20th Cracow Methodological Conference: Philosophy in Science

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The 20th Cracow Methodological Conference took place on May 30-31, 2016, at the Polish Academy of Arts and Sciences in Kraków. It was organized by Copernicus Center for Interdisciplinary Studies, Department of Philosophy of Nature at the Philosophy Faculty of the Pontifical University of John Paul II and Polish Academy of Arts and Sciences. The meeting brought together physicists, cosmologists, mathematicians and philosophers interested in research program called *philosophy in science* started and popularized by Michał Heller. It is worth noting that the 20th Cracow Methodological Conference was dedicated to Professor Heller and can be considered as a contribution to the celebration of the 80th anniversary of his birthday.

The opening lecture entitled "Problems with singular Universe" was delivered by Leszek M. Sokołowski (Jagiellonian University, Astronomical Observatory). Professor Sokołowski claimed that cosmology – as the discipline dealing with the Uni-

verse as a whole – is the most philosophically involved among all natural sciences. Essentially, by philosophy Sokołowski meant *philosophy in science*. The main goal of the talk was to indicate the consequences of the fact that there is only one single Universe (at least there is only one Universe that is accessible to the method of physics). Taking that into account one needs to assert that scientific description of the Universe in terms of physics is extremely excessive – in General Relativity we have infinite number of solutions of Einstein field equations, i.e. infinite number of models that are meant to describe a single object – the Universe. Secondly, since there is only one Universe, it cannot be subjected to any experiments. We cannot repeat the evolution of the Universe with different initial data. For the same reason we cannot observationally compare it with other real universes. In the light of above considerations speaking of the laws of the Universe does not make any sense. Since there is only one single object, one cannot differ between necessary laws that rule it and its contingent features. Similarly, the concept of probability is not applicable to one single Universe. Sokołowski concluded that there is no reason to claim that the Universe is generic – it is what it is and there is no way to explain it.

The second lecturer – Marek Biesiada (University of Silesia, Department of Astrophysics and Cosmology) – entitled his talk "Michał Heller and cosmology – a brief history of time". The talk concerned the history of Cracow Cosmology Group that had been started and held under the patronage by the Jubilarian – Michał Heller. The Group was formed in the 1970s and

then developed rapidly in the 1980s . In 1972 members of the Group established *Acta Cosmologica* – unique for those times international academic journal devoted exclusively to cosmology (the journal was being published until 1996). In the 1980s the Group was interested mainly in the problems of inflation, multidimensional Kaluza–Klein theories as well as statistical homogeneity of the large-scale Universe and topology of the Universe. The vast part of the talk was devoted to above problems and their renaissance in nowadays cosmology.

Third talk entitled "Colorful Universe" was given by Zdzisław Golda (Jagiellonian University, Faculty of Physics, Astronomy and Applied Computer Science). During the lecture Professor Golda told the story of astronomical observations, electromagnetic waves, the spectrum of electromagnetic radiation, "observational windows" in astronomy, spectrometry, mechanisms of radiation, modern astronomical instruments, the colors of the Solar System and of the Universe and Hertzsprung-Russell diagram.

The second session of the conference dealt with the issues of philosophy of mathematics. It was started by Roman Duda (University of Wrocław, Institute of Mathematics) who deliberated on "Troublesome Axiom of Choice". The Axiom of Choice was controversial ever since it has been formulated by Zermelo in 1904. The disputes concerning this axiom have been alleviated by conciliatory standpoint of Sierpiński. Later, in the second half of 20th Century – thanks to the results of Gödel and Cohen – it has become commonly accepted and essential part of modern mathe-

matics. Nevertheless, there were some attempts to replace it with another axiom – strong enough to produce similar mathematical outcomes yet weak enough to avoid unintuitive paradoxes, like the Banach-Tarski paradox. The reason that stands behind these vivid debates over Axiom of Choice is that it concerns many fundamental problems in philosophy and foundations of mathematics, e.g. the problem of the criterion of existence in mathematics, the problem of its finitary or deductive character.

The next lecture entitled "Georg Cantor and set theory in the face of theology and theologians" was given by Roman Murawski (Adam Mickiewicz University, Faculty of Mathematics and Computer Science). Professor Murawski started with the assertion that there is no mathematics without the concept of infinity. Nevertheless, for Centuries this concept has been very problematic for mathematicians and philosophers. That was the case until the times of Georg Cantor. His set theory allowed mathematical investigations of the actual infinity. At the beginning, Cantor's work lacked the appreciation among mathematicians. For this reason the German mathematician turned to theologians. Their positive response strengthened Cantor's conviction that set theory is appropriate, correct and true mathematical theory of infinity. On the other hand, catholic theologians sought stronger tools for their own research on the infinity of God and set theory seemed to be a good candidate for such purposes. The lecture was devoted to these interesting relationships.

The idea of mathematicity of the world has been creatively developed by Michał Heller. The talk of Bogdan Dembiński

(University of Silesia, Department of the History of Ancient and Medieval Philosophy) entitled "At the root of the Greek conception of the mathematicity of the world" concerned the sources of this idea in classical philosophy. Professor Dembiński presented few important steps towards mathematics and natural sciences taken by the ancient thinkers as well as some modern "myths" concerning ancient philosophy, e.g. discontinuity between doctrines of Plato and Aristotle. Dembiński concluded that standard views in the philosophy of mathematics – such as formalism, intuitionism and logicism – do not correspond to classical philosophy, while the idea of Michał Heller seems to be more in line with ancient thinkers.

The following lecture also had a historical character. It was entitled "Is Stefan Zachariasz Pawlicki (1839–1916) a predecessor of the Kraków philosophy of nature?" and delivered by Paweł Polak (Pontifical University of John Paul II, Department of Philosophy of Nature). Professor Polak asked an interesting question on the subject of the origins of philosophy of nature cultivated in Kraków since the late 19th Century. Usually, it is believed that the precursors of this style of practicing philosophy are Władysław Heinrich and Maurycy Straszewski. Nonetheless, the nineteenth-century initiators and their role in the formation of this style seem to be forgotten. Pawlicki contributed to Kraków philosophy of nature with the ideas that cannot be found in the works of its founders (Heinrich, Straszewski). These ideas have been undertaken (probably unknowingly) by the contemporary philosophers of nature in Kraków.

During the final lecture on that day – entitled "Philosophy in the context of scientific worldviews" – Zbigniew Wróblewski (John Paul II Catholic University of Lublin, Faculty of Philosophy) provided substantial criticism of so-called Third Culture. Professor Wróblewski claimed that popularization of science practiced by scholars gathered around John Brockman is ideologically charged. According to Wróblewski that kind of popular science smuggles worldviews between the lines concerning scientific results. On his account, the formation of a worldview is the task reserved for philosophers and philosophy, not any philosophy though. He also accused analytic philosophy of offering nothing but "puzzles" for other professional philosophers. Wróblewski sought the remedy for ideologically-oriented popular science in "pure" philosophy.

The second day of the conference begun with the talk of Jan Woleński (University of Information Technology and Management in Rzeszów) who stood up in "Defense of naturalism". Most arguments provided by Professor Woleński were in favor of moderate local and methodological naturalism (note that all these attributes have different *fundamenta divisionis*). According to Woleński there are two main criterions of naturalism, namely: 1) everything exists in space-time; 2) everything that exists is embodied. He also indicated several subjects of controversies between naturalists and anti-naturalists, such as question of the existence of God, origins and nature of life and consciousness, the question of values and normative order or the nature of mathematics. The vast part of the talk was devoted to the first of

the above topics, i.e. discussions between naturalists and theistic anti-naturalists.

During the next talk entitled "Is *experimentum* still *crucis*?" Michał Eckstein (Jagiellonian University, Faculty of Faculty of Physics, Astronomy and Applied Computer Science) pointed to the relationship between empirical data, physical theories and mathematics (as well as philosophy and technology) in modern science and its methodology. Examples that he used to illustrate these interactions included Special and General Relativity, mathematical physics and "physical mathematics", cosmology, quantum mechanics, quantum field theory and quantum gravity. He argued that many of above theories lack of certain elements of the commonly accepted method. Eckstein also asked some interesting questions concerning methodology of science such as 'what is the role of the experiment?' or 'are the limits of scientific method determined by the method itself?.'

The lecture of Elżbieta Kałuszyńska (University of Warmia and Mazury in Olsztyn, Institute of Philosophy) entitled "Linguistic pitfalls" was devoted to the presuppositions of so-called fine tuning. In the first part of the talk Professor Kałuszyńska reminded that the motivation to introduce the idea of multiverse to theoretical physics was to mitigate philosophical implications of anthropic principles. The concept of multiverse, however, does not alleviate the theistic worldview that often accompanies that kind of philosophical consideration. The problem with anthropic principles is that they share certain presuppositions, namely that the Universe is indeed fine-tuned. But what does it mean "to be

tuned"? According to Kałuszyńska that kind of expressions has some teleological component. She argued that it is the life that is adopted to the conditions imposed by the Universe, not the Universe tuned to be life-friendly.

The two lectures delivered during the following session concerned the relations between science and theology. First of them entitled "Theism is not an explanatory hypothesis" was given by Mieszko Tałasiewicz (University of Warsaw, Institute of Philosophy). Professor Tałasiewicz told of one of the form of the disputes about the rationality of faith. In some cases both sides of these disputes claim that faith consists of the set of beliefs among which "God exists" is the most important one. Such a theistic standpoint is considered here as competitive to the atheistic one in explaining existing scientific evidences. An example of such a dispute is the discussion between Richard Dawkins and Alister McGrath. According to the latter, the choice between theistic and atheistic hypotheses is analogous to the choice between two scientific theories which are not sufficiently determined by the empirical data. Tałasiewicz argued that neither theism nor atheism cannot be regarded as the explanation of the evidences in the sense of philosophy of science. An explanation requires a specific connection between the facts and the theory that explains them. If theism and atheism served as an explanation, there would be common agreement about which facts militate in favor of theism and which of them stand for atheism. Nevertheless, it is not the case. Tałasiewicz provided a number of arguments that can be converted in favor

of both – theistic and atheistic worldviews. He concluded, however, that this does not mean that religion is beyond the limits of rationality.

The next lecture given by Wojciech Grygiel (Pontifical University of John Paul II, Department of Philosophy of Nature) concerned "Theology of Michał Heller as an open project". In the first part of the talk Professor Grygiel revealed the main theological questions present in the works of the Jubilarian. They stem from Heller's unique personal experience in the areas of both – science and religion. Heller often criticizes the state of the contemporary theology. On the other hand, he also tries to contribute to theology in a constructive way with the attempts to set new trends inspired by the achievements of modern science. The paradigm of modern science allows to integrate theological doctrines and to express them in terms of different philosophical systems. Heller's theology is an open project, since it benefits form the conceptual background of science, which is constantly evolving. The second part of the lecture was devoted to possible application of the theory of mathematical invariants on the ground of philosophy and theology.

The last session of the conference was devoted to the philosophy of mathematics. It started with the lecture of Krzysztof Wójtowicz (University of Warsaw, Institute of Philosophy) who deliberated on the idea of mathematical rationality of the Universe in the context of realism and instrumentalism in the ontology of mathematics. The main question posed in the talk was whether mathematics is the description of the structure of

the world or just a useful tool that facilitates the computations. Professor Wójtowicz firstly sketched the debates between realists and instrumentalists in the philosophy of mathematics. Then he reflected upon the concept of explanation in mathematics. He concluded that the idea of mathematical explanation become meaningful when we presume that the mathematics corresponds to the structure of the world or – in other words – the Universe in its essence is mathematical.

During the lecture entitled "Will we ever know the shape of the Universe?" Zdzisław Pogoda (Jagiellonian University, Institute of Mathematics) brought forward the history of the efforts to discover the topology and geometry of the Universe from the mathematical perspective. He started from Hilbert's sixth problem, i.e. the axiomatization of physics. Thanks to this famous program two branches of physics (classical mechanics and General Relativity) earned proper mathematical models based on topology and differential geometry. Since there is a continuum of solutions to Einstein's field equations, scientist still look for the solution that best matches the empirical data. To this end we firstly need to know how many models do we actually have at our disposal, which is tantamount to the question of the classification of 3-manifolds describing the spatial sections of the Universe. To answer this question William Thurston proposed so-called geometrization conjecture according to which all 3-manifolds admitted a certain kind of geometric decomposition involving only eight "model" geometries. This problem was undertaken by Richard Hamilton whose work inspired Gri-

sha Perelman and ultimately led to the proof of the Thurston's geometrization conjecture as well as to the solution of Poincaré conjecture. Despite the above results, according to some theorems (*Theorema egregium*, Borsuk Theorem) we will never be able to measure the curvature of the Universe. Moreover these theorems concern compact and 3-dimensional spaces. Thanks to the works of Michael Hartley Freedman and Simon Kirwan Donaldson we know that the case of $\mathbf{R}^4$ is even more complicated. Pogoda concluded that the solution to above problems may consists of the application of different mathematical models. As an example he recalled Heller's attempts to apply noncommutative geometry to cosmology.

Finally, the closing lecture entitled "Science for philosophy – an offer one cannot refuse" was given by Michał Heller (Copernicus Center for Interdisciplinary Studies). The main claim of the talk was that science suggests philosophy the revision of logic and this revision seems to be inevitable in the light of future theories in physics as well as contemporary interpretation of physics in terms of category theory. The general question asked by Professor Heller was "what philosophy can learn from science?". The history of culture shows that every scientific revolution entailed conceptual revolution on the ground of philosophy. Today we are on the verge of the next scientific revolution (that will come with the theory of quantum gravity or "great unification"). It seems plausible that such a revolution will cause very profound transformation of concepts. Most probably this philosophical transformation will also include the modification of

logic. Heller devoted the vast part of his talk to an introduction to category theory and its application in physics. It occurs that "logical environment" for different levels of physics is determined by a certain topos (topos is a particular kind of a category in the category theory). Hence, we should not use classical logic for every analyses of more sophisticated physical theories. At the beginning we ought to reconstruct "inner logic" of a given theory and then this particular logic should be used to the (philosophical) analysis of the theory in question. Heller concluded that obedience of the laws of classical logic is an important element of rationality. Nevertheless, extending the jurisdiction of our logic on the whole realm of reality would be an irrational anthropocentrism.

It is worth noting that most of the lectures were followed by lively and interesting discussions. Moreover, all sessions were chaired by scholars associated with the Copernicus Center for Interdisciplinary Studies (Ł. Mścisławski, A. Olszewski, J. Mączka, M. Hohol, D. Wąsek, K. Maślanka). The conference also aroused moderate interest of general public which was actively involved in the discussions as well. According to the declaration of the organizers, all talks will be collected in the proceedings that are meant to be published several months after the conference. Additionally, all lectures were recorded and are available on the YouTube channel of the Copernicus Center for Interdisciplinary Studies[1].

[1] http://youtube.com/CopernicusCenter.