
SCIENCE UNITY IN BETWEEN NECESSITY AND RESEARCH POLICY

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Abstract

There are periods of time in which the issue of Science unity occupies a forefront of the debates within the Philosophy of science. In this paper we will analyze how this issue became an important one and if it is based on a need of an internal development of Science. We will study the specific theories, the ways in which they were imposed, and what was their role in Science development. We will also explore the ways in which these theories are accepted, and how they are supported by research policies.

Keywords: reductionism, transdisciplinarity, division/classification of science, encyclopaedias, scientific liberalism

1. Introduction

The issue of Science unity is a reminiscence of medieval times, when it was necessary to have a single vision over reality and knowledge. This can be synthesized under the so-called 'issue of unique truth' that confronted the scientific and theological knowledge. In opposition with the Averroism that considered, for an independence of science, that two different types of truth (scientific and theological) really existed, Thomas of Aquinas sustained the unity of it [1]. This perspective permitted to have just one image, and a unified method that implied a unity of Science and also a control of Theology over the other way of understanding the world.

The well known classification of Science in the Middle Ages in *trivium*: grammar, rhetoric, and dialectic and *quadrivium*: Arithmetic, Astrology, Geometry, and Music, was only didactic. The principal direction was to focus the human knowledge to complete encyclopaedias as those of Moslem Averroes, or Cristians Albertus Magnus and Roger Bacon. In the same context, the *homo universalis* of the Renaissance and the complete vision of unity were developed. Even if there was other methodical classification of science as that inspired by Plinius and Lucretius or the Biblical Genesis [2] the principal idea was related with the unity.

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In relation with this epistemic vision, at the beginning of the Modern Age the idea of science unity was normal and the Cartesian *mathesis universalis* was part of the theoretical context. Also, Francis Bacon’s ‘classification of Science’ was actually a division from a unique scientific corpus.

2. Francis Bacon’s division of Science and the beginning of a new vision of diversity

The most important synthesis of Science classification since the early years of the Modern Age was Francis Bacon’s *De Dignitate et Augmentis Scientiarum* [1623] (it was a completed form of English: *Of Proficiency and Advancement of Learning* [1605]). What was passed on from unity to a systematic diversity prepared the scientific specialization of modernity. This transfer could have been possible if Bacon had used the logic operation of division, not classification. We have two arguments for this idea.

The first one is the nature of language. In the introduction to *Instauratio Magna* [3] Bacon called the first part of his work, *Partiones scientiarum* (represented by *De Dignitate et Augmentis Scientiarum*) where he talked about ‘classification of sciences’. The word ‘*partior, -tiri, -titussum*’ – division – was different by *distribuo, -ere, -bui, -butum* – classification – word used to review the summary, entitled *Distributio operis*.

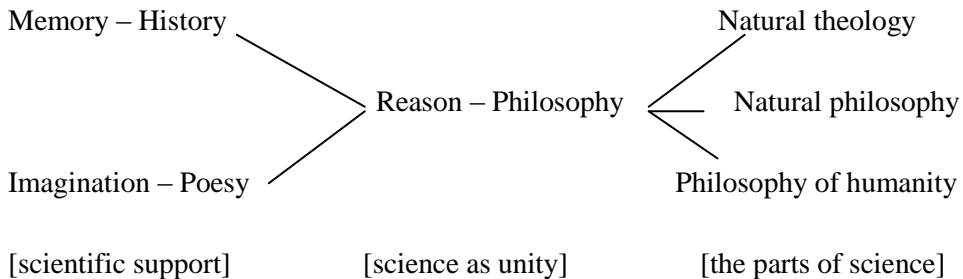


Figure 1. A very short representation of Bacon’s scientific map.

The second is the distribution itself. He started from the faculties of the human intellect (mind): memory, imagination, and reason. History is the science of memory, poesy of imagination, and Philosophy, divided into the science of God, Natural science and Human science, was considered the science of reason. From this, almost every description of an area of Science being a novelty, he focused on the necessity for a good understanding of reality. He invented several Science areas, domains, disciplines for covering any kind of possibilities of knowledge, getting the most comprehensive map of science. An important part of these disciplines didn’t have any tradition; some of them developed in the 18th – 19th century (for example mix Mathematics–Astronomy, cosmography–Psychology), and the other ones only at the end of the 20th (physiognomy, cosmetic, negotiation, preservation of health, preservation of life [macrobiotics],

dietetic, or Political science). He made a perfect synthesis between the existing sciences and the new (inventing) sciences with the principal objective to cover the entire area of knowledge.

The first two classes, History and Poesy were not only fully considered as sciences, but also as a support for Philosophy. If we want to synthesize, we need to consider the classification started from philosophy like in Figure 1. Bacon divided each part of these disciplines in domains and sub-domains.

3. The separation between Science and Theology

An important aspect for the evolution of Science in modernity, like specialization, was the relation between Science and religion. Thomism, from the perspective of the unique truth, unified these two possibilities of knowledge from an epistemological point of view. Theology and Science were thus unified and they had the same perspective to different parts of the universe.

The implications of the unique truth were important. First, is the political aspect: a priest of the church hierarchy top (or from Inquisition) can judge the scientific values and condemn every person and theory in disagreement with the theological perspectives, even if those theories were only scientific. The well-known conflict between Science and theology is the sentencing of heliocentric theory. First, it was accepted as pure theory, in Nicolaus Cusanus' vision, but strictly censured if it was considered real, as sustained by Giordano Bruno or Galileo Galilei. Inquisition made the judgment and sentencing in the name of God and theological unique truth.

Other implication, very important, is the epistemic. If it is one truth and this truth is universal because it is founded by God, the scientific and theological truths are both universal and undoubtedly. If the perspective is the 'dual truth' (we use this term for Averroes's theory that split the knowledge separating theology and science), and the scientific truth is different from the theological ones, an epistemic separation between Science and religion appears. In this case, the theological truth can be undoubtedly and the scientific ones can be speculative, or a phantasm. (This was the case of Nicolaus Cusanus when his heliocentric theory was considered just a mathematical speculation.)

However, it is very important for Science to express the fundamental and undoubtedly truths (nowadays we can use the term 'scientific law' – this is a modern expression developed by Bacon and Descartes, and that was inconsistent before the beginning of the 16th century [4]). The advantage of the certainty was very important for the development of Natural theology (a name for Natural science) and each accepted political (theological) idea became a real truth. In this case, the problem raised was: how was it possible to have the independence of Science and in the same time to transfer the certainty from Theology? René Descartes and Francis Bacon tried to solve this problem easily, without any kind of conflicts, using different solutions.

René Descartes chose the metaphysical solution integrating the idea of God as the foundation of all knowledge. *Meditationes de prima philosophia* is a symbol of renewing the epistemic word of modern time. Covered by the idea of finding a good argument regarding the existence of God and soul, Descartes' step into finding the certainty for Science used the Biblical Genesis pattern. *Meditationes* are, step by step, a new epistemic genesis [5]. Following this idea, in the third meditation (corresponding to the third day of the Genesis – the day in which the Earth was created as support for all the future creation) Descartes developed the idea of God as the foundation of every other knowledge. The existence of God, using valid arguments, is undoubtedly. So, using the same methods we can find the truths from nature.

But where was the novelty? Descartes changed the ontological and epistemological position between God and human being using the 'cogito'. In medieval classical interpretation the ontological God is the Creator of all the human beings, too. The epistemological God was the source of truth, and the human being using his own mechanism of knowledge (the cogito) could find the truth just in relation to God (because God gave that). According to Descartes, the ontological God could be the Creator of everything, but epistemologically the human cogito discovered God, and I am sure regarding the existence of God because the idea of God is in my cogito. In conclusion, we have an epistemological reversed position between God and cogito where cogito is a foundation for God, and if my cogito could be sure about the existence of God, in this case we can certainly know everything else. Of course, moreover, it was very important to define the methodology in finding the truth and Descartes did this well.

Bacon's solution for the independence of science was inspired by the 'dual truth' that split the scientific and theological knowledge. "For all Knowledge admits two kinds of information; the one inspired by divine revelation, the other arising from the senses. (...) I will therefore divide knowledge into Divinity and Philosophy; meaning by divinity the Sacred or Inspired, not Natural Divinity." [6] There were two kinds of science and the separation is complete. But in this case it was necessary to prove that Philosophy, using the senses could have access to undoubtedly truth. This is the reason why Francis Bacon tried to develop an important methodological empirical system, and an epistemological way to eliminate the error.

4. The separation between sciences and the scientific 'autism'

The 16th century represents the beginning of what was called the disciplinary 'Bing Bang' [B. Nicolescu, *Manifesto of Transdisciplinarity*, online at www.nicol.club.fr/ciret/vision.htm]. It started with Bacon's division of Science, that was fulfilled with the independent development of every particularly discipline and finally completed with the current map of sciences. There was an ample process of the sciences grown-up through: independence from Religion; development of a specific methodology (including the

mathematical system) – that implies the belief in the universality of the scientific law (this implied the possibility of perfect repetition of the experiments).

But the grown-up of the sciences was made in a different ontological explanation of the reality. For example, Chemistry started from the Aristotelian's substance vision. This interpretation is the source of the alchemy that focused on the practical transformation of the matter and the spiritual transformation of man. The evolution to classical Chemistry was made by eliminating the spiritual and all energies were focused to how it is possible to transform the substance without any practical importance into a more important one. All this combination was made, from a pragmatic point of view, for discovering the metallurgical technique (as in the myth of the Philosopher's Stone), drug, poison etc.

This is a traditional vision and it was adopted in accordance with the animist's vision of Biology (with all branches) that was not only a classification of life, but also an analysis of the ways to control life. Genetics today is in accordance with the first steps of the science of Biology and the idea of transformation from alchemy.

In opposition with the animistic vision was the mechanical aspect of physics that developed the ideal space, into a reductionism of substance proprieties to a material point. How well Patrick Suppes [7] described in *Probabilistic Metaphysics* shows a very straight relation between causality and a non-restrictive (average) dimension. So, reductionism is the perfect context to develop a vision of causality, the support for scientific prediction and, in this case, for experimental science.

Another face of reductionism was pure mathematics. It developed a pattern of an ideal space and the relation between number and figure. In the 19th century, too, with the evolution of the non-Euclidian's space, Mathematics looked like a pure ideal science and the idea of the special position and independence was confirmed.

Parallel to this, another ontological perspective is accepted, a combination between atomism from Antiquity and a simplified planetary model: Bohr's atomic model. The atomism has a long history from Democritus atomism, through Bacon's interpretation to Bohr model. There was also a metaphysical perspective consistent with atomism such as Leibniz' monads.

These different ways of interpretation led the world to a radical separation of science. For the same phenomena there were different explanations and the same reality was differently represented. Gradually, different branches of science development were distinctively promoted by each of them.

This difference was not only present at the level of the ontological vision, but also at the level of language and method. At the beginning of the 20th century it was almost impossible to communicate between sciences, and specialization focused the entire effort of every man to one direction.

In the same time with the development of the individual sciences and paradigms, maturation arose an opposite phenomena, the connectivity between them. The connectivity had two sources: 1. the expansion of Science and the

emergence of new and original sciences. In this situation, the so-called ‘frontier science’ and the ‘hybridization’ phenomena appeared [8]; 2. the need to consider an object from a different point of view. That determines the emergence of the interdisciplinarity and multidisciplinary, not only at the methodological level, but even at the ontological or axiological ones.

5. The necessity of Science unity

At the beginning of the 20th century the number of specializations has become increasingly more, their differences have deepened and the dialogue was almost impossible. In the same time the necessity of dialogue was more heightened because no other discipline could give the solution to a complex problem. In this case, the dialog started by natural way, but it was not considered a suitable solution. There was necessary to solve the problems at four levels – language, theory, image, and method. Without this, the relationship between sciences becomes rigid, and multiple misunderstandings may appear. Even the information imports from one science to another have been either an inadequate comprehension and sometimes determined a conflict between domains. This explains the necessity of a renewed dialogue of the sciences and implicitly why the unity of science has become a prominent topic.

Even in the crisis, the solution to this issue was mainly of a reductionist nature. There has been an attempt to identify ‘the best methodology possible’ [9], the most efficient language [10], or the most relevant theories, but all these belonged to the area of a single science, i.e. the reference science to which the other disciplines were reduced. This is relevant of how the concept of the unity of science resembles a beauty contest for the perfect science and the process seems to be continued by the ongoing projects that dwell on identifying the efficiency of translating certain theories, languages and images into different sciences.

Only one method left from the Middle Ages was the encyclopaedic classifications. Made by Diderot, and D’Alembert in the 18th century and rediscovered by Neurath [11] in the 20th century, the Encyclopaedias preserved the idea of unity of Science intrinsically, in accordance with the medieval unique, though. Therefore, the analysis dwells on how the Humanistic sciences are defined, on the specific features that mark the difference from other sciences, and the contribution of humanities to a more comprehensive image of the world revealed by the encyclopaedic projects. We will then draw a comparison between the encyclopaedic and formal classifications and focus on the same aspects of the Humanistic sciences.

6. The reductionist projects on the unified sciences. Humanities as imported methods

The reductionist projects on the unity of sciences at the beginning of the 20th century attempted to apply at a universal scale a methodology belonging to

the sciences, whose key concepts were objectivity and universal language. And that, inspired by the physicalist trend of the time and backed by a rigorous logical and mathematical development, was supposed to remove the ambiguities. Thus, the essentially scientific nature of a scientific endeavour depended on such reference points. But from a set of such references, the characteristic of the natural sciences, of physics in particular, and also doubled by the limits of the mathematical language, the Humanistic sciences were marginalised and treated as ‘tolerated’ sciences [10, p. 45]. But that attitude is not to be regarded as a form of intolerance or forced marginalisation; it actually results from the very internal approach typical of the humanities in the process of identifying their own scientific character by resorting to the model provided by the sciences. The notions of formalism, empiricism, rationalism are the ideals of those sciences; reason why the reductionist view of the early 20th century should be considered a normal one, whereas the Humanistic sciences were treated as the ‘candidate’ to the science status, generally on the account of the methodological import. The situation changed until the early 21st century, though. The humanities were not entirely structured, but in the initial stage of their development, they have eventually gained identity while the models-to-be might often appear as artificial or redundant.

It is not the fact that sciences interact and the methods are imported, which should be questioned, but their frequent presentation through the reductionist mechanisms as unique solutions at times when there are alternative types of analysis and representation within Science itself. That is why the marginalisation of the humanities was submitted through the reductionist projects as inadequate for the stage of development in each science.

All these will provide the context to be considered in the second section of the project on the benefits for the humanities deriving from the fundamental work of those who used the methodology specific to Natural science and Mathematics in the area of Humanistic sciences and to their reception by the promoters of the reductionist model of the unitary science at the beginning of the 20th century. We will also analyse the impact of current reductionist theories directly related to the Neo-Darwinist direction in Socio-biology [12], to the converging sciences of Bayesian extract [13], and the relative hierarchy and the approximate reduction [14].

7. Inter-, multi-, pluri- and trans-disciplinarity from political to epistemological solutions

The reductionist solutions do not generally prove acceptable for the problem concerning the dialogue of the disciplines, especially when those are considerably different. This can be explained by an intentional rank inequality among disciplines. Their collaboration is in fact based on ‘force’ doubled by tolerance. As a consequence, the search for alternative dialogues began stimulated by the group of the Humanistic sciences in a process of establishing an interdisciplinary dialogue. This paved the way for the debates in the line set

by Jean Piaget, Edgard Morin and Erich Jantsch, concerning an interdisciplinary dialogue and the representation of transdisciplinarity as a domain beyond science(s).

The introduction of this perspective stands for a non-reductionist solution of humanistic vane to the issue of science unity. After founding the International Centre for Research and Transdisciplinarity in Paris in 1987 and that of UNESCO – supported Group for Transdisciplinary Reflection in 1992, coordinated by Rene Berger and Basarab Nicolescu, the transdisciplinary system of ideas appeared as an alternative solution to the world's major problems. Although the most systematic approach was done by Basarab Nicolescu, a physicist who used the revolution in quantum physics and computer science as model, transdisciplinarity is through its objectives a form of humanism.

The humanism is first of all implied by the aims stated in the Charter of the First World Congress of Transdisciplinarity (Convento da Arrábida, Portugal) from 2-7 November 1994. The first article asserts that the human being must not be reduced to one definition and be decomposed into formal structures, no matter what they are. Man's positioning at the centre of scientific research in the transdisciplinary programme is the most significant contribution from the Humanist sciences to the projects on the unity [<http://nicol.club.fr/ciret/ro/chartro.htm>]. The analysis of the scientific theories is thus redirected towards a transfer from the formalism – empiricism – rationalism trinity to rigour, openness and tolerance. These three fundamental elements of transdisciplinary attitude and vision should be the starting point of a revolution in (all) science(s).

When asked what transdisciplinarity is, Basarab Nicolescu said: “Trans-disciplinary research which corresponds to a certain degree to trans-disciplinarity will be closer to multidisciplinary (as in the case of ethics); one which corresponds to another degree will be closer to interdisciplinarity (as in the case of epistemology); and that corresponding to yet another degree will be closer to disciplinarity. *Disciplinarity, multidisciplinary, interdisciplinarity and transdisciplinarity are like four arrows shot from but a single bow: knowledge*”. [B. Nicolescu, *Manifesto of Transdisciplinarity*, online at www.nicol.club.fr/ciret/vision.htm] The essence of trans-disciplinarity is the open dialogue between Science and the natural transformation of sciences after the dialogue.

The idea of ‘trans-’ as we also find in Helga Nowotny's definition: „*Transdisciplinarity is therefore about transgressing boundaries*” did not have a metaphysical sense. It did not represent something beyond of this world, how can we understand from “As the prefix ‘trans’ indicates, *transdisciplinarity* concerns the fact that it *is* at once *between* the disciplines, *across* different disciplines, and beyond all discipline. Its goal is *the understanding of the present world*, of which one of the imperatives is the unity of knowledge.” [Helga Nowotny, *The Potential of Transdisciplinarity*, www.interdisciplines.org/interdisciplinarity/papers/5] The “beyond all discipline” did not have any transcendental understanding, this referring to the

unity of all. Also, the 'level of reality' is the interpretation of different dimension and perspective of reality, not a vertical Aristotelian organization of reality.

Transdisciplinarity represents a liberal way of dialogue between sciences towards a mutual practical understanding.

8. Conclusions

In the history of Science the idea of unity was developed both from a political perspective and from the internal need of Science. From the political point of view it wanted to control (in the Middle Ages) or to discover the independence (transdisciplinarity) of knowledge. In the same time, it was necessary to have a dynamic and full open dialogue between sciences, because only under these conditions, Science can really develop beyond any constraint.

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