Horia-Costin CHIRIAC
"Gheorghe Asachi" Technical University of Iaşi (Romania)

# European Cultural Identity and the Emergence of Scientific Imaginary

**Abstract:** The present paper intends to emphasize the relation between the European cultural identity and the emergence of scientific imaginary in this space. In fact, we are interested to emphasize the link between some features of European culture and the birth of modern natural science within European space. Social, geographical and even some cultural factors, including religion, seem to be in favor of the emergence of science in Europe, especially in Renaissance times and afterwards, while later on, the cultural influence of scientific theories seemed to prevail. Nowadays European cultural identity benefited enormously from the development of natural science, which played a major role in spreading through technology the European culture in the whole world, but was also placed at the origin of some spectacular philosophical developments regarding the rational descriptive perspective upon the world which individualize Europe among other cultural spaces.

**Keywords:** scientific imaginary, conceptual developments, European cultural identity, history of science

## 1. Scientific imaginary as identitary element

The present paper intends to cover a subject treated mainly by historians, namely the relation between the development of modern science and the European cultural identity. What interests us is the possible link between the cultural profile of the European space and the emergence of scientific culture within it (Gaukroger 2006, 3). On the one hand, it is intriguing the fact that Europe was the major geographical area in which a coherent rational conception about nature was shaped gradually up to the point of a veritable independence from religion and mythology. On the other hand, the same European space suffered later remarkable social and cultural transformations triggered by the considerable success of scientific theories.

There are two distinct ways in which science influenced European culture. The first is the technological one, which involved – together with the beginning of the Industrial Revolution – significant social transformations, affecting the way in which political ideologies were understood, developed and applied. The second one refers to the manner in which scientific theories and their successes were received and understood not only by scientists, but also by cultural personalities, writers, philosophers, painters etc. Such process influenced in time, together with other factors, important cultural mutations regarding the way in which Europeans understood the human condition, the relation between the Human Being and the surrounding Universe and so on. Major philosophical themes were connected in a way or another to the remarkable success of natural sciences and the manner of questioning them was indirectly influenced by cultural "trends" in which the cultural understanding (or, sometimes, misunderstanding) of one or another of scientific theories by the large public played an important role. Social ideologies and sometimes even important artistic trends such as modernism and post-modernism can be linked in their evolution to the influence of natural science upon the European historical evolution. Consequently, although one can still operate nowadays with the distinction between humanistic culture and scientific culture, the scientific spirit present in various theories can be regarded as an important part of the European cultural identity. For this to happen, it is necessary to assume science as a cultural activity, involving the use of moral and cultural values far beyond its immediate pragmatic purposes. Even the production of technology, as a human fundamental activity linked from one certain point in history to the emergence of science, has to be understood as having sometimes cultural consequences or even as having a cultural component. All these could seem quite strange from an anthropological point of view, but we are going to try to justify the rightfulness of such attitude, especially nowadays. Any kind of argumentation in this respect should start from the cultural influence of scientific theories as historical processes.

As we already mentioned above, such influence had two components or, in other words, took place at two distinct levels. Directly, natural sciences influenced, throughout the process of their methodological emergence, the majority of social sciences. Important philosophical trends were also influenced by their emergence, among them being materialism and physicalism. Furthermore, the maturation of natural sciences consolidated the various types of academic institutions,

which in their turn favored further conceptual transformations with social impact (including politics). Indirectly, natural sciences influenced the development of technology, which in its turn had a major influence upon the dissemination of European culture throughout the entire world and, at the same time, favored the contact with different cultural spaces, a process through which European culture became the first one with veritable universal vocation. War was another human activity with tremendous social impact, an activity deeply linked to the history of science and technology. In a way, war modified radically the perspective of Europeans regarding the world. In this respect, the two World Wars triggered a chain of social mutations that determined the dissolution of the great colonial empires. Science and technology were at the core of such processes, mainly through their impact upon the development of modern and increasingly faster transportation and communications.

What interests us in the present paper is not the history itself in all its details; we intend rather to emphasize some crucial points in the complex process of conceptual development, especially those moments in the evolution of science that affected the general view about the surrounding world. In this respect, as we are going to see, not all important scientific discoveries or theoretical developments triggered at the same time equally important changes in scientific imaginary. An important factor in this context refers to the dissemination of the acquired knowledge through various channels, a process highly influenced by the historical context.

## 2. Ancient Greeks and some of their contributions

As we already mentioned above, we are going to analyze the importance of some crucial points in different periods of time within the historical development of scientific theories in terms of their influence upon the development of scientific imaginary (Kosslyn 1995). The natural philosophy of Ancient Greeks represents undoubtedly one of the most spectacular achievements regarding the possibility of understand rationally the awkwardness of natural phenomena.

One interesting question in this context would be that regarding the contribution of Ancient Greeks to the evolution of scientific imaginary. Obviously one of the most remarkable contributions is that of initiating rational theories about the surrounding world, including the primary constituents of the cosmos. Gradually, such primary constituents used in building ontological theories evolved from simple physical elements to

abstract concepts like *apéiron*, a phenomenon which could be compared to the increasingly abstract character of explanatory concepts used in contemporary physics. Up to a certain point, even the Ancient atomism can be linked to the present day conceptions about the fundamental constituents of matter.

However, beyond all these details regarding the conceptual profile of ancient Greek theories of natural philosophy, there are three crucial elements introduced by their authors that contributed decisively to the progress towards a scientific perspective upon physical reality. First, one could take into account the fact that such theories represented a coherent alternative to mythological explanations of natural phenomena. Hundreds of years after that moment, philosophy would also contribute to the independence of scientific methodology, this time through René Descartes. As we are going to see, not scientists themselves, but rather philosophers introduced this change in attitude, giving the fact that laic theology was still assumed at that time by the majority of natural science pioneers.

Coming back to the Ancient Greeks, one can easily notice another important idea that survived in the modern scientific culture: the deep conviction that numbers are a key ingredient of scientific discourse in any attempt to unveil the characteristics of nature. In fact, it is a Pythagorean idea, but its influence on Plato led to the development of a profound investigation of the relation between scientific truth and the possibilities of human senses to shape our image about surrounding world.

Thus, for many philosophers and later for many scientists it became clear that mathematical demonstrability of scientific truth goes hand in hand with another remarkable characteristic of it: the fact that most of the time scientific truth goes beyond our senses, being unattainable by simple observation. In fact, its non-intuitive character calls for the introduction of experimental scenario, which represents at the same time an imaginary projection of the phenomena, but also an effort of forcing nature to manifest its characteristics in a measurable way. After all, technology in this context brings natural phenomena into the range of human senses.

Of course, all these evolutions took place long after the moment of Greek philosophy of nature and the Greek philosophers operated a distinction that prevented them from developing a unitary mathematical approach of nature. The distinction was that between the cosmic space beyond the lunar orbit and the terrestrial space. Mathematical approach of natural phenomena was restricted in times of Aristotle only to cosmic

space. Eratosthenes and Archimedes were amongst the very few that used mathematics for investigating the terrestrial world. Unfortunately, in the case of the last one, historical events prevented the spreading of its mathematical treaty called “The Method”, which contained a primitive form of infinitesimal calculus that could have brought an extraordinary jump forward in the history of Ancient natural science. Thus, the link between mathematics and observation remained rather weak in Ancient Greek science. As it is well-known, this handicap limited severely the achievements of Aristotelian Physics and later, in times of Archimedes, in spite of its remarkable contribution represented by the so-called “material method” in geometry, such limit was not convincingly surpassed. Contemporary historians of Mathematics admit that Archimedes was far ahead of his time and his treaty entitled “The Method” could have changed the development of scientific imaginary if it had not been lost for a long period of time.

In spite of this historical misfortune, some other important concepts used by Greek philosophers contributed to later historical development of science in Europe. For example, the so-called “structural perception” of a natural phenomenon can be linked to the contributions of Aristotle, who introduced in this way a remarkable conceptual ingredient within the theory about the properties of the physical world: causality. Of course, the Aristotelian concept of causality can be linked to his teleological approach of nature, but still it represents an important step forward in the direction of modern scientific causality.

As one could easily notice, causality plays a crucial part in the development of experimental scenarios. In spite of the fact that in his times the scientific experiment was not yet introduced, systematic observation being used instead for gathering information about different characteristics of nature, Aristotle emphasized the importance of the so-called structural perception, as the first step towards a rational understanding of a phenomenon. The descriptive and the explanatory effort of any scientist can benefit from the Aristotelian theory of logic, which allows him to use correctly the classical methods of induction and deduction.

Furthermore, Aristotelian dialectics is another important heritage in terms of methodology, playing a crucial role in times of scholastic movement and contributing decisively to the shaping in Western Europe of a debating culture, which represented one of the key factors in the emergence of modern science there.

The heritage of the Ancient Greek culture, an intellectual treasure spread beyond the borders of Greece itself by the Empire of Alexander the Great and later by the Roman Empire, was to be placed at the origin of some spectacular cultural mutations in Europe hundreds of years after. For the moment, some places that favored intercultural exchanges played a crucial role in the development of science and for the Hellenistic period of time such a place was the town of Alexandria. The great library exerted a strong attraction on many important personalities who came to town in order to benefit from the great diversity of information gathered there, but also from the freedom of expression. For example, being placed at the intersection between the Greek Culture and the Egyptian Culture, the town of Alexandria inspired the famous physician Galenius to come here and to perform dissections on animals and human bodies which were forbidden elsewhere. This way he was able to emphasize the great importance of the brain in coordinating human senses. As far as Geometry was concerned, Alexandria was also a remarkable center and one could refer in this respect to the personality of Hypatia, for example.

### 3. Some conceptual developments in the Middle Ages

At first glance, it seems that in the Middle Ages the rational investigation of nature proper to the Ancient Greeks was lost and replaced by a mystical approach that involved also a significant change in structuring the description of the world. Such a process could be linked to the dissolution of the political and administrative structures of Western Roman Empire. But in the second part of the Middle Ages, interesting transformations took place. In fact, a significant part of Greek knowledge, collected in some of the greatest towns of Antiquity, in spite of inherent destructions that marked the period of decadence and dissolution of the Western Roman Empire, was took over by another great civilization in full process of rising up: the Arabian civilization.

Especially in the period between $7^{th}$ – $11^{th}$ century, the Arabs took over, interpreted and even developed further on some extremely valuable knowledge of the Greek and Roman Antiquity. The contribution of Arab scholars such as Al-Farabi, Avicenna and Averroes, as well as the commentaries made by Christian scholars such as Albertus Magnus, Roger Bacon and Duns Scotus could be linked to the much later cultural mutations that made possible the Renaissance at the end of the second part of Middle Ages. Cultural centers like Toledo, for example, were placed at the core of an intense cultural exchange between the Mors and

European Christians. Such an exchange permitted, for example, the introduction and spreading of paper in Europe, a process that dramatically accelerated the intellectual dialogue. Nonetheless, the Crusades and the cultural treasures of Constantinople played also an important part in triggering such a process with great consequences in terms of scientific imaginary evolution.

What interests us in this context are those ideas with great innovative potential in what concerns the further development of European science. Among them, the notion of zero was a crucial step forward, together with the introduction of Arabian numbers and Algebraic calculus. Moreover, the receiving and the development of Aristotelian philosophy by the Arabian scholars represented a rich starting point for philosophical syntheses like that of Thomas Aquinas (2008, 81). Later on, these theories opened in European theology the way towards a rational understanding of God, but in the same time of nature as His Creation. This ideology favored the inquiry of the characteristics of nature in a rigorous and systematic manner. In fact, the so-called laic Theology that dominated the general perspective upon the world adopted by the majority of Modern Science pioneers like Kepler (1995), Galileo (1961, 175), Descartes, Leibnitz or Newton is rooted in this tradition or at least could be related to it.

Of course, the fact that Aristotelian conception about nature (Aristotel 1995) dominated for so long the Middle Ages' perspective upon the world determined numerous historians of science to place Scholastics in genuine opposition with the idea of progress in science, but what interests us in the present paper is to emphasize those aspects that could be linked to the idea of scientific imaginary evolution. In this respect, Aristotelian philosophy favored the dialectical approach of various aspects of nature, which in time contributed to the development of a methodical approach to nature in the European cultural space. Naturally, such a process benefitted enormously from the contributions of some remarkable personalities like Pierre Abélard, Anselm of Canterbury. The already mentioned idea of understanding God by investigating Nature, for example, was well developed in the 12$^{th}$ century by a few authors clustered around the town of Chartres: Adélard of Bath, Bernard of Chartres, Guillaume of Conches and Thierry of Chartres (Nay 2008, 132). The importance of such efforts would become obvious later, throughout the increasingly opening of European medieval culture towards an empirical way of thinking the gathering of knowledge about surrounding world.

## 4. Renaissance, Enlightenment and modernity: a few considerations

We are going to make a jump to the moment of scientific imaginary emancipation. Naturally, it seems quite strange to associate three important and distinct periods of time, but as far as the history of scientific imaginary is concerned, they can be well linked by a basic element, namely the "Reasoning-Imagination" couple.

The profile of this pair, in terms of proportionality and richness, varies considerably from a period to another, but the basic components remain. In other words, taking into account the epistemological standards of Modern Science, we could talk about the richness of pre-scientific Renaissance imaginary associated with personalities like Marsilio Ficino or Giordano Bruno who started from the Aristotelian concept of "phantasia" (Culianu 1994, 19). We could also talk about the genuine enthusiasm towards the possibilities of human reasoning in times of Enlightenment and we could link that to the emerging Cartesian philosophy which contributed decisively to the development of scientific methodology. But in the same time we could talk about the maturity of scientific methodology in modern times, combining mathematical reasoning with measurement and experimental methodology, which involves also the "Reasoning-Imagination" pair, but in a considerable different proportionality, imagination being well confined within the limits of causal and mathematical reasoning.

What is remarkable in these three periods of time is the pattern of mutual influence between scientific imaginary and cultural trends. Starting from the great enthusiasm triggered by the spectacular success of Newtonian Mechanics (Mach 2001), there were quite few philosophical trends that became influential in the period of Enlightenment and later on. At the same time, through the continuous growing industry, the prestige of science and technology consolidated. A new cultural profile of Europe was shaped, including the changes induced by the worldwide spreading of European culture through modern transportation and communication.

Paradoxically, religion seemed to prevent in medieval Europe the emergence of a genuine scientific culture, but at the same time offered the philosophical premises for later developments (Stan 2004, 33) in this respect by underlying the distinction between Creator and Creation, by nurturing the enthusiasm of scientists through the epistemological

optimism implied in the conviction that God, in His kindness, created the world and enabled human reasoning, another divine gift, to investigate and understand it (Funkenstein 1998, 13).

Ironically, the moment of emancipation for human reasoning, assumed as universal capability of Human Being to investigate and represent objectively the structure of the physical real, was at the same time a moment of abandonment of the comfortable privileged place reserved to humans by God in what regards the understanding of the world. Thus, methodological struggle in selecting true, verifiable and objective knowledge about Nature became the only option for modern scientists. After all, modern scientific methodology transforms experience from an observational or sensorial investigative stance into a measurable (Cartwright 2006, 141), objective and basically repeatable process of interaction between human cognitive faculties and the surrounding physical real (Cushing 2000). From that moment on, scientific imaginary was dominated by conceptual parsimony in representing the properties of Nature and the concatenation of descriptive representations within a coherent theory became a mandatory condition for the morphological evolution of any scientific concept. The sharp distinction between real and fictional became crucial for Modern Science, but at the same time shaped the analytical, rationalistic and pragmatic specificity of European culture in comparison with other spaces.

As a conclusion, we could say there was a spectacular mutual influence between the emergence of scientific imaginary and the unique cultural profile of the European space. In the beginning, the cultural profile of European space favored the development of scientific culture, but later on the prestige and influence of science itself induced dramatic changes in the axiological profile of European culture. Therefore, any attempt of enforcing the feeling of cultural, social and political unity within contemporary Europe should not ignore or neglect the epistemological implications of the rich history of scientific imaginary in this area.

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