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Editorial: Philosophy of Science

Since its phenomenal advent in 20th century, Philosophy of Science experienced a steady growth and has now proved to be a significant discipline influencing many of the current scientific discourses. An important historic foundation of this relatively new but rapidly spread scientific discipline had been the philosophy of early modern sciences, popularly known as *philosophia naturalis*, as represented in the seminal works of Descartes, Kepler, Locke, Newton, Hooke, Galileo, Boyle, Berkeley, Leibniz and others. The theoretical basis of this extraordinary emergence of a nexus between Philosophy and Science in the early modernity was apparently a philosophical strategy to reexamine the status of knowledge – the *episteme* – by strictly demarcating it from a system of belief that seemed to underlie many of the axiomatic notions of the late scholastic natural philosophy. The early modern *philosophia naturalis*, which is regarded as the prototype of the current philosophy of science, was in principle a philosophical attempt to exclude the *fact of belief* from a rationally founded axiomatic system of knowledge. This *epistemic turn* also marked the beginning of modern scientific rationality.

The early modern *philosophia naturalis*, adequately represented in the development of the mechanical philosophy, established the historic transition from a belief system into a knowledge system that was built on axiomatic knowledge of nature alone. The reestablishment of the knowledge system can be regarded as a contemporary Renaissance of the ancient platonic epistemology that historically legitimized the episteme against *doxa*, the opinion which is closer to a belief. The outbreak of modernity - after the transitional phase of the Renaissance - was characterized by the radical development of the method of scientific thinking. The method of doubt or skepticism from which the true knowledge - the episteme - of nature and human mind should arise, was, on closer examination, opposed to a system of belief that prevailed over the late medieval natural philosophy. Descartes *Meditations* begins with a methodological debate between belief and knowledge, in which the absolute doubt differentiates the true knowledge from the unfounded belief and elevates it to the status of first and axiomatic principles of philosophy and science. In many examples that Descartes in defense of his method of doubt proposes, we can identify a clear transition from a *residual* belief system of late medieval philosophy to the knowledge system of modern age.[1] But already the scholastic philosophy prepared ground for this transition, as clearly represented in various philosophical attempts to *scientifically* prove the metaphysical notions such as the existence of God, immortality of soul, limits of universe etc. The philosophers of the early modern era - especially the rationalists - felt obliged to scientifically prove the traditional philosophical and metaphysical notions. This characteristic tendency in the history of early modern philosophy can be regarded as a paradigmatic-categorical shift of the fundamental metaphysical questions – and indeed a shift from a perishing system of belief to an emerging modern system of axiomatic-scientific knowledge which eventually led to the disappearance of a philosophical obligation to provide sufficient proofs for the above mentioned metaphysical notions (as particularly observed in the post-Kantian philosophy). The advent of natural sciences in the modern era redefined the *philosophia naturalis* which then began to establish a common epistemological basis both for philosophy and for natural sciences. The early modern classical mechanics, represented in the works of Kepler, Descartes, Newton, Galileo, Hooke and others, did not observe a clear differentiation between a scientific and a philosophical epistemology.

It is interesting to note that certain discourses which the *philosophia naturalis* introduced in the early modern philosophy and science remain unresolved until today. To name a few examples: the nature and structure of space and forces (in the context of classical mechanics), nexus between mind and body, problems of sensory - particularly visual - spatial perception etc. A philosopher of the 20th Century, Edmund Husserl, described philosophy as a rigorous science (*'eine strenge Wissenschaft'*).[2] In his later work, *Die Krisis der europäischen Wissenschaften*

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1. It is a well known fact that Descartes, through his schooling at the famous Jesuit school La Flèche in France, was closely acquainted with the scholastic philosophy - especially with the scholastic Aristotelianism. The liberation from the scholastic tradition remained for Descartes a lifelong philosophical strategy, as clearly expressed in his conception of philosophical education as *reading the book of nature*. Ignoring the approved texts of the scholastic tradition and the adherence to the first principles of nature formed the essential characteristics of the Cartesian system, it also reflected his antipathy against a belief system - against the scholastic dogmatism that declared the established works from the tradition as irrefutable - and yet a striving for a knowledge system which is free from dubious facts of belief. In one of the famous examples Descartes shows how the color of an external object, which we usually attribute to the object, is in reality a mere subjective perception, and exists as such only in our mind (see Rene Descartes, *Meditations*, edited by John Cottingham, Cambridge 1996, p. 56-57). This example shows how Descartes departs from the medieval notion of the *localization* of the subjective perception of color *in object* and negates the objective facts of color perception in favor of their merely subjective existence. See Anneliese Maier, *Zwei Untersuchungen zur Nachscholastischen Philosophie*, Rome 1968, p. 18.

2 See Edmund Husserl, *Philosophie als strenge Wissenschaft*, Meiner Verlag, Hamburg 2009.

und die transzendentale Phänomenologie, Husserl discusses the crisis of the modern European sciences in the 20th century. Philosophy, as a strict or rigorous science, implies primarily the methodological rigor of philosophy, best represented in their theoretical foundations - epistemology and ontology - and in their application to all original scientific intuitions which formed the axiomatic knowledge of modern sciences.

The crisis of European Sciences - as observed by Husserl - apparently arose from an inadequacy of the epistemological and ontological basis of modern Sciences. The primary task of the philosophers of science would therefore be to re-examine the methods of epistemological *intuitions* and of all ensuing scientific deductions employed in natural sciences and mathematics. For every science proves to have in the course of their emergence and establishment a tendency to keep the original axiomatic foundations for once and for all secured, without considering how they can be reexamined and questioned time and again by theoretical philosophy – through its epistemological and ontological tools. The axioms - the first principles - indeed form the basis of science, but they are mostly predestined to a hidden existence in the course of time. The sciences grow in their visible superstructures, with the assumption that their invisible (axiomatic) foundations remain intact i.e. in the same state as they were at the beginning. This is the belief which can be shaken at any instance of a reexamination of the axiomatic knowledge base of sciences through philosophical tools. If philosophy, according to Husserl, is a rigorous science, its rigor lies precisely in its capacity to exhume the deepest theoretical foundations of sciences – the axioms on which they are premised – and reexamine their epistemic status. This basic tendency of theoretical philosophy makes this fundamental discipline unpopular among natural scientists and mathematicians who seek to keep the axiomatic basis of their scientific structures forever intact.

The categorical differentiation between a philosophical and a scientific epistemology - as well between a philosophical and scientific logic - seems to be absurd from the outset. The essential (epistemological and ontological) scientific reflections or thought processes do not observe the contextual-disciplinary differences that are normally attributed to the applied sciences. Purely theoretical thought - in the context of epistemology and ontology – presupposes a rather uniform structure of perception and cognition irrespective of disciplinary differences. Therefore, it was not a coincidence that both the antiquity as well as the Cartesian (early) modernity did not differentiate between a philosophical and scientific thinking. The separation between philosophy and sciences cannot be diagnosed in an earlier phase of modernity which paved the theoretical foundations of modern philosophy and natural sciences, but in a later phase which saw the advent of applied sciences. The much acclaimed liberation of natural and social sciences from philosophy was hardly based on a differentiation of their theoretical i.e. axiomatic foundations, but rather on their methodology and, more precisely, on semantic considerations as demonstrated in the historic emergence of differentiated scientific methods and terminologies.

What distinguishes a philosophical-epistemological examination from a scientific-epistemological investigation, especially when both methods relate *in the context of philosophy of science* to the same object of natural science – to the natural phenomena? The axiomatic knowledge (such as the principle of inertia in classical mechanics) clearly marks an end or finality of epistemological investigation. Pure scientific thought will not cross the bounds of axiomatic knowledge. The axioms of science emerge from the finality of the scientific-epistemological thought processes as *end products*, which are then identified or rather *branded* as the foundations of science. Therefore it is undesirable for the scientific community that philosophy reexamines and questions the established axiomatic foundations of science. However, the philosophy of science works mainly on scientific axioms; where science ends, there begins the philosophy – with its characteristic methods of problematising the scientific foundations. The philosophic-epistemological investigations aim principally at deeper foundations of axiomatic scientific knowledge and their finalities. This is done, on one hand, by more precise and uncompromising methods of epistemology and, on the other hand, by a characteristic intrusion into deeper domains of ontology. Apart from the methodological rigor and precision, a deeper ontological basis imports legitimacy and higher effectiveness to the philosophical and epistemological investigations in scientific research.

Since the philosophic-epistemological investigation reaches out deeper foundations that are latent in the axiomatic structure of sciences and, thereby, exposes the unseen ontological realms of scientific disciplines, it may bring about an aporetic puzzlement that when a fundamental problem in the axiomatic foundations of a science is *philosophically* detected, it will in all the probability remain unresolved in the history of science. For, as a rule, philosophy attempts a final explanation – in the framework of both epistemology and ontology – and reaches an epistemological finality that science in ordinary sense will find hard to overcome. In spite of considerable progress in the neurosciences and in the current so-called neurophilosophy in relation to unraveling the mysterious causal nexus between brain and mind, a belief prevails to date over many philosophers and scientists, that after the Hobbesian atomism (that causally reduced the mental states and processes to the atoms in brain) there is hardly any major progress in the historical discourse of brain-mind-reduction (or the brain-mind-identity). Another example would be the still unresolved problem of the infinitesimal in mathematics, which had found its most adequate expression in the invention of calculus by Leibniz and Newton. Already the Greek Philosophers had dealt with the problem of the *infinitesimally small*. One of the famous paradoxes of Zeno, namely Achilles and the tortoise, is based on the principle of the infinitesimal. Aristotle conceived the infinitesimally small as a potential entity, i.e. as something that can exist only in a constant process. The problem of the infinitesimally small re-emerged in some early modern philosophical and mathematical discourses. The most important case was apparently Berkeley's criticism of the method of differential calculus by Newton and Leibniz.[3] Although this criticism of Berkeley was *paradigmatically* suppressed and, consequently, ruled out from the evolving field of applied mathematics (for which differential and integral calculus formed the basis), it emerged again in the 19th century philosophical and mathematical discourses, best shown in the vain attempts of the mathematician Georg Cantor to conceive the infinitesimally small – in contrast to the Greek philosophies – as an actual i.e. final and discrete entity.[4] The debate on the causal connection between mind and brain is still based on its historical and philosophical origins in the 17th century Cartesian philosophy. This shows that the philosophic-ontological investigations always tend to a final axiomatic limit of knowledge which the scientific-epistemological methods unsuccessfully try to overcome.

In a rapid and continuous progression of sciences, their problematic (axiomatic) foundations are easily overlooked. The natural sciences are conceptually built on elementary entities - such as the subatomic particles in Chemistry or Physics, forces in Mechanics, cells in Biology, etc. – without problematising their fundamental nature of existence. Even the science of mechanics, which is closely linked with mathematics, would not necessarily raise fundamental ontological questions such as: *what is space*, or *what is force* (in other words: what is the *true and essential nature* of space and forces).[5] Due to an overwhelming teleological inclination which is inherent in the progress of science and which characterizes the scientific epistemology in general, the axiomatic foundations of sciences – even if they originally evolved out of ontological considerations – are not adequately tested further. Even

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3 See George Berkeley, *Schriften über die Grundlagen der Mathematik und Physik*, Frankfurt 1969, p. 89-103.

4 See Dimitry Gawronsky, *Das Urteil der Realität und seine mathematischen Voraussetzungen*, Marburg 1910, P. 39. See also Gottlob Frege, *Kleine Schriften, hrsg. Von Ignacio Angelelli*, Hildesheim 1967, P. 163.

5. Newton is popularly known to have tried to grasp the true nature and cause of gravitation in vain. The basic ontological questions that remained unresolved in the early modernity, namely: what is gravity, and how can the gravitational attraction and repulsion be sufficiently explained, have been variously treated by the scientists of celestial mechanics. Many of the definitions used even anthropomorphized terms, such as *sympathy* and *antipathy* by Hooke, *affection* and *desire* by Leonhard Euler etc. Newton failed in his attempt to define adequately the nature and cause of the gravitational force, and seemed to have satisfied himself with the conviction that gravitational force exists, although we do not know what this force is and how it can act at distance.

in the early modern age, mathematics provided - with its absolute apodictic axioms - a secure ontological foundation for the natural sciences. Newton tried to justify his claim to the discovery of his laws in classical celestial mechanics (which were originally discovered by Kepler) - such as the law of inertia, area law etc. – by repeated assertion of the fact that he could prove them mathematically. Newton's *philosophia naturalis* was based on *principia mathematica* (as shown by the title of his seminal work "Philosophiae Naturalis Principia Mathematica"). This strategic attempt of Newton remains a striking example for how the mathematization of science in the early modern age emerged principally out of a historical necessity to determine the essential nature of the theoretical and axiomatic foundations of science - such as *forces* in classical mechanics - and how this tendency, which sustains even today, is invariably based on a philosophic-ontological principle.

However, philosophy does not seem to recognize the ability of mathematical principles to facilitate final explanations and justifications for the axiomatic foundations of natural sciences. The philosophical ontology can look beyond the scientific-ontological finality of fundamental mathematical forms and principles, such as the axiom of *line*, arithmetic *number* or a *variable* in algebra. Hence it was a natural philosophical attempt that Thomas Hobbes, in the pretext of negating the rationalism and its a priori assumptions, dared to question the real existence of the basic forms of Euclidean geometry. When Hobbes argues that the dimensionless point or one-dimensional line cannot *exist* in reality, he points to an insufficient ontological finality of mathematical forms and principles.[6] It is important to observe here that both in mathematics as well as in science the question of existence forms essentially a philosophic-ontological proposition. The ontological and epistemological issues are of great importance, because they only can extend the axiomatic foundations of sciences and thus accomplish effective fundamental research in different scientific disciplines. In this way the philosophy of science contributes significantly to the historical progress of sciences. The disregard for this fundamental discipline can therefore lead to stagnation – more precisely, to a *paradigmatic stagnation* - of sciences. The limits of science, which are constantly extended in its historical development, are not just the obvious limits of its applications, but more significantly

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6. In a sense, Hobbes only repeated (unknowingly) an observation of Cusanus from the early middle Ages, namely the imperfection of materialized geometric forms. According to Cusanus, the geometric forms such as circles, lines etc. can exist only in our mind as ideal or perfect forms (conforming entirely to their axioms). Against it, the real or materialized geometric forms always prove to be imperfect. Important to note here is that both Cusanus and Hobbes ascribe axiomatic perfection of geometric forms not to a system of knowledge, but apparently to a system of belief. This shows that a fact of belief underlies even the science of mathematics which is normally held to be apodictic.

the limits of its axiomatic foundations. Accordingly, the growth of sciences presupposes - in analogy to a tree - first and foremost the deepening of its axiomatic roots to unseen depths of philosophical i.e. epistemological and ontological finalities. In this respect, philosophy of science constitutes a basic discipline for natural sciences and mathematics.

Part II

Indeed the philosophy of science constitutes a basic discipline for natural/social sciences and mathematics, and the limits of its applications are constantly extended in its historical development. This volume of *Tattva*, Journal of Philosophy, contains six original and scholarly papers, which explore, from the perspective of Alfred North Whitehead who was always regarded as an applied, rather than a pure, mathematician, the applications of philosophy of science to various disciplines of human knowledge.

In "The One Mind Model of Quantum Reality" Mark Germine recognizes Whitehead's two conscious actual entities, 'God' (PR 87) and the 'I' (PR 75); and the Indian parallels of God and the 'I' as *Brahman* and *Atman*. Here Germine argues that the Universe is an actual entity, the mental pole of which is the consequent nature of God, and the physical pole the physical Universe. In a similar vein, *Brahman* embodies the movement from the mental to the physical pole, *Atman* the movement from the physical to the mental pole, and *Brahman/Atman* the totality of the Universe, as an actual entity. Indeed Germine draws his inspiration and support from Von Neumann, Wigner, and Stapp, who argue that individual minds collapse the wave function of quantum possibilities, or parallel universes; and the 'One Mind Model' of quantum reality, according to which all individual minds are united within the One Mind, creating One Universe.

In "The Minkowskian Background of Whitehead's Theory of Gravitation," Ronald Desmet purports to show that Minkowski's work forms an essential factor in the genesis of Whitehead's relativistic theory. Desmet is of the view that Whitehead's alternative theory of gravitation is a Minkowski background-dependent theory of gravity, both in the historical sense of being rooted in a Minkowskian context, and in the technical sense of describing the gravitational field against a Minkowskian space-time background. Contrary to Einstein's gravitational field tensor, which is called the fundamental tensor, Whitehead calls his gravitational field tensor the impetus tensor, and he uses it to define the gravitational field against the background of Minkowski's space-time, and thus Whitehead fulfils the hope that Minkowski expressed in "Space and Time."

Thandeka Tandeka, in her paper on "Whitehead's Brian Science," offers an overview of Whitehead's brain science of emotions, with a clear intention to update his work. She shows how Whitehead created this science of emotions, first, by separating emotional feelings from "their mere sensory elements," secondly, by studying "generalized emotional qualities [such as] love, admiration, the feeling of exquisiteness, the feeling of worth, hate, horror, the general feeling of association that is of particular objects entwined with one's own existence," and, finally, by identifying the brain as the focal point for this work. Whitehead called his brain science of emotions his "doctrine of feelings. Furthermore, using insights from the work of Jaak Panksepp, the founder of the contemporary brain science of emotions called affective neuroscience, Thandeka shows how Whitehead's "generalized emotional qualities" are akin to "raw feels," the links between what goes on within the brain and how it shows up in the body and the mind.

In the paper "Whitehead and Particle-Wave Duality" Luke George addresses the concerns and problems aired by Filmer S.C. Northrop, Roy Wood Sellers and Paul F. Schmidt, who reviewed Whitehead's process philosophy of science as 'critical realism' (instrumentalism); and suggests a solution through an innovative theory of reality, namely the System Philosophy. According to Luke George Whitehead's critical realism treats the quantum phenomena, with particle-wave duality, as metaphysical processes of *actual entities*, and this view conflicts with the 'representational realism (physical realism), which is the epistemology adopted by Einstein for his theories. He believes that 'System Philosophy' can reconcile the conflict of Whitehead against both Einstein and the materialist thinkers in respect to the ontological status of particle-wave duality, and integrate mechanistic worldview and process worldview, and thereby solve the problems of philosophy of science.

Meera Chakravorty, in "An Inquiry into Time" explores the notions of time, such as 'the birth of time' and 'what is time'. The question 'what is time' may appear redundant to many scientists, as different studies reveal that it rarely obeys any fixed pattern and theory. Nevertheless, Chakravorty contents that it is meaningful to investigate the path Time has treaded through diverse areas, which in turn may or may not provide us with one absolute criterion regarding its nature. For instance, from the flight of fancy based on folk experience and culture came the understanding of Time as an all encompassing phenomenon which is never going to be extinct.

"Whitehead and Grof" is an attempt by Leonard Gibson to resolve the ontological ambiguity of Jung's archetypes by drawing on Whitehead's metaphysics and Stanislav Grof's psychological discoveries concerning the human birth process. Anthropologically, ontologically, and literally speaking human birth is the embodiment of individuation. The bodily and psychic individuation from an all-encompassing maternal universe that takes place in birth represents a particular actualization of universals. The specific circumstances of the human birth process afford instantiation not only of the birth archetype itself but also a host of other archetypes, including those which manifest in what Jung calls the Shadow. Stanislav Grof's prenatal theory resolves the ambiguous ontological status of the Shadow and explains how the Shadow's force in the world derives from the experiential singularity of birth. Grof's understanding of human coming-to-be reflects Whitehead's metaphysical characterization of becoming and brings the existential richness of Jung's Shadow to Whitehead's metaphysical account of evil.

Let these essays enable, as Whitehead envisages, "philosophers, students and practical men [...] to re-create and re-enact a vision of the world, including those elements of reverence and order without which society lapses into riot, and penetrated through with unflinching rationality" (*Adventures of Ideas*, 126).

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