How is *philosophy in science* possible?

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Translated by Bartosz Brożek and Aeddan Shaw*

Abstract

The Michael Heller's article entitled "How is *philosophy in science* possible?" was originally published in Polish in 1986 (see Heller, 1986) and then translated into English by Bartosz Brożek and Aeddan Shaw and published in 2011 in the collection of essays entitled *Philosophy in Science. Methods and Applications* (Heller, 2011). This seminal paper has founded further growth of the 'philosophy in science' and become the reference point in the methodological discussions, especially in Poland. On the 40th anniversary of *Philosophical Problems in Science* we wanted to make this paper freely available to the international public by reprinting its English version. In this issue it is followed by two additional articles-commentaries (by Paweł Polak and Kamil Trombik).

Keywords

philosophy in science, philosophy of science, metaphilosophy, interdisciplinary research, science and religion, analytic philosophy.

* In this edition some quotations have been replaced by the translations of their original sources (if available). The references have been adjusted to the standards of the journal.

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1. Introduction

'Philosophy in science' grew out of practice. Its most significant example is the phenomenon of the 'philosophizing physicists'. And even though the philosophical reflection of the representatives of the empirical sciences often falls short of the professional philosophical standards, it does not change the fact that the sciences are filled with philosophical contents.

In the recent years in the Polish philosophical literature such terms as 'philosophical issues in science' have appeared on the covers of several publications.[1] The English 'philosophy in science', through its contrast with, and similarity to 'philosophy of science', has been 'sanctioned' in the title of a new periodical.[2] The paper by W.H. Stoeger, published in the first volume of *Philosophy in Science*, may be considered a manifesto of the editorial board, as well as an attempt to provide a theory of 'philosophy *in* science'.

I am against any planning what kind of philosophy should be practised, i.e. determining *a priori* the method of analysis and its consequent application. It is more natural when the methodological reflection follows the period of abundant, sometimes instinctive or even chaotic research in a new discipline. I believe, however, that the time has come for an attempt to systematize what *de facto* is 'philosophy in science'.

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[1] Cf. *Zagadnienia Filozoficzne w Nauce*, a periodical published in Kraków since 1978; see also (Heller, Lubański and Ślaga, 1980).

[2] *Philosophy in Science* is published by Pachart Publishing House, Tuscon. The first volume appeared in 1983.

2. Philosophy in science and philosophy of science

Among the philosophers of nature (in particular those belonging to the neo-thomistic school) there is a commonly accepted doctrine of the non-intersecting planes. Generally speaking, it says that philosophical cognition lies at a totally different epistemological plane than the empirical sciences; they use different methods and operate with mutually untranslatable languages.[3] In order to justify this view the theories developed within the contemporary methodology are cited. It is sometimes tempting to say that the major motive behind such stances is to safeguard one's philosophy against any conflict with the sciences, as well as the theoretical justification of one's incompetence in the sciences.

The proponents of the two planes doctrine may protest against the 'philosophy in science' project as methodologically flawed and epistemological nonsense, an attempt at a comparison of the incomparable. I recall those objections not in order to dismiss them (the best way to reply to them is through the results already obtained in the 'philosophy in science' field), but to underline the relationship between 'philosophy in science' and philosophy of science. It is obvious that any philosophizing which is open for the dialogue with the empirical sciences must take into account their achievements. Otherwise it would be subject to the objection of anachronism. It is equally difficult to reject the claim that there exist serious differences between the 'cognitive plane' of the empirical sciences and some philosophical currents. I do not believe, however, in any strict isolation-

[3] This is a kind of philosophy advanced in two books: (Mazierski, 1969; Kłósak, 1980). Both these authors seem to see the need for the mutual influences of philosophy and the sciences and develop subtle distinctions in order to open the way for such influences despite the non-intersecting planes.

ism: of the philosophy in relation to the sciences, or *vice versa*. The methodological bans will be breached anyway, and it is often through the violation of the received canons that new paradigms emerge, i.e. some progress is made in our attempts to understand the world: the two non-intersecting planes may turn out to be elements of the same stratification of a more-dimensional space.

'Philosophy in science' has *de facto* been practised from the beginnings of the empirical sciences. For example, looking at the Newton's oeuvre, it is difficult to determine whether it is a case of science in philosophy, or already of philosophy in science. Thus, an attempt to categorize *ex post* the problems of 'philosophy in science' is possibly realizable; however, in face of the richness of this problematic, I shall concentrate on a succinct analysis of three exemplary issues. Although they do not exhaust the content of 'philosophy in science', they remain typical examples so that they enable to reconstruct its nature and methods. In what follows I shall present (A) the influence of the philosophical ideas on the development and evolution of scientific theories; (B) the traditional philosophical problems intertwined with empirical theories; (C) philosophical reflection over some assumptions of the empirical sciences.

3. The influence of philosophical ideas on the development and evolution of scientific theories

Empirical science originated through the separation from the old, all-embracing philosophy and still bear the imprint of this origin. Contemporaneously, various philosophical ideas often serve as an inspiration for developing new conceptions in the empirical sciences. How-

ever, many methodologists defend the 'purity' of science by introducing the well-known distinction: indeed, in the context of discovery philosophical ideas often influence the development of science, however it is not their role only—other factors, even irrational ones, may be influential in the process of arriving at new discoveries; on the other hand, in the context of justification, i.e. the sphere of the proper science-creating activities, philosophy has no bearing—it is an 'alien body', effectively eliminated by the built-in mechanisms of science. It is the disregard for this distinction that led to the phenomenon of the 'philosophizing physicists'—the representatives of the empirical sciences who, wrongly taking the context of discovery for the discovery itself, believe to have something philosophically interesting to say, while in fact they reveal only their psychological associations.

In the recent years, the distinction between the two contexts has been severely criticized. A case in point is the following passage from Stefan Amsterdamski's study:

> Metaphysics, myths or superstitions are in some manner as immanently a part of science as the facts which we attempt to include into the rational reconstruction. The neoplatonic metaphysic of Kepler and Copernicus were as much an element of the rational organization of the universe which they attempted to reconstruct as the strictly empirical statements of their astronomic systems. (Amsterdamski, 1973, p.99; 1975, pp.65–66)

To put it more succinctly:

> Therefore, science consist not only of statements about the universe under study, but also of assumptions about the knowing subject. (Amsterdamski, 1973, p.100; 1975, p.66)

If this line of argument is sound, 'philosophy of science' is simply a part of the science itself.

It is worth underlining, that the psychological or sociological accounts of the philosophy of science—which have recently gained in strength and prestige—almost completely dispense with the distinction between the 'logic of science' and the 'external circumstances' of that logic (Amsterdamski, 1983; 1992; cf. Życiński, 1983). It is not my goal to engage in a philosophical discussion. However, I personally consider the distinction between the context of discovery and the context of justification useful under the condition that it is understood in a flexible way, which paves the way to a gradual passage from one context to the other. All in all, the impossibility of drawing a sharp demarcation line between 'inspirations' and 'justification' is a sufficiently strong argument in favour of the 'philosophy in science'.

Another conception of the contemporary methodology which clearly points towards some philosophical elements in science is the so-called thematic analysis, proposed by Gerald Holton (cf. Holton, 1998). He believes that in many concepts, methods, claims and hypothesis of science there are certain elements he calls *themata*, which as if from hiding influence or even determine the development of new scientific ideas. *Themata* often come in pairs (of opposites), sometimes in triplets, and have surprising durability over the centuries—they are capable of surviving many scientific revolutions. Here are some examples of *themata*: unity—multiplicity; determinism—indeterminism; continuity—discontinuity; symmetry; invariance, complementarity, etc. Holton is surprised with the relatively small number of *themata*—in physics he identified some 100 thereof—and underlines their interdisciplinary and philosophical character. *Themata* may constitute the pivotal ideas for the studies in the history of science, but considered from the perspective of their philosophical load they are nothing else but 'philosophy in science'.

4. Traditional empirical problems intertwined with empirical theories

One can enumerate a number of such problems or rather clusters of problems. Here, I shall limit myself to examples pertaining to time and space. It would be difficult to find a philosophical system that has nothing to say about time and space; and it would be difficult to identify a relatively comprehensive contemporary physical theory that would assume no theses pertaining to time and space. A classical objection against such bonding of philosophy with empirical theories consists in stressing the fact that any doctrine which 'migrates' from philosophy to the 'specialized' disciplines loses irrevocably its philosophical character, and the only thing that speaks to its philosophical origins are words, which—even though they sound the same—have completely changed their old meanings. As elsewhere, the doctrine of planes guards here the purity of philosophy. As I remarked earlier, it is not my goal to fight this doctrine; I would like to show, however, that philosophy exercises much more direct influence over the development of empirical theories than granted by the traditional wisdom.

Sometimes, in philosophy a view or a complex set of ideas—we shall say: a doctrine—is established which becomes a kind of paradigm or a research programme for one or more empirical theories. It so happens that philosophical paradigms are incorporated into some empirical theories (possibly in violation of the rule that forbids trespassing from one 'plane' to the other, while changing its 'meaning content'); but it happens also that a paradigm resists all such attempts, which leads to partial effects or side-effects only. When an empirical theory succeeds in realizing such a philosophical programme, one may say that the given empirical theory is a model of the given philosophical doctrine. The conception of empirical models

of philosophical doctrines is still awaiting a more thorough analysis. Below, I confine myself to examples pertaining to the philosophy of space and time.

In the famous *Scholium* at the beginning of his *Philosophiae Naturalis Principia Mathematica*, Newton formulated a philosophical doctrine of the absoluteness of time and space:

> Absolute, true, and mathematical time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration.—Absolute space, in its own nature, without regard to anything external, remains always similar and immovable. (Newton, 1687, Scholium B)

Today one would say that these definitions functioned within the context of discovery of the classical mechanics. It is certainly true, but this was not their only role. It was Newton's intent to incorporate the doctrine of the absolute time and space into the new mechanics. Newton himself, as well as generations of physicists that followed him, believed that he had succeeded in doing so. However, a careful analysis, with the use of the contemporary mathematical tools, reveals that—indeed—the absolute time plays an important role in the structure of the classical mechanics, but the structure does not include an element that would correspond to the philosophical intuitions pertaining to the absolute space (Raine and Heller, 1981, pp.57–81). Thus, one must carefully distinguish between Newton's own views concerning space and time and the structure of space and time presupposed by the Newtonian mechanics. The fact that Newton's views are incompatible with the 'views' of his mechanics is clear evidence that philosophical ideas are active not only in the contexts of discoveries, but are also intimately linked to the history of justifications of scientific theories.

To sum up this stage of our reflection, one may succinctly say: the classical mechanics is a physical model of the philosophical doctrine of the absolute time; however, it is not a physical model of the doctrine of the absolute space.[4]

The 'other side' of this story is equally instructive. Long before Newton there was known a philosophical doctrine rival to the conception of the absolute time and space. Its most famous incarnation was formulated by Leibniz:

> As for my own opinion, I have said more than once, that I hold *space* to be something *merely relative*, as *time* is; that I hold it to be an *order of coexistences*, as time is an *order of successions*. (Leibniz, 1717, p.57)

Despite the clear attractiveness of the Leibnizian philosophy of time and space, it belonged the philosophy textbooks only till the development of the theory of relativity (cf. Heller and Staruszkiewicz, 1975). The obvious reason for this was that neither Leibniz nor any of his followers managed to create a physical model of the philosophical doctrine of the relative character of space and time (cf. Raine and Heller, 1981). There is a deeply rooted conviction that such a model was provided by the general relativity theory. This conviction proved essentially wrong,[5] but the analysis led to a new, interesting observation. In the past, the doctrines of the absoluteness and relativeness of time and space were treated as mutually exclusive; only

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[4] In connection to the problem of the logical structure of the classical mechanics analysed with the use of the contemporary mathematical techniques, it is also worth mentioning two studies (Friedman, 1983; Torretti, 1983).

[5] The problem is more subtle than the above considerations suggest. One would need to identify at least several senses of 'relational' and 'absolute'. There is no place in this essay to go into the details, thus I recommend the cited works (Raine and Heller, 1981), as well as (Friedman, 1983).

one of them would turn out true, *tertium non datur.* The general relativity theory falsified this view: it is a model of a partially relational (as it depends on the bodies that populate it), and a partially absolute (in the Newtonian sense) space-time (cf. Raine and Heller, 1981, chap.13).

This example illustrates again in which way a philosophical doctrine reveals its presence (or absence) in empirical theories; it is completely independent of the beliefs of the authors of these theories (i.e., the problem lies beyond the context of discovery), and often in violation of such explicit beliefs. An empirical theory may be—or not—a physical model of some philosophical doctrine: it is its fully objective feature, which may be analysed with the contemporary formal means.

The elements of the conception of absolute time and space stubbornly remain *inside* the theories of the contemporary physics, despite many attempts at their removal and creating a physical model of a doctrine of fully relative space and time. One may even say that the drive towards such a model is one of the determinants of the tendencies in the contemporary theoretical physics. It is in this sense also that philosophical doctrines are present in the evolution of science.

5. Philosophical reflection over some assumptions of the empirical sciences

This type of analysis has long been applied in the contemporary philosophy. For example, it is the general framework of the important part of Husserlian phenomenology. Here however, a different aspect of this problematic is interesting. Again, it is suitable to use examples.

I shall sketch the problems surrounding the following assumptions of the empirical sciences: (a) the assumption of the mathematicity; and (b) of the idealizability of nature, as well as (c) the assumption of the elementary character and (d) the unity of nature. These assumption may in a natural way be joined in pairs (a-b and c-d), which should be analysed together. A number of remarks and short commentaries concerning these assumption has already been formulated; however, they still await a more thorough, monographic study that would provide a precise formulation of the fundamental questions to which the assumptions inevitably lead.

(a) **The assumption of the mathematicity of nature.** From the most general point of view, the mathematicity of nature boils down to the fact that nature can be described mathematically. It may be considered a fact since it is 'empirically' confirmed by the development of the sciences from the times of Galileo and Newton. Moreover, this development is extremely efficient, documented with a sequence of successes, both theoretical and pertaining to the 'technical' conquest of nature.

The mathematicity of nature may be considered a counterpart of the medieval *intelligibilitas entis*—the comprehensiveness of being. In this context, Wigner discusses "incomprehensible comprehensibility of the universe", and Einstein remarks that "the most incomprehensible thing about our universe is that it is comprehensible." In order to better grasp this problem one should distinguish between at least three senses in which nature could have been non-mathematical:

1. Nature could have been amathematical, i.e. non-describable with the use of any mathematics. This would mean that nature is irrational and would probably exclude it from existence.[6]
2. Nature could have been mathematically transcendent in relation to our cognitive capacities, i.e. mathematics needed to adequately describe nature would require such formal means that are in principle inaccessible to our cognition. Simple models of universes that are non-mathematical in this sense were constructed by Kemeny (1959; see also my study Heller, 1974, pp.112–119) and Staruszkiewicz (1980).
3. Nature could have been mathematically too complicated in relation to our capacities, but not in principle—only regarding the level of difficulty. Some level of difficulty would make impossible or very unlikely the rise and development of the empirical sciences. For example, the fact that the Newtonian equation

$$F = G\frac{m_1\, m_2}{r^2}$$

approximates well the gravitational force between two point masses, facilitated or even enabled the development of the theory of universal gravitation at the end of the 16th Century. If the exponent in the denominator did not equal 2, but, say, 2.009, the orbits of planets would be so complicated that Kepler would most probably fail to discover any significant regularities.

[6] It must be stressed that I am speaking of the mathematicity of nature only. The complicated problem of the relationship between 'mathematicity' and mental phenomena cannot be addressed in this essay.

This final understanding of mathematicity of nature is strictly connected to the next tacit assumption of the contemporary empirical method, i.e.:

(b) **the assumption of the idealizability of nature.** It is worth noticing that the modern empirical method proved successful not when it began its experimental game with nature, but when people learnt to ignore a number of 'inessential' factors of that game. The failure of the Aristotelian physics as an empirical science was connected to its insistence on accounting for the entire complexity of nature (friction or drag were not ignored). One may even say that the 'creation' of 'non-existent', but mathematically simple 'entities' was a prerequisite of the success of the empirical method, to mention but the class of inertial coordinate systems, energetically isolated systems, etc. The possibility of approximating nature with sufficiently simple mathematical models is the mathematical manifestation of the idealizability of nature.[7]

The assumption of the idealizability of nature accommodates also the assumption of its stability of a certain kind. For example: if small perturbations of an observable measurement led to significantly different (non-equivalent in certain respect) mathematical models of the studied domain, then—given the fact that observable parameters are always measurable with some perturbations (measurement error)—the study of nature would be impossible. By excluding such situations, one assumes the observational stability of nature. The observational stability of nature is a special case of a more general concept, that of the structural stability of nature. By postulating such a kind of stability, one needs to determine an equivalence class of structures, kinds and magnitude of their perturbations and assume that a small perturbation does not exclude the given structure from

[7] Some aspects of this problem are discussed in my paper (Heller, 1983).

the equivalence class.[8] The role of structural stability was stressed by René Thom (1977), but a systematic discussion of this problem in relation to the philosophy of science is still missing.

In the contemporary empirical sciences a significant role is reserved for probabilistic models. When operating with them, one needs to assume a special kind of stability, known as frequency stability. In the standard probability calculus, the probability measure of the elementary events is taken to be represented by the numbers close to their observed frequency. Such a definition of probability assumes that the future series of similar experiments shall, in the long run, give relative frequencies substantially similar to the relative frequencies observed currently. This assumption—which is verified both in our ordinary experience and in the scientific practice—is called the assumption of frequency stability. It attributes to the world a certain feature, thanks to which it can be studied probabilistically (cf. Heller, 1985).

The problems of the mathematicity and idealizability of the universe are connected to one additional issue. Both these assumptions attribute to nature a feature, which is responsible for the nature's mathematicity and idealizability, but they also say something about the human mind, which is capable of accounting for nature as mathematical or idealizable. Thus, the assumptions in question may be considered both from the ontological and the epistemological perspectives. It is also possible that one cannot take one of the perspectives, while excluding the other. This problem must also be scrutinized.

The assumptions of the mathematicity and idealizability of nature are strictly connected to:

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[8] On the subject of the concept of structural stability and its applications in the methodology of the sciences see (Szydłowski, 1983).

(c) and (d) **the assumptions of the elementary character** and **unity of nature.** These assumptions are counterparts of two essential features of the mathematical method. Understanding in mathematics may proceed either in the direction of analysis (towards axioms and primitive concepts of the given mathematical theory) or in the direction of synthesis (i.e., towards 'embedding' the given mathematical 'entity' within some global structure, from which it can be—artificially?—extracted). The reductionist and holistic explanations outside of mathematics have their sources in the same two opposite tendencies of the human mind.

The assumption of the elementary character of nature urges us to uncover the 'elementary level' in reality. At the first sight, it seems that the process of descending towards more elementary levels never ends (as the drive 'to understand' requires to reduce any 'data' to something more elementary) or must be 'artificially' terminated by a conventional acceptance of some 'rudimentary' level. In the contemporary theoretical physics there is a strong tendency to reduce physics to pure mathematical structures. In this sense, the 'mathematical material' becomes elementary for physics.[9]

The problem of the unity of nature has been analysed in detail (cf. Weizsäcker, 1980). Doubtless, it has many dimensions. One of them is the clearly visible tendency of the contemporary physics to develop unification theories. However, from the philosophical point of view a deeper dimension of the problem is constituted by the unity postulated by the very mathematical-empirical method of studying the universe.

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[9] This is illustrated by the example of the concept of matter, which—during the evolution of physics—was replaced by purely formal structures; cf. my paper (Heller, 1982).

In this context a question arises: may totality (i.e., unity in one of its meanings) turn out to be an elementary category? Even if it is not the case, I believe that the assumptions of unity and the elementary character of nature must be analysed together. Possibly, one has no definite sense without the other.

6. A Proviso and an appeal

It goes without saying that the above mentioned problems are only a preliminary catalogue of questions delineating 'philosophy in science'. Under no condition the above considerations should be considered an attempt to provide event partial answers.

It was also not my intent to provide a theory of 'philosophy in science', although I am not against such undertakings. I would only protest against calling 'philosophy in science' some meta-considerations which are not rooted in the scientific practice. However, this proviso is barren: philosophical issues in science are so interesting that they will be contemplated irrespective of any appeals or restrictions. They require interdisciplinary research and thus only one appeal is in place—an appeal for a responsible cooperation between philosophers-methodologists and the representatives of the empirical sciences. Only through expertise in both disciplines it may be guaranteed that 'philosophy in science' will not transform into commonsensical (and hence: naïve) considerations, but will become a truly creative domain of knowledge, one indispensable in the contemporary intellectual ambience.

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Philosophy in science: A name with a long intellectual tradition

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Abstract

This paper presents Michael Heller's notion of "philosophy in science" and re-introduces Michael Heller's classical text that first presented this concept of philosophy entitled *How is Philosophy in Science Possible?*. The paper discusses the historical context of Heller's idea as it emerged from the discussions and works of the Krakow philosophical scene and discusses the basic tenants of this philosophy, its analytic character, the role of intellectual tradition in the development of this philosophy, and the critical role played by an interdisciplinary dialogue between philosophy, science, and theology. Despite the idea of philosophy in science having emerged about 40 years ago, this concept still inspires and fuels innovative research. The notion of "philosophy in science" lies at the foundations of the philosophy published in two journals: *Philosophical Problems in Science* (*Zagadnienia Filozoficzne w Nauce*) and *Philosophy in Science*.

Keywords

Michael Heller, philosophy in science, metaphilosophy, analytic philosophy, Lvov-Warsaw School, non-fundational philosophy, interdisciplinary research, science and religion.

The term "philosophy in science" has been in use for at least 40 years. It was first proposed in the late 1970s during the seminars held in Kraków by the scientists and philosophers working

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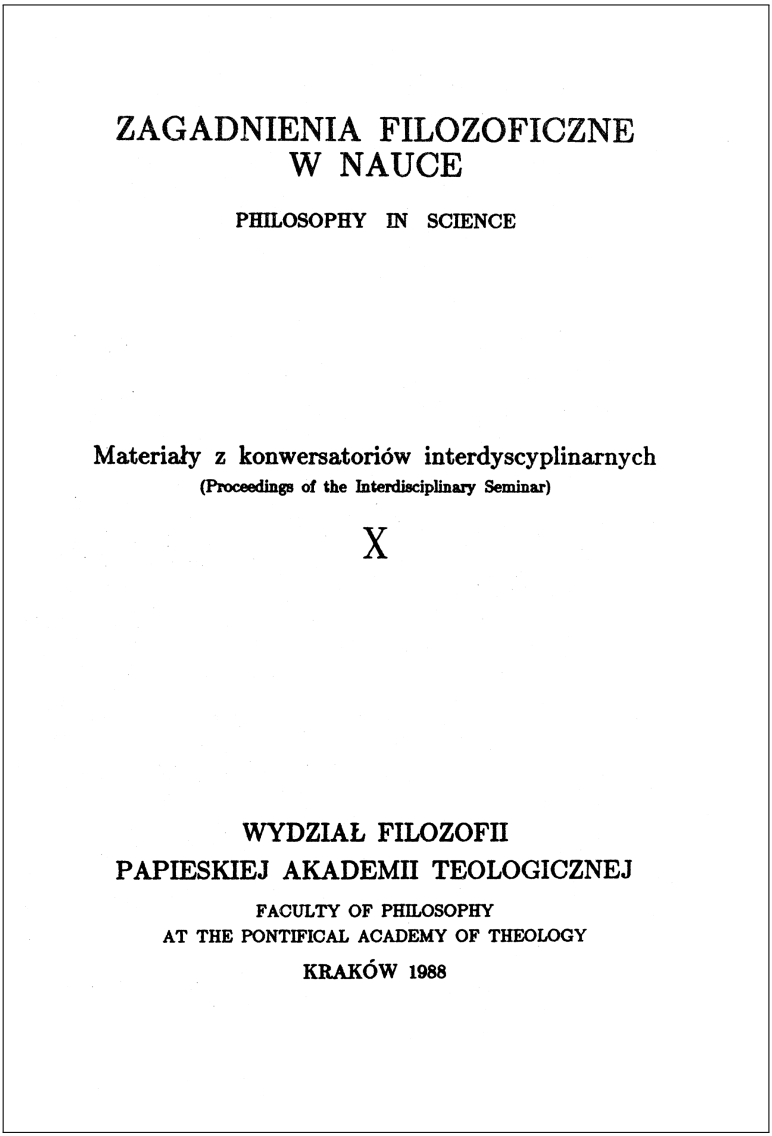

ZAGADNIENIA FILOZOFICZNE
W NAUCE

PHILOSOPHY IN SCIENCE

Materiały z konwersatoriów interdyscyplinarnych
(Proceedings of the Interdisciplinary Seminar)

X

WYDZIAŁ FILOZOFII
PAPIESKIEJ AKADEMII TEOLOGICZNEJ

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KRAKÓW 1988

Figure 1: Frontmatter of *Philosophical Problems in Science* (*Zagadnienia Filozoficzne w Nauce*), no. 10.

with Michael Heller and Józef Życiński. Over the years, these seminars evolved into the Center for Interdisciplinary Studies (Trombik, 2019), which had its own journal, namely *Zagadnienia Filozoficzne w Nauce*. The term "philosophy in science" was used to denote the distinctive character of the philosophical topics discussed in his journal. Since the first issue, in addition to its Polish title *Zagadnienia Filozoficzne w Nauce* (1978/1979), also featured on its cover page the English equivalent "Philosophy in Science" (see fig 1).[1]

One article that defined the concept of "philosophy in science" also became a reference for methodological and metaphilosophical discussions about the roles of philosophy in science and of science in philosophy, specifically in Poland. This was Michael Heller's paper titled *Jak możliwa jest filozofia w nauce?* (*How is philosophy in science possible*?) (Heller, 1986).[2] The impact of this article, despite its historic significance, has been limited because the text has only

[1] The same concept of philosophy was also applied in a second journal edited by Heller and Życiński (also co-edited by W.R. Stoeger) entitled *Philosophy in Science*. This journal was also published by the Center for Interdisciplinary Studies (Vatican Observatory and Pontifical Academy of Theology in Kraków) by the Pachart Publishing House (during 1983–2003). The periodical *Zagadnienia Filozoficzne w Nauce* was initially published in Polish, while *Philosophy in Science* was published in English. The current editions of the former periodical are now bi-lingual and cover both the English and Polish versions. The English title, *Philosophical Problems in Science,* is a direct translation of the original Polish title *Zagadnienia Filozoficzne w Nauce.* We keep this name because it reveals an important aspect of this approach, namely a focus on philosophical problems relating to science. The significance of this difference will become clear after reading this paper.

[2] Józef Życiński shared Michael Heller's concept of philosophy in science, but he focused on different aspects. A good example of this distinction is the co-authored article in which Życiński takes many parts of Heller's text verbatim and exposes in them new epistemological aspects of science and philosophy relationships that are not obvious in Heller's original text (Heller and Życiński, 1987).

been available in Polish. Hopefully this publication of an English translation of Heller's article, together with a commentary, will fill this gap.

1. The historical context of Heller's publication

Heller's paper needs to be viewed from the historical context. In sixties of the 20th century, Polish philosophy was entangled in a debate about the concept of the philosophy of science that was later described as counter-productive. The debate was provoked by Kazimierz Kłósak's papers about the traditional neo-scholastic philosophy of nature that were published around this time (Heller, 1995, p.150). Heller considered this debate misguided, however. In his view a new approach to the philosophy of science was needed that would differ from Kłósak's *a priori* method. The new approach also required a name that would differentiate it from older approaches.[3]

Together with Życiński, Heller aimed to create a philosophy grounded in science but harmonized with the Christian faith. This philosophy was supposed to compete with Kłósak's traditional philosophy of nature, and it was conceived as a modern, non-standard interpretation of the *ad mentem St. Thomae* metaphilosophical rule

[3] It is worthwhile noting that Michael Heller used the traditional name of the *philosophy of nature* (*filozofia przyrody*) in the sense of philosophy in science when it does not lead to misunderstandings, and he sometimes used this term in the broader sense of the "philosophical theory of nature." He formulated two necessary conditions that this "theory of nature" must satisfy: "(a) it cannot be a theory that ignores the natural sciences in whatever domain it studies, and (b) it cannot ignore at least the fundamental methodological rules elaborated by the contemporary philosophy of science." The meaning of these requirements is clarified by the following remark: "Violations of the first condition make the given philosophical conception an anachronism; neglect of the second condition threatens methodological anarchy" (Heller, 2011, p.15).

(Leo XIII, 1879). The new philosophy was intended to create a framework for science–religion studies that accounted for the most modern scientific knowledge.

In those years, Krakow, with its tradition of interdisciplinary debates, was a special place for engaging in the philosophy of science. At the center of these disputes was one Karol Wojtyła (Życiński, 1999, p.8nn), who later became Pope John Paul II . He organized and encouraged seminars and informal discussions among scientists and philosophers. Philosophical discussions that were initially rather informal continued with great success at more formal interdisciplinary meetings and seminars. The debates convinced Michael Heller that a new philosophy of science, which he denoted as "philosophy in science", was needed, one that should be founded on the assumption that philosophy must have an interdisciplinary character (Heller and Mączka, 2006, p.50), because it could not exist in isolation from other scientific disciplines. The second assumption, one inspired by positivist philosophy, was that modern science should serve as a tool for clarifying or solving classical philosophical problems (Heller and Mączka, 2006, p.50). However, contrary to positivist philosophy, which perceives classical philosophical problems (e.g., metaphysical issues) as fully reducible to science, the *philosophy in science* proposed by Heller saw these problems as having their own nature, one that transcended scientific methods.

2. Philosophy in science: A metaphilosophical concept

"'Philosophy in science' grew out of practice" (Heller, 2019, p.2): This sentence in the opening paragraph of Heller's paper reveals the

source of this philosophy. The term "practice" may mean two things. It may denote philosophical reflection by scientists on their own research (e.g., philosophizing physicists), or it may refer to the concept of *philosophy in science*, which is a specific mode of philosophical reflection practiced by the philosophers and scientists in the Kraków milieu.

The former interpretation shows that the intuitions and the actual praxis both play equally fundamental roles in *philosophy in science*, and this philosophy should be undertaken with knowledge of hard facts and be enlightened by intuitions. Heller (2011, p.86) pointed out that neglecting scientific results and a lack of scientific intuition led philosophy astray. The former was the source of poverty in the German romantic philosophy of nature, while the latter led neo-scholastics to a false interpretation of the role of St. Thomas Aquinas's philosophy. In the "Introduction" to the *Philosophy in Science* journal, we find the following statement:

> One of the most dangerous movements of traditional philosophy has been its attempt to develop philosophical analyses independently of scientific results. And one of the most hopeless illusions of 19th century science was its desire to replace philosophy by science and to give scientific answers to questions posed by classical philosophy (Heller, Stoeger and Życiński, 1983, p.7). (Heller, Stoeger and Życiński, 1983, p.7).

Grounding *philosophy in science* in scientific praxis was behind Heller's aversion to the formalization of philosophy. Philosophy should take place spontaneously as part of scientific work. One may claim that *philosophy in science* has in fact been practiced from the very beginning of the history of empirical sciences. For example,

looking at Newton's work, it is difficult to determine whether it is of a scientific or philosophical nature, or was it already a form of *philosophy in science* (Heller, 2019, p.4)?

For a long time, Heller avoided publishing any formal declarations or manifestos. He preferred to have tangible results that would speak for themselves (and his philosophy) rather than developing a complete theory. In his view, philosophy could generally be accurately characterized only *ex post,*[4] and any *a priori* claims about philosophy may be misleading and dangerous. He formulated only one necessary condition for practicing *philosophy in science*: "I would only protest against calling some meta-considerations that are not rooted in scientific practice 'philosophy in science"' (Heller, 2019, p.16). This statement could suggest an approval of a chaotic approach to philosophical work. However, a critical assessment of the traditional rigid methodology does not imply methodological anarchy or philosophical *laissez-faire*. Anticipating this interpretation, Heller clearly stated that "developing philosophy in science cannot generate an epistemological chaos" (Heller, Stoeger and Życiński, 1983, p.8). Thus, to correctly understand Heller's idea, we need to keep this declaration in mind.

The supremacy of practical science over purely intellectual pursuits as a source of philosophical insight reveals another facet of Heller's philosophy, namely its evolutionary character. Heller viewed philosophy as being engaged in an endless process of adjusting to science. Science is largely not static, so *philosophy in science* also should not be, because philosophy in science cannot remain blind to what occurs in the sciences. For Heller, the continuous development of philosophy is possible, because he conceived his philosophy

[4] Michael Heller wrote: "I believe, however, that the time has come for an attempt to systematize what *de facto* is 'philosophy in science"' (Heller, 2019, p.2).

as non-foundational.[5] His philosophy is consequently minimalistic in the sense that it, as a rule, avoids the creation of a closed, static, defined, and rigid philosophical system (Heller, 2006b, p.34).

Michael Heller also stressed another metaphilosophical assumption behind *philosophy in science*, namely the possibility for a dialogue between philosophy and science. This assumption led him to reject the "doctrine of non-intersecting planes." The paradigmatic representation of this doctrine was a neo-scholastic philosophy of nature based on Jacques Maritain's concept of separation science from philosophy and theology. This principle, even if it seemed to be more logical or better than the non-separation methodologies, was unable to resolve the conflicts between science and philosophy precisely because of its *a priori* assumed separation. Thus, because of this *a priori* assumption, as well as its heavy historical baggage from its origins in scholastic philosophy, Jacques Maritain's approach to philosophy has been generally criticized and rejected by both philosophers of science and scientists. Scientists, in reaction to the poverty of classical philosophy, attempted to create their own form of philosophy, one inspired by their own scientific practices using their own scientific methods. Unfortunately, these philosophies made by scientists for scientists have been frequently judged by philosophers as being uncritical and sometimes naïve, at least from the philosophical point of view of course. Philosophy in science should be grounded in sci-

[5] In Heller's view, fundationalist philosophy is a philosophy that provides indubitable knowledge, and it is grounded in the incontestable fundamentals (Heller, 2006a). This kind of fundationalism is called *methodological fundationalism* by Heller, because it describes a philosophical method. The methodological fundationalism is opposed by psychological fundationalism, which requires indubitable grounds for knowledge. Anti-fundationalist philosophy rejects incontestable fundamentals and replaces them with hypothetical claims. This type of philosophy could never create a conceptually closed (complete) system. However, this philosophy improves philosophical methodology and clarifies conceptual resources.

entific practice, but at the same time it should be critical and firmly rooted in philosophical analysis. Of course, philosophy in science could not be reduced to just a few such rules, because its scope is largely determined by the ongoing dialogue between philosophy and science.

Heller's text from 2019 outlines three main assumptions of philosophy in science (Heller, 2019, p.4). These are:

(a) The development and evolution of scientific theories should be influenced and informed by philosophical ideas.
(b) The traditional philosophical problems are closely interwoven with modern empirical theories.
(c) Some assumptions in empirical sciences are open to philosophical reflection.

Philosophy in science has been also analyzed in a larger context, namely the epistemological (Heller and Życiński, 1987), methodological (Życiński, 1988), and even axiological (McMullin, 1982; see also Rodzeń, 1999).

While Michael Heller's text laid the foundations for philosophy in science, it left some of its aspects poorly defined. By mentioning Gerald Holton's concept of *themata*, Heller turns our attention to the role of the history of science in philosophical analysis. In Heller's view, the history of science is a rich repository of cases for analyses of the philosophy–science relationship. For Heller, the paradigmatic cases for the importance of history of science in philosophical analysis are Newton's and Leibniz's studies into the concepts of space and time. Taking a lesson from these examples, Michael Heller redefined the fundamental condition of practicing philosophy in science, namely a personal involvement in scientific praxis:

> There are two ways to clarify the intricacies of the empirio-mathematical scientific method: Practice the particular science by yourself or look at the history of science. The second method could be more effective, because it is not restricted to the perspective of a single person, and it enables someone to learn from the best scientists (Heller, 2005, p.156, all Polish quotations are translated by PP).

By drawing on the history of science, a philosopher or scientist can become involved in philosophy in science. Historical studies open up the possibility of dialogue between philosophers and scientists, thus creating an opportunity for historians of ideas, philosophers of science, and scientists to practice philosophy in science. With Heller's seminal works on the role of the history of science in philosophical analysis, detailed studies of the history of science have become the hallmark of philosophy in science at Kraków (Polak, 2018).

3. Is philosophy in science analytical?

The unique character of philosophy in science is revealed in its analytic nature. It is well known that the boundaries between the analytic and other types of philosophy are rather poorly defined, despite the fact that the concept of analytic philosophy is well entrenched in phi-

losophy.[6] Describing analytic philosophy, historians of philosophy frequently use a strategy like the one presented by Aaron Preston (2019):

> Even in its earlier phases, analytic philosophy was difficult to define in terms of its intrinsic features or fundamental philosophical commitments. Consequently, it has always relied on contrasts with other approaches to philosophy. . .

For Preston, analytic philosophy is defined by its opposition to phenomenology, "continental," or "postmodern" philosophy. (It is also frequently separated from pragmatism.) One could also say the same about philosophy in science. The concept of analysis is fundamental for philosophy in science[7] but not at the exclusion of other methods. Heller suggests that while the precise concepts and language of science require the employment of an analytic method, the research methods should be much richer.[8]

The analytical character of philosophy in science could also be attributed to the role played by mathematics in scientific and philo-

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[6] An interesting example is the description of analytic philosophy in Encyclopedia Britannica, which describes it as "a *loosely related set of approaches* to philosophical problems, dominant in Anglo-American philosophy from the early 20th century that emphasizes the study of language and the logical analysis of concepts. Although most work in analytic philosophy has been done in Great Britain" (Preston, 2019). The emphasized fragment of this text shows that analytic philosophy is not defined by their properties. For Keith S. Donnellan, it is rather "a *loosely related set of approaches*" distinguished on the basis of unclear and problematic criteria (mostly historical or intuitive).

[7] "Analytical approach of philosophy of science was conceived as a very important constituent—we would say a necessary precondition—of such research in a new style." (Heller, Stoeger and Życiński, 1983, p.8). (Heller, Stoeger and Życiński, 1983, p.8).

[8] In a later text, Heller stated his view on the role of definitions in this context: They play secondary roles and they could help with analysis, but they are less important than the analysis of mathematical structures. Clarifications could be made only through interpretation of the mathematical structures of the laws of nature.

sophical studies. It is true that philosophy in science employs mathematics in its analyses, but it focuses more on mathematical structures and their roles rather than on the mathematical language itself.[9] Heller explains the relationship between philosophy in science and analytic methods as follows:

> An empirical theory may be—or not—a physical model of some philosophical doctrine: it is its fully objective feature, which may be analysed with the contemporary formal means (Heller, 2019, p.10).

He further explains:

> Analytic philosophy (at least in the field of philosophy in science [filozofia przyrody]) is I consider consequently as a useful tool in philosophical work, but it is not an independent research method (Heller, 1995).

However, the analytic approach of philosophy in science differs from the methods of analytic philosophy proper, at least if analytic philosophy is assumed to exist. The analytic approach of philosophy in science focuses on factual philosophical problems within science rather than on the careful language analysis characteristics of classical analytic philosophy. Philosophy in science could not be developed without using an analytical approach, yet it is not reducible to analytic philosophy. One may therefore ask a rhetorical question: In future, will the analysis of mathematical structures be interpreted as the analysis of language, because mathematics plays the role of the language of science, and according to Heller, mathematics is the best language (or linguistic form) to describe reality?

[9] One of the latest examples is (Heller, 2016).

4. Discovering the role of tradition

The analytical character of philosophy in science is to a large extent rooted in the central European analytic tradition. Some aspects from the analytic tradition of the Lvov-Warsaw School were brought in by Zygmunt Zawirski, a member of this school (Jadacki, 2009). The Polish analytical school of philosophy and philosophy in science has drawn on the traditions of the 19th century Kraków school of philosophy (Polak, 2011) and the works of the Krakow circle for analytic philosophy (Wolak, 2005).

Historical studies have shown significant similarities between the methods employed in Heller's philosophy in science and the philosophy practiced in Kraków before the Second World War, which had its roots in the19th century. With the continuation of late-Enlightenment philosophy, the Kraków Scientific Society (Towarzystwo Naukowe Krakowskie), which later became the Polish Academy of Arts and Sciences (*Polska Akademia Umiejetności*), developed a specific methodology to compete in some aspects with the positivist philosophy that was prevalent at the time. The leading role in this school may be attributed to Józef Kremer, a former Hegelian, who was inspired by his scientist colleagues to create the concept of a non-foundational philosophy of science, traditionally called the "philosophy of nature (*filozofia natury*)" (Polak, 2019). This minimalistic, non-systematic approach focused on scientific problems and methods, having been developed at the onset of the Second World War in 1939.[10] Another center of analytic thinking in the first decades

[10] During Nazi Germany's occupation of Poland (1939–1945), science and philosophy could not develop officially and were banned as a part of Polish culture. Following the Second World War, roughly speaking, communism enforced the "official" Marxist philosophy, and the representatives of other philosophies, especial the analytical, were persecuted. The tradition of philosophy in Krakow could therefore not

of the 20thcentury was that of analytic philosophy in Lwów (Polak, 2016; Woleński, 2019). Of course not everyone in Krakow, or other centers of philosophical studies in Poland, was practicing this philosophy. For example, Franciszek Gabryl and Feliks Hortyński were still adhering to the neo-scholastic philosophy of science.

5. Philosophy in science: The role of an interdisciplinary approach

"Mutual interdisciplinary enrichment" (Heller, Stoeger and Życiński, 1983, p.7). was an important core methodological assumption of this philosophy. The short manifesto opening the first volume of Philosophy in Science declared:

> An interdisciplinary dialog among science, philosophy, and the philosophy of science seems to be the best way to avoid the traditional pseudo-solutions that are often created in the climate of epistemological isolation (Heller, Stoeger and Życiński, 1983).

In Heller's view, philosophy should be "critically sensitive and open to the resources available to it from the sciences and other dis-

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normally develop for some decades. In the long term, however, communism's efforts turned out to be counter-productive. Heller's text is one that appreciates an unofficial philosophy when it became possible. I t is worth noting that creating a new philosophy needs a critical assessment of the existing philosophy. This role was played by Józef Życiński's article that was published in the first volume of the *Philosophy in Science* periodical. This article did not formally fit with the other publications in this volume, and it can be understood only by looking at the local situation in Poland during the early 1980s. A remark from the "Introduction" confirms this interpretation: "Through such case histories, we may hopefully avoid simplistic, uniformed, but often commonly held assessments regarding the encounter between science and philosophy, as well as the pitfalls of the past" (Heller, Stoeger and Życiński, 1983, p.19).

ciplines" (Heller, Stoeger and Życiński, 1983, p.9). The interdisciplinary approach of philosophy in science was further analyzed by Stoeger (1983). He listed, among the other important features of this philosophy, the inclusion of metaphysical problems in the philosophical debate (i.e., problems that cannot be reduced to epistemology or meta-scientific analyses), its evolving character because this philosophy must be both critical and self-critical, and a strong reliance on interdisciplinary cooperation, for which this philosophy seems to be a natural platform. Heller generally agreed with Stoeger. He wrote that "[Stoeger's article] may be considered a manifesto of the editorial board, as well as an attempt to provide a theory for 'philosophy in science"' (Heller, 2019, p.2). However, Heller and Stoeger's visions differed in some small but important ways. For Stoeger and Heller, the goal of the new philosophy was to overcome the divide between philosophy and science, but Heller stressed the need for cooperation between disciplines, something that was not an important factor for Stoeger. He stated that:

> They require interdisciplinary research and thus only one appeal is in place—an appeal for a responsible cooperation between philosophers–methodologists and the representatives of the empirical sciences.

Heller also added:

> Only through expertise in both disciplines can it be guaranteed that "philosophy in science" will not transform into commonsensical (and hence naïve) considerations but instead become a truly creative domain of knowledge. . . " (Heller, 2019, p.16).

When formulating the conditions of this interdisciplinary cooperation, Heller drew on his own experience as a scientist and as the organizer of interdisciplinary seminars in Krakow since 1970s:

> The conditions of this interdisciplinary dialogue are: (1) not just intellectual openness but also a willingness to learn from co-debaters, (2) the aversion of any kind of indoctrination, (i.e., imposing one's own philosophical assumptions on co-debaters) (Heller and Mączka, 2006, p.50). (Heller and Mączka, 2006, p.50).

Confidence in the fundamental role of the interdisciplinary approach of philosophy in science was a heritage of a long tradition in Krakow's philosophy. Since the beginnings of the Krakow Scientific Society (*Towarzystwo Naukowe Krakowskie*) in 1815, philosophical problems were always discussed in cross-disciplinary seminars (Polak, 2019). The interdisciplinary studies continued later in the Polish Academy of Arts and Sciences, as well as in the Polish Copernicus Society of Nature Studies (later the Philosophical Society in Krakow). Michael Heller summarized over 30 years of experience of interdisciplinary dialogue in this sentence:

> This dialogue brought, I dare to say, results better than expected, mainly because it was founded (although initially we were not aware of it), on a rich [intellectual] tradition in Krakow, that goes back at least to the turn of the 19thand 20th centuries (Heller and Mączka, 2006, p.50).

6. Concluding remarks

The notion of philosophy in science is needed to understand the specific nature of the philosophy published in the *Philosophical Problems in Science* (*Zagadnienia Filozoficzne w Nauce*) journal. This philosophy was developed in an interdisciplinary dialogue between philosophy and science. The concept of "philosophy in science" had

its origins in Heller's broad understanding of the philosophy of nature. Michael Heller described it as a new philosophy for the philosophical interpretation of science. The interdisciplinary nature of this philosophy was also at the foundations of research into the relationships between science and religion. The essence of this dialogue lies in the non-isolationist epistemological perspective that philosophy in science takes toward theology (Polak, 2015).

The metaphilosophical foundations of philosophy in science are grounded in the long philosophical tradition of Krakow's philosophy and seem to be very stable. Heller's text could even be interpreted as a renewal of this tradition. After over 40 years, philosophy in science still inspires new research at the junction of science, philosophy, theology, ethics, metaphysics, and even the philosophy of computing and information. Its unique interdisciplinary character, its methodology, and its openness to new avenues of research have proved quite successful in the past and will certainly inspire new studies for years to come.

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The origin and development of the Center for Interdisciplinary Studies. A historical outline by 1993

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Pontifical University of John Paul II in Kraków

Abstract

The paper concerns the origin and early stage of development of the Center for Interdisciplinary Studies at the Pontifical Academy of Theology in Kraków. Center for Interdisciplinary Studies was founded by Michał Heller and Józef Życiński in the late 1970s. It was an informal institution which focused on conducting scientific activity in the area of philosophy of nature, relationship between mathematical & natural sciences and philosophy, history of science, as well as relationships between science and religion. In this paper I would like to present how this institution developed, I will discuss various forms of its activity and present—very generally—what kind of philosophy was promoted by M. Heller, J. Życiński, as well as their pupils and close associates. An important element of the paper will also be presenting the Center for Interdisciplinary Studies as a unique institution, which developed—in difficult historical period in Poland—philosophical research in the spirit of freedom and respect for the new achievements of science, and also promoted interdisciplinary dialogue between scientists and philosophers.

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40 years ago the first issue of journal *Philosophical Problems in Science (Zagadnienia Filozoficzne w Nauce)* appeared.[1] Over the past four decades, the magazine has obtained a reputation in Poland, appearing continuously to the present days. Despite the transformations in science and technology, changing political realities, and sometimes also debatable attempts to modify scientific standards by academic establishment, the journal remained the mainstay of independent and creative thinking in the field of philosophy practiced in the context of modern mathematics and natural sciences. Therefore, there is an opportunity to consider the future of the periodical, and also to summarize and at least provide initially outline the development of the Center for Interdisciplinary Studies (Polish name: Ośrodek Badań Interdyscyplinarnych, OBI), an institution closely related to this journal.[2] Regular publication of *Philosophical Problems in Science (Zagadnienia Filozoficzne w Nauce)* was in fact one of the

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[2] Due to the length of this paper, I will provide the outline of the early period of activity of the Center for Interdisciplinary Studies, illustrate the history of this institution until 1993. The regular organization of interdisciplinary conversations in the form in which they were held since the end of the 1970s, has been stopped this year. Due to the fact, that these seminars had a significant impact on the creation and development of the Center for Interdisciplinary Studies (as will be discussed later in this article), it seems appropriate to adopt this date, symbolically closing the early stage of the Center for Interdisciplinary Studies activity.

key factors of activity of this institution, and the content of individual numbers testified to the area of research interests of the members of the Center, with the founders: Michał Heller and Józef Życiński.

Center for Interdisciplinary Studies operated at the Faculty of Philosophy at the Pontifical Academy of Theology (PAT) in Kraków. PAT was an ecclesiastical university established by pope John Paul II (*motu proprio* "Beata Hedvigis", 1981). In fact, this academic institution derived from the former Faculty of Theology of the Jagiellonian University, erected in 1397, and formally liquidated by a unilateral decision of the communist authorities of the Polish People's Republic in 1954. Despite the decision of the communist government, intellectual traditions in Kraków have survived, as a result of which the former Faculty of Theology has not stopped trying to regain its rights and conducting autonomous activities based on catholic church law. Over the years it has resulted, *inter alia*, in structural changes within the department, caused by the gradual development of the group of philosophers. The efforts of catholic philosophers brought desirable effects, which resulted in the creation of the Faculty of Philosophy, established in 1976, but for various reasons—mainly of a political nature—functioning as a separate scientific unit exclusively from 1981.

The Center for Interdisciplinary Studies was not established as a completely autonomous and ideologically independent institution, devoid of references to important intellectual traditions—the origin and initial development of Center can even be considered in the context of the specificity of the Kraków scientific milieu, including the philosophers associated with the Faculty of Theology of the Jagiellonian University. So, before I begin to discuss the first stages of the

Center's development, I will briefly present how the interdisciplinary tradition in Kraków was born and shaped in the period preceding the initiatives of M. Heller and J. Życiński.

1. Interdisciplinary traditions in Kraków – from S. Pawlicki to K. Wojtyła

Due to historical reasons, Kraków can be considered as the place of the greatest philosophical traditions in Poland. These traditions were also cultivated and developed by the Faculty of Theology of the Jagiellonian University. Christian philosophy was developed for several centuries in this Faculty, although its rapid development when encyclic "Aeterni Patris" by pope Leon XIII was published in 1879. Then, the pioneer of modern philosophy in Kraków became Stefan Zachariasz Pawlicki, who was the first scholar appointed in 1882 to the head of the Department of Christian Philosophy at the Faculty of Theology at the Jagiellonian University. Pawlicki turned out to be one of the most important Polish philosopher of the second half of the 19th century, who tried to develop modern, non-thomistic philosophy based on the models taken from ancient philosophy and acceptance of modern science results (Polak, 2017b).

Another philosophers of the Department of Christian Philosophy—the neoscholastic philosopher of nature (Franciszek Garbryl), historian of the philosophy (Konstanty Michalski) or famous logician, representative of the Kraków Circle (Cracow Circle) (Jan Salamucha), laid the foundations for the philosophy trying to show a coherent image of the broadly understood modern culture and faith. Parallel to their activities, Kraków's philosophy also developed among non-scholastic scientists and philosophers. These

scientists were interested in philosophy, although many scholars at that time shared the opinion of the positivists, questioning the cognitive value of the philosophical reflection on nature. Meanwhile, in Poland, especially in Kraków, even in the interwar period (1918-1939), the philosophy of nature had its representatives who addressed specific issues for it, e.g. during the Polish Philosophical Conventions (Polskie Zjazdy Filozoficzne). It should be noted, however, that the Kraków milieu—starting from the initiatives of Władysław Heinrich and Maurucy Straszewski—stressed the development of interdisciplinary dialogue between scientists and philosophers. Philosophical issues were mainly taken up in the context of formal sciences, physics, biology and psychology. Concepts and propositions developed at that time are considered to be crucial in the development of the Kraków philosophy of nature (Heller and Mączka, 2007; Mączka, 2007; Polak, 2018b).

After the Second World War (1945), Polish philosophers faced the challenges of Marxist ideology. In that difficult period of the Polish history, Kazimierz Kłósak and Tadeusz Wojciechowski were active in the field of philosophy of nature in Kraków[3]. They tried to develop the philosophy of nature in the neoscholastic context (methods, terminology etc.). However, they differed from orthodox thomists, because they attached more importance to the achievements of natural science, trying to reconcile new scientific theories with classical philosophy. As a result, they become key representatives of "open thomism" in Poland.

The intellectual efforts of these philosophers coincided with the activity of Karol Wojtyła in Kraków. Already in the 1950s, Wojtyła readily participated in informal discussions among physicists from

[3] Both, Kłósak and Wojciechowski were philosophers from Faculty of Theology in Kraków.

the Jagiellonian University. Over time, these meetings began to take on a more organized form, which favored the exchange of ideas between Kraków's philosophers and scientists. The year of 1963 was important, because Wojtyła was appointed a Kraków bishop. He quickly began to develop the local milieu, initiating a series of interdisciplinary events. One of this event can be mention here, for example, the philosophical symposium devoted to the analysis of the kinetic point of departure and the teleological argument for the existence of God, which took place in the residence of Cardinal K. Wojtyła in Kraków (January 10-11, 1968), and in which participated scientists from Faculty of Theology in Kraków, Academy of Catholic Theology in Warsaw (Akademia Teologii Katolickiej w Warszawie) and Catholic University of Lublin (Katolicki Uniwersytet Lubelski), as well as professors and professors of physics and biology from the Jagiellonian University.[4] Among the speakers were: K. Kłósak, J. Iwanicki, S. Kamiński, M.A. Krapiec, M. Lubański, A. Stępień, S.J. Zdybicka, Sz. Ślaga, B. Bejze, et al.. Scientist were represented, among others, by S.J. Twarowska, L. Balczewski, Z. Chyliński, J. Janik.

Scholars and philosophers meeting was not the only such event in Kraków in this period. Wojtyła initiated further symposia—thanks to that, philosophy continued to develop in the spirit of interdisciplinary cooperation. One can mention in this context the symposium, which was held on January 9-10, 1970 in the archbishop's residence of Cardinal Wojtyła. The participants of the event were professors and lecturers of Catholic universities in Poland and scientists from the Jagiellonian University, mainly physicists, though there were also philosophers—an active participant was, for example, Roman Ingarden (Heller and Mączka, 2006). During the meeting a few topics

[4] Extensive report from this event, see (Morawiec, 1968).

emerged in the field of natural philosophy, including metaphilosophical question concerning the way of doing the philosophy in the context of modern scientific knowledge. The problem of theory of philosophy of nature was discussed, especially the issue of the language of this discipline in the context of terminology used by physicists. The symposium was interdisciplinary and constituted another attempt to maintain the Kraków ambience of cooperation between philosophers and scientists. Cooperation, which did not always bring results in the form of working out a common position of scientists and philosophers. Michael Heller, who participated in the symposia initiated by Wojtyła, mentioned, for example, that "one of the philosophical lectures rose up one of the physicists and said to the speaker: 'I don't understand this'. You must know that in the physicists language the sentence 'I don't understand this' means that it is impossible to understand, that this is nonsense. But the philosopher did not know the habits of physicists and began to explain again what he meant. It struck me then that the languages spoken by them are so divergent" (Heller, Bonowicz et al., 2016, pp.227–228).

M. Heller was a young philosopher at the time and he has just begun his academic career in Kraków. Although he was associated with the local community earlier, he was officially employed at Faculty of Theology in 1972. His activity in Kraków was also related to the efforts of K. Wojtyła, who tried to develop the scientific and didactic facilities of Faculty of Theology (since 1974 Pontifical Faculty of Theology) related to the philosophy of nature. Shortly after, Józef Życiński (K. Kłósak's pupil) became a close associate of M. Heller.

Heller and Życiński got to know each other at the beginning of the 1970s, but they started a more profound cooperation a few years later, when Życiński was preparing his doctoral dissertation (Heller, Bonowicz et al., 2016, p.230). Heller was in that time a philosopher

with considerable scientific achievements, who was not interested in developing the traditional, neoscholastic philosophy of nature. In contrast to the thomists, he emphasized to identify the philosophical problems in the sciences and then analyze them using methods of contemporary logic and science. He was looking for inspiration to work in the field of philosophy in natural science, not in closed philosophical systems (Polak, 2019). It is not excluded that the space of dialogue and freedom of scientific research promoted by Wojtyła favored the development of the philosophical views of Heller and Życiński, who wanted to maintain a dialogue between science and philosophy. In such circumstances, the idea of organizing interdisciplinary seminars arose.

2. Development of the Center for Interdisciplinary Studies

Interdisciplinary seminars were initiated by M. Heller and J. Życiński in the autumn of 1978. These meetings between philosophers and scholars inaugurated the activity of the Center for Interdisciplinary Studies, which aimed to conduct research in the field of philosophy of nature, philosophy and history of science, the relationship between science and religion, etc. The seminars organized by M. Heller and J. Życiński in Kraków referred to the earlier initiatives of K. Wojtyła.

Starting from the first seminar on October 27, 1978, many scientists participated in the meetings organized by M. Heller and J. Życiński—not only philosophers and theologians, but also biologists, physicists or mathematicians—who discussed problems arises on the borderline of philosophy and science, faith and art. Speakers and listeners met initially at Franciszkańska 3 street on the first Friday after

the fifteenth day of each month, and when the group of participants began to grow (lectures were heard by up to 200 people sometimes), meetings were moved to the Augustinian monastery at Augustiańska street. Despite the poor conditions, lack of financial resources and official statutes, and at the same time against the reluctance of state authorities to the Church, the philosophical milieu at Pontifical Faculty of Theology developed extremely well, with its initiatives acting as a "clear primacy of the spirit over matter" (Skoczny, 1999, p.13). According to Włodzimierz Skoczny, a deponent of those meetings, "the ability to not notice shortcomings, and only to notice the positives has been perfected by the participants. Indeed, it is difficult today to reflect the unique atmosphere of those days. Something imperceptible hovered in the air, something that had a taste of self-denial, friendship and Truth" (Skoczny, 1999, p.15; see also Życiński, 1999).

The seminars were organized in two thematic series: "Science—Faith" (1978-1991 and 1992-1993) and "Science—Philosophy—Art" (1983-1985). The first meeting in October 1978 was opened by M. Heller and J. Życiński.[5] Over time, the seminars began to gather speakers representing other scientific centers, also from outside Poland.[6] In the mid of 1980s, the meetings organized by M. Heller and J. Życiński were permanently included in the calendar of important scientific initiatives in the country. The lectures were given primarily by physicists and astronomers, among others: Andrzej Staruszkiewicz, Konrad Rudnicki, Zygmunt Chyliński, Jerzy Rayski, Carl Friedrich von Weizsäcker, Bronisław Średniawa, Jan Mozrzy-

[5] M. Heller gave a lecture entitled „The problem of extrapolation in theology" („Problem ekstrapolacji w teologii"), in turn J. Życiński—"Contemporary tendencies in the philosophy of science" („Współczesne tendencje w filozofii nauki"), see (Liana and Mączka, 1999, p.133).

[6] E.g. Ch. W. Misner, J. Dougherty, W. Greenberg (USA), E. Barth (Netherlands), M.A. McCallum (Great Britian), L. Michel (France).

mas, Jerzy Janik, Charles W. Misner, Andrzej Fuliński, Leszek M. Sokołowski, Małgorzata Głódź. Despite the significant advantage of papers in the field of physics and the philosophy of inanimate nature, as part of the seminars lectures were also delivered by mathematicians (including Krzysztof Maurin, Stanisław Krajewski), chemists (Zbigniew Grabowski) and philosophers (including Jan Woleński, Stefan Amsterdamski, Barbara Tuchańska). The subject matter of the presentations coincided with the interests of M. Heller and J. Życiński: lectures devoted to philosophical problems in physics, relationship between science and religion, fundamental problems of the philosophy of mathematics, there were also presentations addressing contemporary issues of the philosophy of science. Philosophy of biology generally played a smaller role—over several years only a few papers devoted to the topic of the origin and evolution of life were declaimed.[7]

In later years, seminars were held with less regularity, however, still attracted many interested scholars who could participate in discussions on current problems occurring at the borders of science and philosophy or science and religion. Guests representing other research centers from Poland and abroad continued to appear (including A. Plantinga, S. Desjardinis, L. Kostro, and E. Mickiewicz), which allowed to strengthen Center's position on the national and international arena. In 1990, the continuation of the seminars was stopped for some time, and then returned in 1992-1993 at Jagiellonian University. At that time, several meetings took place, initiated by M. Heller and the physicist and philosopher Andrzej Fuliński. Af-

[7] It is worth mentioning at this point that also the seminar entitled "Science-philosophy-art" (although some sources give a different title: "Art-religion-science", initiated in May 1983, was very popular. The first session was attended by 130 participants. It is noteworthy that scientists such as K. Maurin and Z. Chyliński also declaimed their papers as part of the seminars.

ter 1993, the idea of interdisciplinary meetings was no longer carried out in the same scope as before, and the role of seminars was taken over by the Methodological Conferences, organized annually.

The seminars organized by M. Heller and J. Życiński resulted in the creation of the periodical *Zagadnienia Filozoficzne w Nauce* (now entitled *Philosophical Problems in Science*)—the first strictly philosophical journal published by Pontifical Faculty of Theology in Kraków. The first issue of this journal appeared in 1979 and contained eight articles. The journal, edited by M. Heller and J. Życiński as a yearbook, initially contained primarily materials delivered as part of the seminars, although there were also content independent of the Kraków's meetings.[8] From the first issue, the journal was focused on publishing papers from the frontiers of philosophy, formal and natural sciences. An important part of the magazine were reviews of the scientific books, those published in Poland and abroad. Philosophers and representatives of other scientific disciplines, interested in broadly understood philosophical issues, published in this journal. Already in the first issues of the magazine, there were also translations of well-known scholars, including A. Einstein or K.R. Popper. The scope of the journal reflected the research interests and

[8] Publishing of this periodical was initiated by M. Heller together with J. Życiński for two reasons. First, both philosophers wanted to create their own independent journal on philosophy and science. The second reason was practical—people who delivered papers as part of interdisciplinary seminars gave M. Heller and J. Życiński texts that formed the basis of their lecture. There was, therefore, a need to publish the texts of the speeches, although it was not possible to obtain official permission from the authorities to publish the periodical. *Philosophical problems in science (Zagadnienia Filozoficzne w Nauce)* appeared, therefore, as *samizdat* (Heller, 2017). *Samizdat* (Russian origin word, coined from *samodielnoje izdatielstwo* or *sam izdaju*, means "self-publish") was a clandestine print, published as a form of dissident activity in countries where communist censorship was active. Samizdats were non legal and not allowed to be distributed, therefore individuals reproduced underground publications and passed them from person to person.

approach to practicing philosophy that began to emerge in Kraków in the vicinity of M. Heller and J. Życiński. This is especially visible in relation to other periodicals in the field of natural philosophy issued by catholic centers in Poland—in relation to the series *Z zagadnień filozofii przyrodoznawstwa i filozofii przyrody* (Warsaw) published by K. Kłósak, or journal *Roczniki Filozoficzne* (Lublin), the Kraków periodical distinguished a greater focus on contemporary philosophy of science (especially the philosophy of physics) and a departure from taking classical problems in philosophy in the context of the methods and language of the neo-thomist philosophy of nature.

M. Heller and J. Życiński were focused on developing an interdisciplinary milieu also outside the Poland. An expression of progressing internationalization was creation of the English-language equivalent of *Philosophical Problems in Science (Zagadnienia Filozoficzne w Nauce)* published in Polish in that time. From 1983, the Center for Interdisciplinary Studies began publishing the journal *Philosophy in Science* in cooperation with the Vatican Observatory and the Pachart Publishing House in Tucson.[9] The editors of the newly created periodical were M. Heller (affiliated to the PAT and the Vatican Astronomical Observatory), J. Życiński (PAT) and William R. Stoeger SJ (Vatican Observatory). The publisher of the magazine was a Polish

[9] It is noteworthy that on the front-page of the magazine the name "Center for Interdisciplinary Studies" was mentioned as the organization initiating the publication of this periodical. This proves that the Center for Interdisciplinary Studies was already an organization operating in the field of science and cooperating with other research institutions.

astronomer living in the USA Andrzej G. Pacholczyk (University of Arizona), founder and chairman of the Pachart Foundation and director of Pachart Publishing House.[10]

The aims of the editors of this periodical were convergent with the philosophical program of M. Heller and J. Życiński. The main task was to develop an interdisciplinary dialogue between science and philosophy, especially the contemporary philosophy of science (Heller, Stoeger and Życiński, 1983, p.8). The journal was conceived as a forum for discussion of philosophical issues emerging in the natural sciences. The article that opened the first issue of the magazine was W. G. Stoeger's text entitled "The Evolving Interaction Between Philosophy and the Sciences: Towards a Self-Critical Philosophy", in which author argued that contemporary philosophy must be internally open to changes generated by scientific achievements. In this sense, the constant nature of self-criticism should be inscribed in the nature of philosophy (Stoeger, 1983, pp.39–43). Interestingly, this view was supposed to be a sort of editorial program, and the article itself was considered one of the first attempts at the theory of "philosophy in science" (Heller, 1986, p.7; Heller, 2019, p.2).

The journal *Philosophy in Science* was not the only manifestation of the opening of Kraków philosophers to the foreign audience[11]. Although the Center for Interdisciplinary Studies operated at the Faculty of Philosophy of the Pontifical Academy of Theology in Kraków, M. Heller and J. Życiński also cooperated with the Vatican Observatory at Castel Gandolfo. Thanks to this cooperation, the organization of an international session was possible. On May 24-25,

[10] A few years later, the editors of *Philosophy in Science* started to publish the book series *Philosophy in Science Library*, in which philosophical works of M. Heller, A.G. Pacholczyk, Józef Życiński and G. Tanzella-Nitti were published in English.

[11] Five volumes of this periodical had been published by 1993. Unfortunately, currently the magazine is not published—the last, 10th issue appeared in 2003.

1984 the English-speaking symposium "The Galileo Affair: a Meeting on Faith and Science" took place in Kraków. Many scientists and philosophers from outside Poland actively participated in this conference (W.A. Wallace, J. Dietz-Moss, J. Casanovas, G. Coyne, O. Pedersen, U. Baldini, F.M. Hetzler, P. Mitra), and also scholars representing native universities (apart from M. Heller and J. Życiński, speeches were given by M. Lubański, J. Dobrzycki, and K. Rudnicki). The symposium was also to be attended by P. K. Feyerabend, but finally he did not appear in Kraków.[12] Individual sessions were held in the archbishop's palace, made available by Cardinal Franciszek Macharski, as well as in the rooms of the Faculty of Philosophy of the PAT at Augustiańska street and the Collegium Maius at Jagiellonian University (Skoczny, 1984).

It should be noted that the symposium was organized in connection with the anniversary of the Galilean trial. For philosophers of nature from the PAT, it was also an opportunity to take up issues that coincided with the interests of the local environment—the history of science and the issue of the relationship between science and faith are key research areas of philosophers and scientists from the circles of M. Heller and J. Życiński. Finally, the symposium was a great opportunity to manifest the existence on the international academic map of PAT as a scientific center in which advanced research in the field of philosophy is conducted. The event turned out to be an organizational success, which was confirmed by W. Skoczny, writing about the atmosphere of "full care of the hosts and unconcealed admiration from foreign guests. For many of them it was the first meeting with Poland, which although poor in material means, was able to fascinate people" (Skoczny, 1984, p.73). However, since the symposium

[12] P. K. Feyerabend was represented in Kraków by his co-worker I. Sieb-Madeja, who recreated the contents of a paper by an Austrian philosopher from a tape recorder.

was organized by an illegal university—from the point of view of the Polish authorities at the time—post-conference materials could only appear as samizdat, in this case issued in cooperation with Specola Vaticana (Coyne, Heller and Życiński, 1985).

In the following years, the Center for Interdisciplinary Studies organized many scientific conferences, as well as national and international symposia. In the years 1987-1993 Center organized: international symposium "Newton and the New Direction in Science" (1987) , the conference "Why is nature mathematical?" ("Dlaczego przyroda jest matematyczna?", 1989), the international conference "Universals and Particulars in the Context of Modern Science" (1990) , conference "Relationships between science and religion in catechesis. Problems of biological evolution" ("Relacja nauka—wiara w katechezie. Problematyka ewolucji", 1991), international conference "Theology, Philosophy and Cosmology: On West and East "(1991), symposium "Cosmos and philosophy" ("Kosmos i filozofia", 1992), scientific session "Theology and science from ancient to the Renaissance" ("Teologia a nauki od starożytności do renesansu", 1993). Many scholars outside Poland participated in these events, like W. B. Dries, S. Jaki, J.D. Moss, M. Novak, D. Park, O. Pedersen. The associates of M. Heller and J. Życiński actively participated in the organization of scientific meetings: W. Skoczny, A. Michalik, Z. Liana, J. Mączka, A. Fuliński. Post-conference materials appeared after almost every scientific event organized by Center.

Surprisingly, despite the difficulties presented by the government, activity in the field of publishing turned out to be an important element of the Center for Interdisciplinary Studies. M. Heller and J. Życiński also cooperated in this field and published common books in early 1980s by the Polish Theological Society (Polskie Towarzystwo

Teologiczne) in Kraków[13]. Although the beginnings were modest, in later years the publishing activity of Center was much greater—books and scripts signed with the name of this research institution or issued in cooperation with other publishing houses were published regularly every year (e.g. Heller, Michalik and Życiński, 1987; Coyne, Heller and Życiński, 1988; Heller, Życiński and Michalik, 1990; McMullin, 1990; Heller, Skoczny and Życiński, 1991; Wolak, 1993).

The early process of development the new approach to practicing the philosophy of nature in PAT was also related to the scientific activity of students of M. Heller and J. Życiński. The diploma thesis of students concerned the topics related to the research interests of the creators of Center, i.e. contemporary problems of philosophy of nature, philosophy of science, philosophy of language and the relationship between science and religion.[14] It is significant that the first doctorate defended at the Faculty of Philosophy of the PAT in January 1983 was prepared under the supervision of M. Heller. The dissertation entitled "Strukturalne relacje między językiem, myśleniem a rzeczywistością" ("Structural relations between language, thinking and reality") prepared by Krzysztof Turek received positive reviews of J. Życiński and M. Lubański, and its author became the first doctor

[13] (Heller and Życiński, 1980; 1983). M. Heller commented the way of making common books: "The method of writing was such that we first made a rough plan of the book and then shared it—this chapter is written by me, this one by you. We didn't write together, but after we wrote the chapters, we read them to each other and made minor adjustments. When you take our books in your hand, you can immediately see who wrote which chapter, because the style of each of us is different (Heller, Bonowicz et al., 2016, p.231).

[14] Various aspects of the Center research activities have already been discussed (see e.g. Krauze, 2008; Mączka, Skoczny et al., 2012; Skoczny, 2012).

appointed by the authorities of the newly established university.[15] In the initial period of the Faculty of Philosophy of the PAT, the bachelor's thesis—based on the work "Argument kinetyczny za istnieniem Boga w ujęciu K. Kłósaka" ("Kinetic argument for the existence of God in K. Kłósak's concept")—in turn, a student of J. Życiński, W. Skoczny. The interest in the problem of philosophy of physics was continued by W. Skoczny in his doctoral dissertation from 1986, entitled "Filozoficzne aspekty zasady antropicznej" ("Philosophical aspects of the Anthropic Principle").[16] In the same year, Z. Liana graduated the title of MA in philosophy[17], and the canonical licentiate was obtained by J. Dadaczyński[18]—another students of J. Życiński, who will become permanently associated with Center and PAT in the following years.[19] Over the years, a group of students gathered around

[15] PhD defense was preceded by the publication of two articles in *Philosophical Problems in Science (Zagadnienia Filozoficzne w Nauce)*: (Turek, 1978; 1981). Recently, these works met with interest and were analyzed (Krzanowski, 2016).

[16] W. Skoczny's article was related to the subject of his doctoral dissertation (Skoczny, 1985).

[17] The Master's thesis prepared by Z. Liana was entitled: "Rola matematyki w poznaniu naukowym w ujęciu Rene Thoma" ("The Role of Mathematics in Scientific Knowledge from the Rene Thom's Point of View").

[18] Canonical licentiate was awarded owing to dissertation entitled "Problem racjonalności teizmu chrześcijańskiego w *Neues Glaubensbuch*" ("The problem of rationality of Christian theism in Neues Glaubensbuch's view"). Paper related to this dissertation see (Dadaczyński, 1984).

[19] It is worth mentioning here that the academic degrees awarded by the PAT were not acclaimed by the state authorities at this time. It happened that doctoral students defended dissertations at other universities. For example: Jan Woleński, then associated with the Jagiellonian University, became the promoter of Krzysztof Gurba, who defended his dissertation entitled "Methodological aspects of the representation of linguistic knowledge" in 1986. This dissertation was created at the seminar of J. Życiński, although his defense took place at the Jagiellonian University (Woleński, 2017).

M. Heller and J. Życiński began to grow.[20] Academic degrees were soon obtained, among others, J. Dembek, J. Mączka, A. Olszewski, T. Sierotowicz, Z. Wolak, W. Wójcik.

The early development of the Kraków philosophical circle reminds, in some respects, the early stage of the Lvov milieu around Kazimierz Twardowski, from which the Lvov-Warsaw school emerged. Why do I make such an analogy? As in the case of the Lvov-Warsaw school, one can point to the factors determining the intellectual formation of the trend, which I would call initially the Kraków school of "philosophy in science": the genetic factor (activities of M. Heller and J. Życiński), geographical factor (scientific activity in Kraków), temporary (development in the 1980s and 1990s) and substantive[21] (although students of M. Heller and J. Życiński conducted research in various fields—such as philosophy of nature, philosophy of science, logic, philosophy of mathematics, history of science, and Polish philosophy of nature—it combined their conviction, taken from their teachers, that philosophy should be practiced in a strict, critical way and in connection with the scientific and methodological knowledge, which at the same time does not exclude possible references to metaphysics and Christian theology). These criteria for belonging to the "philosophical school" obviously do not have

[20] It is worth mentioning that students and collaborators of M. Heller and J. Życiński undertook many initiatives to build unity and develop the scientific community in Kraków, e.g. they prepared reports on the activities of interdisciplinary seminars, discussed important academic events or undertook initiatives aimed at reaching agreement between various currents philosophies practised at the Pontifical Academy of Theology, see e.g. (Michalik, 1984; Głódź, 1987; Samborski and Wójcik, 1987; Liana, 1989; Dembek, 1990; Wolak, 1992; Samborski and Wójcik, 1992; Wolak, 1993).

[21] According to Woleński, all these four factors (genetic, geographical, temporal and factual) were to determine the intellectual formation of the Lvov-Warsaw school (Woleński, 1985). It is debatable whether these criteria are not too broad, considering also the difficulty of clearly defining what a "philosophical school" is.

to be exhaustive; however they suggest the existence of a specific, still developing intellectual community in Kraków, which stands out in comparison with other philosophical trends in Poland and abroad with a specific approach to analyzing philosophical issues that appear in the mathematical and natural sciences (Heller, 1986; Heller, 2019).

3. Summary and research perspectives

The Center for Interdisciplinary Studies played a key role in developing the academic dialogue between science and philosophy in Poland, and the range of its initiatives extended far beyond the local context. M. Heller and J. Życiński proved to be not only continuators of intellectual traditions, developed in Kraków from at least the second half of the nineteenth century (Polak, 2013), but also proposed their own original scientific attitude, which involved a number of research initiatives in the area of relations between science and philosophy, as well as science and religion (Polak, 2019). Large-scale publishing and organizing activities turned out to be a unique phenomenon on a national scale, and we can still use the fruits of M. Heller and J. Życiński's labor to this day.

It should be noted that the organizational activity of M. Heller and J. Życiński has not yet been sufficiently examined in terms of historical and philosophical aspects, including the political context and in reference to the activity of other scientific centers in Poland and abroad. Undertaking such research seems justified—they could show and emphasize the specificity and originality of Center on the national and international background, while providing answers to the question of the role played by this institution in upholding a reli-

able scientific discussion at a time when the ideal of interdisciplinary cooperation was not yet so common, and in some places—such as Poland—was even treated by the authorities as undesirable.

Certainly, it is also worth considering whether the history of the Center—along with its later face in the form of the Copernicus Center for Interdisciplinary Studies—no longer deserves a book study. 40 years of activity in the field of science, organization and publishing is a extensive material for historical analysis, in which one could also take into account the large-scale activity of students and associates of M. Heller and J. Życiński. Considering the significance and scope of the Kraków interdisciplinary environment in Poland and abroad, it would be important not only from the scientific point of view, but also for the promotion of Kraków as a special place in Poland, where interdisciplinary intellectual traditions are still successfully nurtured and developed.[22]

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[22] An example of the creative development of ideas initiated by M. Heller and J. Życiński is, among others, conducting research in the area of the so-called theology of science (Mączka and Urbańczyk, 2015), philosophy of computer science (Polak, 2016; 2017a; 2018a; Krzanowski, 2017), methodological aspects related to the language of theology (Olszewski, 2018) or evolutionary theology (Grygiel, 2018).

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