DIFFERENT UNDERSTANDINGS OF THE NATURE OF SCIENCE, AS THE BASIS OF PHILOSOPHICAL EDUCATION

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Abstract

This paper begins with the stanza that science is the basic common container of every man on earth, regardless of his or her place of residence, which implies that it influences our lives, even though we are commonly unaware of that. The question therefore arises: what makes “science” science? It is assumed that the answer to this lies in the simplicity of its multiplicity. A review of the several key ways to spot the unity of science found in scientific and philosophical literature is offered as well – for example classical and contemporary dialectical unity, metaphysical, practical, ontological or semantic, coherent or positivistic unity. By means of identifying the diversity and the richness of the various types of multiplicity in science, the paper attempts to expose to the readers the importance of unity and its merits. Relying on this philosophical stanza, an explicit and a rather successful unification of sciences is demonstrated, originating in the celestial mechanics developed by Isaac Newton and known as the coherent unity. In this respect, the paper argues that it is essential to comprehend the core of the Newton’s achievement so as to be able to understand similar modern attempts to unify science, as well as the very notion of science. In this regard, the paper claims that the entire western philosophical and scientific tradition is, in fact, an attempt to formulate a unity of science that would be as coherent and as well-founded as possible.

Key words: the unity of science, epistemology, theory reduction, coherent unifying, epistemic virtues.

INTRODUCTION

People come across science in various ways. Some of us do it in a theoretical way, some in a practical one, but, regardless of that, science is an important factor that significantly influences our way of thinking, our understanding and our way of life. It can aid us at times – such as in medical situations or it can harm us – in war, for example. No other spiritual concept has had greater influence over our existence in this millennium. Medicine, cars, hydrogen bombs – these are some of the things that make modern life modern.

What is the essential element that makes “science” science? Or, in other words, what differentiates it from the other spiritual phenomena, such as art or religion? The list of possible answers includes: the accuracy of the confirmed hypothesis, the consistency of theories, the
precise domains of certain disciplines, the simplicity and the elegance of the explanations, and
the like.

It was assumed in the past that there existed a unique, universal scientific method which
generated the unique, or the so-called universal scientific knowledge. Nevertheless, the modern
perspective raises certain questions – for instance: how is it possible to unite social sciences
and their normative and cultural content with the descriptive, non-cultural natural sciences?
Even cognitive sciences now apparently claim their a priori independence from the natural
sciences, both with respect to their method and to their content. The former blames the latter
for its alleged limiting to the logical manipulation of symbols, whereas the latter accuses the
former of its exclusive use of material causes. An example of the natural sciences - biology, for
instance, demands its independence, and even argues to be contradictory to the highly
developed physics. Furthermore, there are crucial distinctions between the methods and the
theories within physics. How is it possible to understand these differences, and, ultimately, to
reconcile them?

Over the centuries, simple theories proved preferable to the complex ones. Is their
theoretical appeal the reason why we believe they are ultimately more accurate or more
comprehensive than some other, complex ones? Can it be proven that simplicity is the key to
truth, and can that aid us in confirming that the world is ultimately simple and unified? What is
unity, after all? Is there an objective means of checking whether one theory strives towards the
unity of sciences, whereas the other one does not? Is simplicity in the eye of the beholder, rather
than in a theory itself? We speak of explanations, idealizations, laws, models, probabilities,
theories, and so on. Too much philosophy resembles swimming. Most people can swim; however, only few can verbally describe what is to be done in order not to sink. The same can
be applied to notions – we have a long way to go before we can understand the accurate meaning
of notions we use in speech and in writing.

This paper is an attempt to demonstrate what the unity in science is, or, to put it
differently, to present the various types of unity, as well as different ways and paths that could
be followed with the aim of achieving and maintaining the unity of science. In other words, the
paper wishes to represent the key ways to recognize the unity of science in both science and
scientific and philosophical literature. This would manifest the importance of unity and its
benefits.

THE GOALS OF THE PHILOSOPHY OF SCIENCE

In addition to the contemplation of the goals, methods, mediums of science, tools,
scientific breakthroughs, the philosopher of science is interested in the products of science, the
contents of its theories – in particular, the very general, unifying ones, which radically shape
the perspective of a sane mind. The philosopher of science contemplates the challenges theory
can pose to the conventional attitudes towards the world, such as the question of whether
quantum indeterminacy shows that causality is not functional.

The philosophy of science strives towards the understanding of the questions the
answers to which require a special technique that is not provided by the scientific training. There does not exist a laboratory for the investigation of the nature of the theories. Experiments
cannot reveal the nature of the explanations. If we desire to answer these questions, we ought
to turn to philosophy. The philosophy of science is in charge of stimulating the dialogue about
the key question: does science still have the same status in our culture as it has until recently had?

One of the basic subjects of the philosophy of science is the formulation and the maintenance of the arguments in favor and against the unity of science. Practically every philosopher of science discusses the unity in various ways. Luckily, it represents a challenge for everyone hoping to discover what it is. Basically, there exists a common core of ideas, determined by the positive epistemic attitude toward the results of the scientific unity.

WAYS OF UNDERSTANDING THE UNITY OF SCIENCE

Prior to the contemplation of the essence of the unity of science, it is useful to differentiate between a couple of formulations of unity found in science and in philosophy.

1. The ancient Greeks did not make a clear distinction between science and philosophy. Nevertheless, Plato makes a difference between ontologically-based mathematics, which, in his opinion, illustrates the true division of being, and the supreme dialectics [1], which perceives the basic principles not as factual, but as hypothetical, and which ultimately strives toward the universal categorical imperative - the form of the Good, from which logically stems all the sciences and all true knowledge. This way of defining unity is known as the classical dialectic one, and is opposed to the contemporary Hegelian and Marxist one, which is the subject of another study.

2. Unlike the dialectic one, the unity dedicated to the existence of the world could be named metaphysical unity. This idea is best explained through the investigation of the opposite ideas. For example, the idea of unity is negated by any one of the attitudes included within the traditional label of ‘incommensurability’, in addition to the certain forms of metaphysical pluralism. The world is irrecoverably divided into multiple building blocks – hence cannot be called a world. One of the forms of metaphysical pluralism is the irreconcilable Cartesian duality. Such pluralistic approach, despite its historical relevance, is rarely present in modern philosophy, with the exception of certain experimental postmodern projects. It is relevant to point out that in the core of metaphysical creed lies the idea that the human conscience and cognition are compatible with the unity of the world that is being observed. For instance, although (Psillos, 1999) establishes a connection between the actual unity and the “mind-independent natural-kind structure” of the world, assures us that the properties of independence are often firmly tied in a metaphysical way (see also Boyd 1999, Humphreys 2004:22-25).

3. Unity is often described as an epistemic achievement, constituted by the success of the scientific theories. This approach links unity to the actual, epistemological experience of the world (or some of its components), which is described in various ways. For example, the majority of people define the unity of science with respect to the discovery of the inherent order of experience. This slightly resembles Plato and his conception of the original rationalism and the thesis that knowledge is memory.

4. A) Certain scientists, but rarely philosophers, define the unity of science in a practical way, as a successful linking of the theoretical notions with the objects in the world, both the visible and the invisible ones. B) However, philosophers are not prone to practically defining the unity of science, but rather believe in the ontology of the unity of scientific theories. All of the manners share the dedication to the belief that the best theories are given a certain epistemic status. Through the contemplation of the unity, the theories are methodologically enhanced,
owing to the fact that the notion of method is very similar to the one of unity on the meta-level, rather than to the one of plurality. (For the definitions of the scientific realism also see Smart 1963; Boyd 1983; Devitt 1991)

5. A growing number of the philosophers of science and scientists agree that the positive attitude towards the unity of science is, in fact, defending science, and must therefore be substantiated by the details obtained from the actual situations – also known as the “first-order evidences” collected from the actual scientific research (Achinstein, 2002). For example, relying on Jean Perrin’s case study from 1908 – Evidences of molecular reality potentially substantial evidence in favor of the unity of science can only be considered to be empirical, rather than general, philosophical one. (For further references compare Magnus and Callender 2004: 333-336)

6. The semantic unity is dedicated to the literal interpretation of the scientific theories on the world. Those in favor of the semantic perspective on the unified science perceive theories as methodologically prearranged. Namely, according to them, the claims of the scientific entities, scientific objects, events, processes, properties and relations must be scientifically-based in order to be considered scientific in the first place. This foundation needs to be interpreted literally, as the validity of truth, be it true or false. The proponents of the semantic perspective primarily stand in opposition to the ones that promote the ideas of the “pluralistic” epistemologies that perceive science as methodologically unregulated and logically anarchic mix of the explanations for the natural and social phenomena. Traditionally speaking, pluralism claims that the scientific assertions lack the literal, deeper methodologically and epistemologically based meaning. Certain pluralists even argue that not only science, but also the entire human experience are immense and split, without realizing that such anarchy enables the emergence of non-scientific and non-ethical “experiences”. We witnessed the various manners in which science was used in the XX century, particularly owing to the certain forms of modern pluralism. The semantic idea that science approaches truth during its development over time is a common subject of the scientific and philosophical debates on the change and development of (Hardin, C., Alexander R., 1982), (Putnam, 1982). Discussion on the unique truth caused to the enhancement of the scientific and technical order, conceptualizing truth as something that can be quantified, qualified differently, and, to put it simply, ordered methodologically.

7. Given that the world is such as the quantum theory claims it to be, there exists a strong dynamic uniqueness underlying the basis of the macroscopic diversity of dynamic laws. [2] Equally strong, but apparently different, the sense of dynamic unity implies the macroscopic diversity for the dialectics (now different from the Platonic, Hegelian and Marxist version). The rich diversity of the properties and the processes results in the specific dynamic unity strong enough to sustain the internal reorganization of the diversity. The diversity of properties is of the key importance for the dynamic unity, rather than, as it may seem, the pluralistic conception of the world. [3]

8. Finally, the traditional unity of the scientific method is briefly discussed. It represents a general unity and an undefined mix of the above stated types of unity. It is tied to any stanza that may reflect the perception of science and existence as unique – organic. The unity of science is a form of scientific realism concerning what reflects our best scientific theories in a
greatest way. What follows, shortly, is a review of the most prominent and successful attempt
to reach the coherent unity.

**THE UNITY OF SCIENCE AND THE COHERENTLY UNIFYING SCIENTIFIC METHOD**

9. The world we live appears to be partially disconnected, incompatible. Nevertheless, we
do not experience it as such. The evidence of order, or, in other words, the unity of experience,
is the fact that we can avoid danger, build, and change this world. Experiencing the world as
ordered and unified is the primary and the basic relationship with it as well as with nature. This
impulse or the genetic code for experiencing the world as unified is inherent to human minds.
It is only in that manner that we can understand the world. Every attempt to understanding
something is, in fact, an act of linking the unknown and the chaotic to the familiar, ordered and
unified and of uniting them into a whole that can be subjected to perception and contemplation.
This need - the desire for unity, has generated the idea of notion (that is the most relevant issue
in logic) and the idea of science.

The most extraordinary and the first explicit successful attempt to unite the previous
scientific achievements into a unified science were undertaken by Isaac Newton, who is
considered to be the father of not only physics, but also of science - such as we know it today.
The question of the purpose of unity of the successful science is valid without a doubt. The
story about Newton actually represents an attempt to answer this relevant question. He is the
originator of the scientific unity and the method he applied in his optics and his celestial
mechanics. Recognizing the stated property of Newton’s methodology rises a question: is the
unity of science one of the epistemic, and, in this case, scientific virtues? Apparently, it is.
Therefore, another question is posed: how does the unity of sciences relate to the other epistemic
virtues, such as explanatory power, empirical adequacy, consistency (Greco, 2003)? Caution is
recommendable, as is the recognition of Newton’s virtuosity, since it is possible that the
supreme intellect of the greatest scientific genius might have failed to give birth to the formula
for obtaining a scientific method. To put it more precisely, how close can personal
ingeniousness and objective reality be? Although it is possible to provide definite answers to
these questions, the discussion that would issue would be likely to give birth of the new ways
of understanding the unity of the world and of science.

A brief overview of the developments of the idea of unity prior to Newton follows. The
impact of unity on the close relationship that exists between metaphysics and the methods for
exploring nature is a suitable illustration of the introduction into the Newtonian science. A
millennium-long Christian religion that was Kepler’s as well as Newton’s forerunner defined
nature as an inherently mystical order, since, according to it, it was permeated by the divine
reason and intelligence. The natural pattern was not obvious, but was a hidden, ordered unity
that would present itself to those seeking carefully for it, and with the help of the irrational
methods. Kepler, on the other hand, attempted to construct a model of the planetary motion
based on the Pythagorean notions and numbers. These ought to take place within the
Aristotelian-ordered perfect spherical planetary orbits. Even the fact that space is a geometrical
tridimensional unity was perceived as a reflection of the single ternary god. Since the facts
arising from his perception seemed to be rather unappealing for this scheme, Kepler attempted
to build a unique model of his own, relying on the harmonies of the Pythagorean music scale (Voelkel, 1999).

Such historical context confused Newton, who hence noticed that the already existing various theories about the celestial orbits – such as Kepler’s or Tycho-Brahe’s, could be mathematically rationalized. The new mathematical law describing gravity is highly dependent on the previous theories, revealing the need for the universal constants in science. Kant, who was inspired by Newton, argued that the goal of science ought to be a strong unity marked by the reveal of the fundamental constants which characterize the forms taken by the universal laws and maxims. According to Kant, this is the sole shape in which science can exist.

A consideration of Newton’s methodology is given next, focusing solely on his formulation of the universal law of gravity he wrote about in his Mathematical Principles of Natural Philosophy (Morrison, 2000). These are the basic steps: (1) referring to Kepler’s and Galileo’s experiments in order to discern the assumed phenomena, paying special attention to Kepler’s laws of planetary motion and Galileo’s law of inertia. (2) Next, applying Newton’s laws of motion to an idealized system of objects of small size and mass moving towards a significantly greater mass under the influence of a force whose properties are geometrically defined. (3) Finally, assuming that the force is a vector linear in nature, and that it enables the construction of the center of mass, which separates from the common motions relatively. This is the framework of Newton’s first law of motion, and it can be expanded so as to provide explanation for all the members of the Solar system. Further elaboration of this matter cannot be undertaken without the mathematical apparatus, whose application in this paper may move it into a different direction.

Newton’s construction of the universal and the unique applied in explaining the world is an excellent methodological as well as theoretical achievement. In addition to the unity, many other methodological components require separate studies. The examples are the laws of motion, the geometrical basis of the force of gravity and all of its significant parameters that are essential for the complete dynamic description of Newtonian unity. A simple formulation of the phenomenon gave rise to the universal law of gravity, in addition to the laws of motion that determine spatial and temporal boundaries. These boundaries encompass the use of the law of unity, thus completing the constructive circle of the unity of science. This construction is marked by a firm unity, visible in the multiple interdependence of all of its components. The convergence of approximations and the coherence of multiply determined quantities is a methodological requirement of the constructive unity which is clearly expressed in all of the Newton’s laws. For the first time in history unity became the center of the scientific picture of the world.

On the other hand, Newton’s method provides a simple example of how the increase in unity brings about the increase in the explanatory powers of the theory. The universal law of gravity unifies dynamics by reducing it to a certain number of the laws of force necessary to describe the celestial and earthly motions. This results in the increase of the explanatory power due to the reduction of the scope and the robustness of its laws, taking into account the fact that the data corps supported by the new theory becomes bigger and more accessible than ever before. This type of unity is termed coherent unity (rather than labeling it as simply constructive unity).
RELATIVISTIC AND POSITIVISTIC UNITY

10. This type of unity was adopted by Kant as the key reason why he believed the Newtonian calculation was given the privilege of intelligibility and appliance (Friedman, 1992). Newton’s theory is no longer perceived as the sole truth, let alone as inevitable. Nevertheless, the standard of the coherence of methods via which the theories are united remains. This role of Newton’s model was of great importance not only for Kant, but also for Reichenbach, and, later on, Einstein and Bohr. Their attempts to lay the foundations of physics in the best possible manner reflect their acceptance of the basic Newtonian ideal of science as a unified construction (Hooker, 1994). On the other hand, despite being defined as opposites of the Newtonian science, quantum theory and relativistic physics in fact are unique theories. Once represented as two-dimensional or three-dimensional, space and time are perceived as unified through the formulation of the fourth dimension – space-time - in relativistic physics. Although this may appear paradoxical, the shift from Newtonian to relativistic mechanics is, in fact, a further confirmation of unity, since space-time marked by its complexity unites the two dimensions into a single one.

THE POSITIVISTIC ONE

11. Relying on the same set of ideas, logical positivists initiated an ambitious methodological project named The International Encyclopedia of Unified Science (Neurath, O. and Carnap, R., 1971). The prerequisite of intelligibility was a single formal language for all sciences to express themselves, which was, generally speaking, a predicate calculus, within which science was supposed to be deductively systematized from the logically-mathematical ordered systems of axioms. According to this point of view, any theory can be inductively derived from the basics of the pure, observational pieces of evidence that would be logically interconnected. Physics would undergo the process first, and would be followed by chemistry, biology, and finally, social sciences. On the other hand, each theory is logically reduced to the one preceding her, which would ensure the formal unity of science. The described reduction of subjects is actually the reduction of parameters which form the theory (see also Causey, 1977). Therefore, reduction is the central concept of the unity of science for the logical positivists, as well as for the analytical tradition that follows.

CONCLUSION

This paper represents an attempt to discuss several relevant ideas related to the unity of sciences. Taking into account both the classical and the contemporary attempts to achieve unity, special attention was paid to the most prominent attempt of unification of the theories and sciences offered by Isaac Newton. Contrary to the times of Newton, now exists a multitude of scientific disciplines, each of which has its own specific domains, theories, and methods specialized for the conditions under which a science investigates our world. In certain cases, the disciplines or their components can still be formally united via logical reduction (Hooker, 1994), (Fodor, 1974). Relying on this, it can be claimed that the greatest power of science resides in the formal monolithicity, as well as the possibility of forming a complex unity of various interactive processes of experimenting (Hooker 1994).
There are several reasons why the unity of theories is a desirable goal. The first one is the wish to achieve the simplicity and the elegance of theories. Next, the fact that unified theories bring about the increase in the generality of subjects and the capacity to explain, and are more informative that a multitude of limited and separated theories. In addition to this, theories marked by a wider scope are methodologically more appealing than the ones with a narrower scope. A general theory is proved to be more easily confirmed that a couple of theories with a narrow scope that are likely to be equally consistent. Unified theories provide the basis for the most serious scientific explainatoriness. According to a number of authors, this very notion is in a large measure a question of unifying instances that appear to be impossible to consider. Finally, explaining individual physical phenomena is successfully achieved by means of introducing them into domains of wider scientific theories.

NOTES

[1] Further on, in our millennium, there appears a historical reading of dialectics, which leads to some utterly different concepts of unity. Hegelian idealism, as well as historical materialism (Marx, Engels, Lenin) simultaneously confirm the fundamentality of unity as opposed to the organic unities – holism.

[2] Within the quantum version of unity there exists a dynamical aspect of the geometric unity: all laws come down to a single one, under the appropriate conditions (for instance, the Big Bang), which differ only with respect to different types of energy known as weak or strong nuclear, electromagnet, gravitational ones.

[3] Parmenides would refuse to accept this version, since change does not exist in his opinion. Therefore, any kind of dynamics or exponentiation of a being represents a mere illusion. However, is it possible for this kind of unity to be a stanza or an attitude useful for our purposes?

REFERENCES


