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THEORY AND PRACTICE IN SCIENCE – PHILOSOPHICAL PERSPECTIVE

Abstract: Modern science is deductive at the starting point. This means that the scientist is free to create hypotheses that must then be confirmed experimentally. The abandonment of the inductive approach has caused the problem of the transition from thought to reality. Existential Thomism is an example of criticism of this deductive approach to science. It seems, however, that the return to induction is impossible, because from the level of observation it is no longer possible to draw general conclusions regarding e.g. nature. General conclusions can be made on the basis of mathematics. This, however, makes reality too complicated for any scientific theory to fully explain it, which accords with the Thomistic notions that starting with thinking one cannot come to reality. Gödel's theorems confirm this Thomistic approach. We find ourselves in a situation where both induction and deduction are insufficient to find the truth, unless we give up mathematics, without which it is difficult to speak of any sciences other than philosophy and theology. We are doomed to constant confrontation between theory and practice.

Keywords: theory, practice, Gödel's theorems, mathematics, induction, deduction.

The history of human thought revolves around a problem that dominated philosophy, especially after Descartes, namely: how to go from thought to reality? Can the theoretical be put into practice? However, the debate over theory and practice lasts much longer. Aristotle was the first to divide into θεωρία and πράξις. Boethius took this division from the Stagirite[1] and fixed it in Christian thought. "Theoria" was a symbol of speculative theology, and "praxis" is practical knowledge relating de facto to moral philosophy. While in the Middle Ages this division into "theoretical sciences" and "morality" made sense, as theology was the queen of sciences and played the role of a "keystone of the system", the division of sciences in modern times led to a change in the perception of what is theoretical and

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[1] D. Radziechowski. *Analiza „theoria" i „praxis" drogą do identyfikacji „humanum" (Boecjusz, Wojtyła)*. „Studia Theologica Varsaviensia" 2010 nr 48/2 p. 165.

practical. Speculative sciences are now translated into practice, and experimental sciences are changing the theory. Ethics, on the other hand, no longer seems to be merely a practical field, as the challenges of technological development make ethical considerations extremely speculative. This text aims to show a holistic approach to theory and practice, i.e. one where a rigid division between them is not of great importance. The article also shows the dangers resulting from the lack of full compatibility between theory and practice. The theory does not fully cover the reality it describes, and what it does not perceive can lead to practical problems, including in the economy.

1. HUMAN THOUGHT AND REALITY

The problem of mutual relation between thought and the world arose from the time of Descartes. He is called the father of modern philosophy. He doubts the reliability of the senses when it comes to certain knowing, because

> […] everything that I have believed to be the most true so far, I have received from the senses or through the senses; I have found, however, that these fail me sometimes, and prudence dictates that I should never fully trust those who have failed us at least once[2].

Descartes broke with the philosophical achievements of the past centuries. This can be seen in his approach to the scientific method, where the followers of Aristotle postulated the creation of as many methods as there are sciences dealing with different objects of cognition, while Descartes argued that one method is sufficient because there is only one type of science[3]. Descartes' reasoning can be imagined as a tree whose root is metaphysics, the stem is physics, and its branches are other sciences, all the sciences, starting with metaphysics, linked by logical implications that are *a priori*[4].

Descartes, by postulating one scientific method, comes close to monism, because the use of one method presupposes a logical continuity between sciences based on one fundamental ontological principle[5]. Thus, by dealing with the way of knowing the world, Descartes determines the way of existence of reality. However, he distinguishes *ordo cognoscendi* from *ordo essendi*. In the order of being, God is first, but in the order of knowing, one's own existence is first[6]. It is the result

[2] R. Descartes. *Medytacje o pierwszej filozofii wraz z zarzutami uczonych mężów i odpowiedziami autora oraz Rozmowa z Burmanem*. Tłum. M. i K. Ajdukiewiczowie. T. 1. Warszawa 1958 p. 21.

[3] F. Copleston. *Historia filozofii. Od Kartezjusza do Leibniza*. Przeł. J. Marzęcki. T. 4. Warszawa 2005 p. 61.

[4] Ibidem p. 62.

[5] Ibidem.

[6] Ibidem p. 68.

of methodical cognition which, by rejecting sense cognition by discovering a sure principle upon which to build a philosophy, comes to discovering one's own self as something unmistakable and hence the famous *Cogito, ergo sum*. Therefore, if one's own existence is first in the cognitive order, then the problem of the so-called the gnoseological bridge: in order to have no doubts about the existence of material things, we must first prove the existence of God, and this is dependent on knowing ourselves as a thinking subject[7]. Thus, it is man through thinking that the existence of the material world exists, but if a man asks himself about the possibility of knowing the world without referring to it, he will never go beyond his own thinking, because there is nothing that could constitute a transition from thought to the real existing world[8].

The relationship between thought and the world was blurred by Descartes, and therefore the relationship between theory and practice as well. What is practical should be related somehow to "real reality" and not to the world of thoughts. Mieczysław A. Krąpiec showed that there is no such transition that would connect the world of thoughts with the world of things. He wrote:

> […] the erroneous, unreal «starting point» which is to be «pure thinking», and thus cogito understood in one way or another – both Cartesian and English empiricists, such as Kant, and finally Fichte or Hegel and contemporary phenomenology. There is no transition from the analysis of thinking and mental content to the real world. And so far – in the history of philosophy – no one has actually managed to make such a «transition»; no one has yet refuted the claim that *a nosse ad esse non valet illatio* («there is no transition from know to be»). This is made impossible by the very nature of human thought, which is real, only reality and the existence of a thinking man who is incapable of «knowing – creating» and granting factual existence to beings he thinks[9].

And yet, it seems Descartes might have been somewhat right.

It is true that man cannot think to create, but our thought is more related to reality than we think. The history of science shows that its development was possible because it broke away from reality. Contrary to what Krąpiec claimed, it is possible to find a transition from thought to reality. However, this transition is subject to conditions and inaccuracies. These conditions are mathematics and experiment. Inaccuracy is a very large inadequacy of scientific hypotheses to describe reality. And here Krąpiec is right – it is impossible to build a scientific theory that would fit the reality one hundred percent. Moreover, theories become less and less relevant to reality over time. Thus, through mathematics, human reason

[7] Ibidem p. 75.

[8] M.A. Krąpiec. *Poznawać czy myśleć. Problemy epistemologii tomistycznej*. Lublin 2000 p. 212.

[9] Ibidem.

is able to bridge the bridge between thought and reality, but it is burdened with a very large inaccuracy.

2. THE NATURE OF MATHEMATICS

Mathematics plays the role of this "gnoseological bridge". Its nature is a question of interpretation. In principle, the following question can be asked: is mathematics a human invention or is it a human discovery from reality? The Thomistic approach shows that mathematics is abstracted, that is, literally "detached" from reality. Everything that is included in mathematics somehow relates to reality. The non-Thomistic approach indicates that mathematics can be "pure" and unrelated to reality. An additional difficulty arises here: where, then, does mathematics exist and what does it describe? There are two possibilities here: either in our minds or in the world of ideas. I believe that mathematics is not "Thomistic" but also not just "pure". It's somewhere in between. Mathematics connects the human mind with nature. It is not known how this happens, sometimes this connection works and usually doesn't.

In practice, it turns out that in most cases theories that include mathematics are incompatible with reality. This incompatibility was expressed in Gödel's Incompleteness Theorem. They can be expressed as follows:

> If an axiomatic theory includes the arithmetic of natural numbers and is not contradictory, it is not complete[10].

Basically, it can mean two things: 1) either the mathematics used to describe material reality is not adequate because its place of existence is the world of Ideas, 2) or material reality is more complicated than mathematics and our "simplified" mathematical models are insufficient.

At least the latter option has been proven. In practice, it turns out that reality is too complicated for mathematical models. There are many theories that need to be corrected over time. The process of developing and replacing theories with more adequate ones was described by Imre Lakatos, Larry Laudan, Karl Popper and Thomas Khun, among others. Each theory has a hard core and a protective belt[11], should answer questions and leave as few unanswered questions as

[10] R. Duda. *Poznawanie świata a matematyka*. W: M. Heller, R. Janusz, J. Mączka. *Człowiek: twór wszechświata – twórca nauki*. Kraków – Tarnów 2007.

[11] I. Lakatos. *The methodology of scientific research programmes*. Cambridge – New York – Port Chester – Melbourne – Sydney 1989 p. 48.

possible[12], it should be falsifiable and verifiable[13]. If a theory ceases to explain and its protective mantle grows thicker, then the theory is replaced with another. If the theory is general, well verified and coroborated, it can become an indicator of doing science, it can become a paradigm. After some time, the paradigm "exhausts", i.e. it is impossible to solve problems that arise with the "influx" of new data based on it. Currently, science is experiencing "the collapse" of two paradigms in practice: general relativity and quantum mechanics. It is impossible to combine these two well-correlated theories. According to Thomas Kuhn, a scientific revolution awaits us in this situation[14]. You can't improve the theory endlessly. Problems pile up over time and to explain them one has to create a new, even more general theory incorporating explanations of previous theories without creating theoretical problems that were experienced by those earlier theories.

The history of science as we know it is the result of the application of mathematics to the description of physical phenomena. So-called "pure mathematics" does not deal with physical reality, but when applied to it it either does not describe the physical world, or the description is very different from reality. However, it is sometimes correct, at least for a while. Due to this mysterious relationship between mathematics and physical reality, the mathematical description requires experimental confirmation. We cannot come up with a theory that we are sure of correctly describing the world without the need for experimental confirmation. However, mathematics determines the types of experiments. It is like a hint of what to do in practice to see if we have found the truth. In practice, it turns out that even a wrong description and an unsuccessful experiment can lead us to an unexpected discovery. But only in this direction, i.e. from description to experiment and possible unexpected discovery. It does not work the other way around, i.e. it is currently impossible to create a general mathematical description from observations alone. Observation must be preceded by math, thinking. Krąpiec argued that thinking as a starting point is a mistake. Meanwhile, Popper clearly points out that there is no other way. To follow the inductive path would mean to create an infinite regress[15]. This regression would be that for a finite amount of data, no general and final conclusions can be drawn. It cannot be said that all swans are white just because we have not met any black swans for this idea. In this way, any break in the theory would disprove the whole theory. It is impossible to generalize

[12] L. Laudan. *Progress and Its Problems: Towards a Theory of Scientific Growth*. Berkeley – Los Angeles – London 1978 p. 70.

[13] K. Popper. *Conjectures and refutations: The growth of scientific knowledge*. New York 1962 p. 37-42.

[14] T.S. Khun. *The Structure of Scientific Revolution*. Chicago 1970 p. 12.

[15] K. Popper. *The logic of scientific discovery*. New York 2005 p. 29.

limited experimental data to the level of certainty that there is no longer any need to collect confirmations for the truth of the theory. There is a way of deduction[16].

Deduction means that first, *a priori*, a hypothesis is constructed and then tested. As a rule, testing reveals that the hypothesis does not describe the real world. Sometimes, however, they succeed, i.e. pure human thought becomes a description of reality. The mathematical expression of this thought is sometimes further than the author of the description themself might have thought. An example of General Relativity and its equations that "knew" about the existence of black holes, which Albert Einstein disagreed with, shows that mathematics can be "discovered" rather than invented. How is such an apiroric discovery possible? Popper spoke of the irrationality of a scientific discovery[17]. There is something elusive, mysterious about this connection between the human mind and *a priori* discovery of the world. Mathematics is the link.

3. GÖDEL'S THEOREMS

Claims of inconsistency and incompleteness rocked science in the first half of the 20th century and are still controversial. Generally speaking, they say that if scientific theories are internally consistent and include arithmetic, they are incomplete. Complete theories that will not require correction are those that avoid arithmetic. However, any attempt to reconcile mathematics with a theoretical description must end in incompleteness. Then the whole process of corroboration of the theory begins to take place and then – after some time – an attempt to replace it with an even more general and precise theory. This process seems endless as soon as we enter the path of a mathematical description of reality. The incompleteness theorem has practical consequences.

The consequences of using mathematics to describe how society works are serious. The consequences of using mathematics to describe the functioning of society lead to the replacement of the real dynamics of social being resulting from the freedom of individual people who make it up with – a model. We begin to perceive society as a thing, not an entity made of real people. The thing behaves in a deterministic manner, therefore mathematics and algorithms are enough to describe it. We select post-initial conditions and anticipate potential scenarios for the further development of such an entity. The model, however, is not a reality. A good example is the phenomenon described by Nicholas Nassim Taleb called the Black Swan[18]. In general, Black Swans are rare, usually negative phenomena that have

[16] Ibidem p. 32-34.

[17] Ibidem p. 32.

[18] N.N. Taleb. *Czarny Łabędź. Jak nieprzewidywalne zdarzenia rządzą naszym życiem*. Trans. O. Siara. Poznań 2020 p. 235-280. Cf. R. Szopa. *Ethical problems in the use of algorithms in data*

a great impact on society. An example of such a phenomenon was the economic crisis in 2008. Black Swans cannot be predicted, fundamentally. This is because the mathematical model of the market operation is too narrow and "rigid" to the more complicated and changing reality. Black Swans is the price we pay for creating a priori models of reality. In life sciences, the use of models does not cause harm. The model can be improved if it does not match the results of the experiment. In economics, however, models are often tested "on people". If they are corrected, it is because some damage has already occurred and someone has suffered. However, even good models have to overlook something. The sum of these omissions remains unnoticeable, as we focus on a model that "tells" what it should be like, while we miss a tsunami of changes that, when they reach the tipping point, cause a crisis, unpredictable within the model.

In practice, it turns out that Gödel's theorems show a very dangerous feature of the mathematization of scientific theories: trusting the model ultimately leads to problems. The reality, however, seems to be too complex to apply the induction proposed by Krąpiec. We are left to either apply mathematics or come up with a method other than deduction. Perhaps the way out is intuition. Einstein also talked about the importance of imagination. I believe that the development of advanced algorithms and artificial intelligence will help to remove the "side effects" of theoretical models based on mathematics. Taking into account what is not currently visible in theory and what may affect the formation of Black Swans is crucial from the point of view of the effects of these omissions resulting from the theorems of Gödel. The model is a bit like the Aristotle form that we can get to know. However, it is matter that changes, and it is this change that "goes" beyond the model. The model redirects our eyes to what is modeled. What the model is overturning is what is not visible now. In turn, what is invisible for the model, it comes directly from reality, which our mind simplified in order to be able to understand it. The practice, therefore, verifies the theory and does not coincide with it. We can, however, approach this compatibility between theory and practice, knowing, that we will never achieve full agreement between them.

CONCLUSIONS

Modern science is deductive, meaning that scientists are looking for an opportunity to move between thought and reality. According to the Thomists (Krąpiec), the so-called gnozeological bridge that stretches between thought and reality does not exist. The history of science shows the need for such a bridge. Everyone who deals with the detailed sciences is walking it today. However, most often it does

management and in a free market economy. "AI & Soc" (2021). <https://doi.org/10.1007/s00146-021-01319-5>.

not lead to the truth understood as the adequacy of thought with reality. Gödel's theorems show that when we start with thinking, even when we manage to "invent" a true theory, it does not fully explain reality, it does not coincide with it. We will not know the full truth in science. We are doomed to strive for it, constantly discovering it. Drawing conclusions from observation is no longer effective. It seems that this road ended at the end of the 19th century. The complexity of reality forces us to follow the path of deduction. It gives good results, but very rarely, and we will be following it forever. In this sense, it is impossible to build such a bridge between human thought and reality that would lead us to the desired adequacy. We get closer to it from time to time.

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TEORIA I PRAKTYKA W NAUCE − PODEJŚCIE FILOZOFICZNE

Streszczenie: Współczesna nauka w punkcie wyjścia jest dedukcyjna. Oznacza to, że naukowiec może tworzyć hipotezy, które następnie muszą zostać potwierdzone eksperymentalnie. Porzucenie podejścia indukcyjnego spowodowało problem przejścia od myśli do rzeczywistości. Przykładem krytyki tego dedukcyjnego podejścia do nauki jest tomizm egzystencjalny. Wydaje się jednak, że powrót do indukcji jest niemożliwy, gdyż z poziomu obserwacji nie można już wyciągać ogólnych wniosków dotyczących m.in. przyrody. Ogólne wnioski można wyciągnąć na podstawie matematyki. To jednak sprawia, że rzeczywistość jest zbyt skomplikowana, aby jakakolwiek teoria naukowa mogła ją w pełni wyjaśnić, co jest zgodne z podejściem tomistycznym: zaczynając od myślenia, nie można dojść do rzeczywistości. Twierdzenia Gödla potwierdzają to tomistyczne podejście. Znajdujemy się w sytuacji, w której zarówno indukcja, jak i dedukcja nie wystarczają do znalezienia prawdy, chyba że rezygnujemy z matematyki, bez której trudno mówić o innych naukach niż filozofia i teologia. Jesteśmy skazani na ciągłą konfrontację teorii z praktyką.

Słowa kluczowe: teoria, praktyka, twierdzenia Gödla, matematyka, indukcja, dedukcja.