geometry with mathematical method for elaborating a descriptive quantitative explanatory model of the studied forces and phenomena.

What unites the two very different conceptions about the world is the structural perception, which for Aristotle arises from the method of systematic observation of nature, whereas in case of Galileo arises from a painstaking imaginative effort regarding the material experimental interaction with nature oriented towards its hidden but repeatedly manifested, therefore testable properties.

The discrepancies between the two methodologies, one centered on systematic observation of nature, which produces mainly qualitative results, and the other one centered on experimental and mathematical investigation of nature, which produces qualitative, but also essential quantitative and verifiable results about the properties of nature, could be seen, at first glance, as a sheer confirmation of Kuhnian point of view regarding the progress in science. But on a closer look, we could easily observe the fact that such a discrepancy is practically impossible to find in another period of scientific development. The practical introduction by Galileo of mathematical method of research combined with the experimental method in natural sciences represent the very moment when modern Physics was born. Once this methodological tandem was introduced, the efficiency of the new methodology was so great, that, since then no other moments in the history of modern and contemporary physics could be found when experimental method was absent. Even the Physics of principles developed by Poincaré, Lorentz and Einstein, or the operational pragmatism of Bohr's epistemology regarding the theory of measurement in Quantum Mechanics remained tributary to the methodological tandem formed by mathematical deductibility and experimental verifiability, in spite of dosage discrepancies.

In the Physics of principles case, the dominance of mathematical tools could be easily emphasized, but the whole investigation starts in fact from intriguing experimental data. Whereas in the case of Bohr's operational pragmatism the limits of measurements dictate somehow the limits of the embedded ontology attached to the explanatory scenario but, while the mathematical tool remains really strong, the importance of verifiable predictions is not at all diminished. Therefore, we could easily consider the history of Modern Physics as being profoundly asymmetrical and such a comparison like that between Aristotle and Galileo, used by Kuhn, as genuinely unrepeatable. That is why no other pair of paradigms within Modern Physics would present the same incommensurability to one another, like those mentioned before. It is as if Kuhn encountered accidentally the Aristotelian account of nature from the outside of Modern Science and was inclined or tempted to compare it to a theory that, in its turn, belongs definitely to Modern Science and even played a fundamental role in the maturation of an axiological matrix, which represents in fact a set of principles that particularize it in comparison to any other type of discourse about nature developed before. We can understand that Kuhn was faced with the reality of his own education as contemporary scientist, which made in fact the contrast more evident, almost insurmountable, but it looks like Kuhn was inspired in his positioning regarding the incommensurability of paradigms by a comparison between two opposite conceptions that generated two different types of descriptive discourse regarding nature. One pre-scientific conception about nature based on observation as an investigative method capable to produce a rather intuitive, qualitative and only metaphysically justified knowledge, and another conception about nature, modern, based on mathematical rigor and experimental strategies aimed to unveil the basic features of physical systems, a conception able to produce a rigorous and quantitative knowledge about nature, experimentally verifiable and mathematically demonstrable.

We consider that such a huge methodological distance and paradigmatic incommensurability will never be encountered in the future between two different scientific theories since the born of Modern Science. Therefore, the Kuhnian incommensurability among different understanding paradigms does not reflect in detail the growth of modern scientific knowledge, but the translation from pre-scientific view of the world to the scientific one. At the same time, it could characterize the translation from a modern natural sciences discourse to a post-scientific discourse about the physical world which for the moment seems plenty improbable in the near future at least. In this respect, the postmodern tendency to regard modern science as a simple form of cultural ideology seems to be also an unwise way of understanding Kuhn's theory (Chiriac 2012, 182-190), because scientific progress happens effectively (giving the growing number of physical constants) and a realistic point of view about natural sciences could be in this regard opposed quite effectively to a constructivist one.

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