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The Value of Mathematics and Its Impact on Philosophy

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Abstract

The significant development witnessed in mathematics has led many philosophers to take an interest in it, engaging with it to the extent of emulating it in much of their research. This science's precision, clarity, and certainty have profoundly impacted the sciences and philosophy. However, this influence has not been uniform among philosophers or has been consistent across different philosophical stages. This variation is attributed to the philosophers' understanding of this discipline and the degree of their engagement with it. On the other hand, some philosophers were not convinced by this relationship, criticising it because it is illogical for mathematics and philosophy to align, as they fundamentally oppose each other in all their essential characteristics. The core difference between them lies not only in their subject matter but also in their methodologies.

Keywords: Mathematics, Philosophy, Value, Impact, Interaction, Emulation.

Introduction

The significant development witnessed in mathematics, in terms of its subject, methodology, and nature, has driven many philosophers to take an interest in it and engage with it to the point of

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emulating it in much of their research. The precision, clarity, and certainty inherent in this science have profoundly impacted the sciences in general and philosophy in particular. However, the degree of influence has varied from one philosopher to another and from one philosophical stage to another. This variation is attributed to the philosophers' understanding of this discipline and the extent of their engagement with it.

On the other hand, some philosophers were not convinced of this relationship. They criticise the interaction between mathematics and philosophy, considering that each possesses its own particularities.

On this basis, we have decided to address this complex issue by examining various divergent viewpoints regarding philosophy's emulation of mathematics. We have framed this topic within a central problem, encompassing a series of subsidiary questions we have endeavoured to explore through analysis and critique. This exploration draws on the positions and views of great philosophers who have left their mark in this field.

Central Problem:

To what extent has mathematics influenced philosophy to the point of emulating it?

This central problem gives rise to a series of subsidiary questions:

- What are the key reasons that have driven philosophers to emulate mathematics?
- How intense and profound has this influence been among philosophers?
- What are the main criticisms directed at those who claim a close relationship between mathematics and philosophy?

First, the Factors That Led Philosophers to Emulate Mathematics:

One of the main reasons that philosophers have emulated mathematics is the distinctive characteristics of this discipline, with the most notable being certainty. This certainty stems from the self-evident nature of its concepts, which are universally accepted upon first exposure. The fact that mathematics remains one of the most advanced sciences today can be attributed primarily to two factors. First, mathematical phenomena are among the least complex and most interconnected. Second, it is due to the mathematical methodology itself. Mathematical concepts appear clear, simple, absolute, and unchanging to the scholar. This certainty also results from the deductive method used in mathematics, where reasoning progresses from premises to conclusions. The strong connection between the premises and conclusions ensures the validity of the propositions, with the latter being entirely dependent on the former. This deductive method employed by mathematics reveals another highly significant characteristic: the truth of mathematical propositions is established through formal proof processes without referring back to the empirical world for verification. Hence, mathematics is a formal or abstract science.

Mathematical subjects are also characterised by necessity. If we accept the premises, we must accept the conclusions and all intermediate steps as long as they adhere to the deductive method. Every mathematical system must possess a fundamental attribute: consistency, meaning that no contradictions should exist between its propositions. Its premises must be true, primary, and direct, known more clearly than the conclusions, and serve as their cause. Here, we can distinguish between the premises and the conclusions, or more precisely, between the self-evident axioms and the propositions derived from them.[2]In addition, another important characteristic is the precision with which a mathematician defines concepts, presents arguments, and constructs proofs. For this reason, a scholar cannot freely create a mental definition of the nature of the studied object, as nature itself imposes or reveals its secrets. However, the mind may not always be ready to listen to these revelations, often leading to incomplete or incorrect definitions. Definitions in the natural sciences are not primary definitions, as is the case in mathematics. They improve with the advancement of science and become more complete in its later stages.

When mathematicians offer multiple definitions of a single concept, this multiplicity does not alter the concept's nature; somewhat, it clarifies its properties. A mathematical definition does not require gradual refinement, as it is the starting point for mathematical thought. Mathematical thinking is based on fundamental principles such as definitions, axioms, and postulates. It can only reason starting from a clear definition of the concept and a precise enumeration of its essential and accidental properties or from general propositions that are self-evident and apparent. Since the principles of mathematics are inherently trustworthy, their results must be accurate. This is why Kant asserted that mathematics is unique in possessing definitions that can never be wrong. The value of mathematical thinking is found in "construction" or composition when a proof progresses from propositions whose truth is already accepted to new propositions that necessarily follow from them. It also involves moving from simple to complex, from known to unknown, and from particular to general.

Today, mathematics provides natural science with the intellectual organisation of natural phenomena, and its methodology, concepts, and results form the backbone of the physical sciences.[3] It now expresses observations in the mathematical language (language Mathématisé), such as equations and graphical curves. The progress achieved by physicists and chemists in the past, owing to mathematics, is a clear test of its pivotal role. Moreover, mathematics is a field for the pursuit of beauty. As Bertrand Russell remarked about mathematics, it "contains a high form of beauty—cold

[2] Yassin Khalil, *Logic of Scientific Knowledge*, Beirut, 1971, p. 51.
[3] Nasser Hisham Mohamed, *Al-Madkhal ila Falsafat al-'Ulūm*, Dar al-Jawhara for Publishing and Distribution, Cairo, Egypt, 1st ed., 2015, p. 72.

beauty that does not smile, like the beauty of sculpture. It does not appeal to any aspect of our weak nature or the bright painting or music embellishments. Nevertheless, it is a pure, refined beauty capable of perfect mastery, as any great art can be. "[4]

Research methods have shifted from description and classification to experimentation and induction, and as a result, outcomes have transitioned from qualitative to quantitative. For example, physicists no longer discuss colours and sounds in a literary descriptive style; instead, they aim to define their waves and vibrations in precise quantitative terms, which are captured by instruments that distinguish their amplitude, range, height, and frequency. Thus, mathematics is distinguished by its symbolic language, and the symbols used in mathematics are essential for clarifying meanings that are often ambiguous in everyday language. A word in a common language may have multiple meanings depending on its context, whereas mathematical language is strictly defined. As in philosophy, those working in this field are more cautious and precise in their approach.[5]

Philosophers are attracted to mathematics because they attempt to present a comprehensive system or framework of truth, starting with clear, distinct, and certain premises. Therefore, proponents of intellectual systems in the seventeenth century, using various methods, sought to establish their systems on self-evident axioms. However, they generally aimed to find self-evident axioms and required no proof.[6] Deductive arguments lead to necessary and inevitable results simultaneously. However, if the premises are so, these results are characterised only by necessity and certainty. This is because the deductive argument does not provide us with any more in the conclusion than what is already contained or implied in the premises.[7]

Thus, through these characteristics, the philosopher exerts every effort to make their system distinguished by these traits to the highest possible clarity. Therefore, it is natural to observe rationalist philosophers, both ancient and modern, who have adopted mathematics as a supreme model in the process of philosophical construction.

Second, Influence of Philosophy by Mathematical Science:

Mathematics has influenced philosophy through admiration for the nature of its subjects and methodology. The characteristics of mathematics are regarded as the ideal model for presentation and clarification, which is why philosophers feel compelled to use mathematical principles and concepts in their philosophical constructions.

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[4] Morris Kline, *Mathematics in Western Culture*, London, 1945, pp. 4-5.
[5] Nasser Hisham Mohamed, *Al-Madkhal ila Falsafat al-ʻUlūm*, *ibid.*, p. 72.
[6] A Group of Contemporary English Philosophers, *Ṭabīʿat al-Mītāfīzīqā* [The Nature of Metaphysics], translated by Dr. Karim Mattā, reviewed by Dr. Kāmil Muṣṭafā al-Shaybī, *ʿAwīdat Publishing and Printing*, 2018, Beirut, Lebanon, p. 58.
[7] *Ibid.*, p. 51.

If we examine the achievements of philosophers from ancient times to the present in the field of mathematical science, we find many significant contributions. Some of these achievements include the following:

1. In Ancient Greece:

No science has a more extended history than mathematics does, as it entered the stage of scientific certainty with figures such as Thales, Pythagoras, and others. Moreover, no science has been passed down through the centuries as a solid testament to the intellectual genius of humanity as Euclidean geometry. However, Plato's philosophy was the first to be significantly influenced by contemporary mathematics. He initially employed the principles of contradiction and self-identity in constructing his world of Forms. The principle of self-identity expresses the permanence and stability of essence, whereas the principle of contradiction asserts that opposites cannot coexist in the world of intelligence. In this context, Plato was greatly influenced by a mathematical proof, which never contains contradictory propositions and where the truth criterion relies on the consistency of the conclusion with the premises.

Plato explored the types of knowledge and identified fourtypes: sensation, which refers to the perception of the accidents of bodies or their shadows in wakefulness, and their images in dreams. The second is opinion or conjecture, which involves judgment about the sensible objects as they are. The third is inference, the knowledge of the mathematical essences realised in the sensible world. The fourth isreason, which is the understanding of abstract essences free from materiality. These types of knowledge are hierarchically structured, with the soul progressing from one to the next in a necessary movement until it reaches the final form of knowledge, at which point it attains peace.[8]

The essence of Plato's position on the theory of knowledge is that everything visible and sensible is plural and unstable and thus cannot be the object of actual knowledge. The only proper subject of knowledge is what the mind knows by itself, without the intermediary of sensation.[9] Consequently, Plato regarded mathematics as a model of actual knowledge precisely because it contains no empirical elements.

In this sense, mathematics naturally leads to the intellect, aided by certain sensations accompanying the mind, towards the truth found in the "World of Forms." Through this, the philosopher escapes the realm of becoming and focuses on the essence, emphasising the need to concern himself with the underlying substance rather than the transient.

[8] Mustafa Ghalib, *Fī Sabīl Mawsūʿa Falsafiyya: Aflātūn, Aristū, Nīchī*, Dar wa-Maktabat al-Hilāl, 1983, Beirut, Lebanon, pp. 34-35.
[9] Mustafa Nasher, *Madkhal Jadīd ila al-Falsafa* [A New Introduction to Philosophy], New Book for Publishing and Distribution, 1st ed., 2017, p. 67.

Mathematics compels the soul to learn through the intellect alone. Thus, the role of mathematics is to direct the soul towards the stable, the absolute, and the perfect, independent of its sensory imitations. The subject of mathematics consists of mental essences that enjoy independent and complete objective existence. Consequently, Plato emphasises that the significance of this science lies in its ability to lift the soul from the world of change to the world of stable truth. It also generates the philosophical spirit, awakens the capacity for thought, and thus paves the way for learning dialectics.[10] This latter involves two mathematical methods: synthesis and division. The first involves gathering the scattered multitude into a single example, whereas the second entails dividing a genus or subject into its respective types. Therefore, for Plato, arithmetic is the science that awakens the ability to think and brings us closer to true existence. Its value lies in its capacity to elevate the soul, pushing it to contemplate numbers. Similarly, the importance of geometry for him lies in its ability to draw the soul towards truth, generating the philosophical spirit and elevating it to contemplate higher realities.[11]

In this sense, we can say that Plato introduced a new perspective, viewing mathematics as a purely theoretical science. He shifted mathematical practice from the world of the sensible to the world of the intelligible, from practical application to metaphysical thought, which seeks what is stable and eternal, not what is transient and temporary.

3. In the Islamic World:

Muslim scholars showed greater interest in mathematics than in other branches of intellectual sciences. They were continually preoccupied with its place in the cognitive system and its relationship with the cultural structure. *Al-Kindi*, the first Islamic philosopher, positioned mathematics as a gateway to the sciences, placing it above all other fields, even logic, which follows mathematics. He regarded philosophy as a bridge to philosophy and famously stated, "Philosophy can only be attained through mathematics." He authored eleven works on arithmetic, twenty-three on geometry, and nineteen on astronomy.[12]

While *Ibn Sina* (Avicenna) placed logic at the entrance, followed by natural sciences, mathematics, and finally theology, this reflects the progression of the mind or the steps of intellectual development. He showed even greater interest in mathematics than did *Al-Kindi*, with his achievements reaching higher levels. He categorised the sciences of mathematics into the main branches: arithmetic, geometry, astronomy (or "the science of form"), and music.

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[10] Fouad Zakaria, *Jumhūriyyat Aflātūn* [The Republic of Plato], Dar al-Kitāb al-ʻArabī, 1968, p. 522.
[11] *Ibid.*, pp. 525–527.
[12] Qudrī Ḥāfiẓ Ṭūqān, *Turāth al-ʻArab al-ʻIlmī fī al-Riyāḍiyyāt wa al-Falak* [The Scientific Heritage of the Arabs in Mathematics and Astronomy], 2nd ed., Committee for Authoring, Translating, and Publishing, Cairo, 1954, pp. 145-146. See also: A. S. Rappert, *Mabādiʾ al-Falsafa* [Principles of Philosophy], translated by Ahmad Amin, "Fasl fī Tārīkh al-Falsafa al-Islāmiyya" [A Chapter on the History of Islamic Philosophy], 1st ed., Dar Ṭība for Printing, Giza, Egypt, 2015, p. 82 and following.

Al-Farabi placed mathematics after the sciences of Arabic language and logic, whereas *Abu Hayan al-Tawhidi* situated it in another context, as did the *Ikhwan al-Safa*. In all cases, Islamic heritage acknowledges mathematical sciences as certain proofs that must occupy their precise place within the structure of the intellect. Even *Imam al-Ghazali* made an exception to mathematics when he unleashed his fury against rationalism and launched a fierce attack on intellectual sciences. He stated that the most significant offense to Islam would be the belief that mathematics could be denied. For him, mathematics always remained beyond dispute: "There is no reason to deny it or oppose it, for it pertains to arithmetic and geometry. "[13]

3. In Modern Philosophy:

The influence of mathematical methods on modern philosophy has been profound. It became clear that modern philosophy adopted mathematics as the highest model to emulate, recognising that the closer thought is to mathematics and its methodology, the deeper and more precise it becomes, or rather, the degree of certainty in it mirrors that of mathematics. Thus, the thesis in modern times was that modern philosophy became systematic, and its output was, in reality, integrated into this system. This is because the second beginning of philosophy came with the Cartesian method in its mathematical form, which *Descartes* inherited from *Plato* and which remained evident in the works of those who followed him.

A. René Descartes (1596--1650):

Descartes dedicated the mathematical method to his philosophy and achieving certainty, even in the natural sciences.[14] He formulated four key rules for this purpose: the rule of self-evidence, the rule of analysis, the rule of synthesis, and the rule of enumeration, all of which are mathematical concepts. Descartes insists that in our quest for a direct path to truth, we should not consider ourselves with subjects in which we cannot attain certainty equivalent to mathematical proofs in arithmetic and geometry.[15] He emphasised that there are no people better suited for metaphysical speculation than those with a background in geometry.[16] Consequently, he ensures that nothing he writes in his "Meditations" lacks rigorous proof. To achieve this, he followed a methodical approach similar to that used by geometers.

[13] Abū Ḥāmid al-Ghazālī, *Mantiq Tahaffut al-Falāsifa* [The Logic of the Incoherence of the Philosophers], titled *Mi'yār al-'Ilm* [The Criterion of Knowledge], edited by Sulaymān Dunyā, 2nd ed., Dar al-Ma'ārif, Cairo, 1969, p. 21.
[14] Muhammad Thābit al-Fandī, *Falsafat al-Riyāḍa* [The Philosophy of Sports], Dar al-Nahḍa al-'Arabiyya for Printing and Publishing, Beirut, 1st ed., 1969, p. 124.
[15] Descartes, René. *Rules for the Direction of the Mind*, in *The Philosophical Works*, trans. E. S. Haldane and G. R. T. Ross, vol. 1. Dover, 1955, p. 5.
[16] René Descartes, *Al-Ta'ammulāt fī al-Falsafa al-'Ulwiyya* [Meditations on First Philosophy], translated by 'Uthmān Amīn, Anglo-Egyptian Library, 1969, p. 44.

Like other philosophers of the seventeenth century, Descartes devised a method that, in his view, guaranteed the attainment of truth. He found in mathematics the ideal model to be emulated in science because he believed that knowledge is only actual knowledge if it is inevitable. Consequently, he considered potential knowledge to contradict in terms. This is undoubtedly the case for anyone seeking certainty in the natural sciences, as only mathematics meets the requirements for the certainty desired in scientific inquiry.[17]

Descartes, then, sought to use the mathematical method to search for nature's primary causes, aiming to establish a system of nature where its parts are interconnected in the same way that axioms and theorems are linked within a mathematical system. Just as mathematics begins with self-evident axioms from which necessary conclusions are derived, Descartes believed that science should begin with clear and self-evident propositions from which other propositions would necessarily follow.[18]Therefore, Descartes' philosophy was a grand structure built upon the foundation of mathematics. The goal of the new method was to reach propositions free from doubt or possibility. Descartes believed that the path to certainty lies in deduction, not induction, because induction often leads to false or probabilistic inferences. He observed that arithmetic and geometry use deduction and that they alone achieve the highest degrees of certainty, being the simplest and clearest of sciences. Therefore, if philosophy or any other science is to have certain propositions, these two sciences should be taken as its model.[19] Descartes' mathematical approach to thinking was a means to attain certainty. He aimed to harness mathematics self-evidence as the foundation for knowledge.[20]

B. Baruch Spinoza (1632--1677):

Spinoza linked ethics with mathematics and sought to build an ethical system through it, starting with definitions, axioms, and postulates—something rarely seen among philosophers. His major work, Ethics, connected the geometric method with philosophical writing. Just as geometry begins with self-evident propositions, Spinoza argued that searching for truth should also begin with self-evident propositions. Just as *Euclid* derived geometric propositions from definitions and axioms, Spinoza derived his philosophy from a series of definitions and axioms.

His entire philosophy can be deduced from two definitions: the definition of substance and the definition of God, along with an axiom about the similarity of cause and effect: that things that do not

[17] Karim Metta, *Al-Falsafa al-Ḥadītha: ʿArḍ Naqdī* [Modern Philosophy: A Critical Overview], 2nd ed., Dar al-Kitāb al-Jadīd al-Muttaḥida, 2001, Beirut, Lebanon, p. 54.
[18]*Ibid.*, p. 55.
[19] Mahmoud Zaydan, *Manāhij al-Baḥth al-Falsafī* [Methods of Philosophical Research], 1st ed., Dar al-Wafāʾ li-Dunyā Printing and Publishing, 2004, p. 74.
[20] Nasher, Mustafa. *Falasifa Ayyaqū al-ʿĀlam* [Philosophers Who Awakened the World]. 3rd ed. Cairo: Dar al-Qubāʾ for Printing, Publishing, and Distribution, 1998.

share anything in common cannot be understood through each other, meaning that the concept of one does not imply the concept of the other.

Spinoza's use of the geometric method was not incidental or optional; instead, it was because it calls for precise thinking and the exclusion of teleological reasoning.[21] His language achieved high precision and clarity, free from ambiguity, to the point where it almost appeared to be a branch of mathematics. Here, we recognise the connection and harmony between form and content in Spinoza's work. He carefully selected the tools that suited his philosophy, ensuring that his philosophy was evident in intent, transparent in purpose, and easily understood in its aims.[22]

Since geometry is based on a set of definitions and axioms, Spinoza had to clarify the conditions for a correct definition. Thus, he states, "The correct method of inquiry is to form ideas from a specific definition, and the more precise the definition of a thing, the better and more useful the method. "[23]

C. Gottfried Wilhelm Leibniz (1646--1716):

Leibniz, too, was influenced by mathematics. He attempted to create symbolic language for philosophy, similar to mathematics, considering that philosophers' problems lay in the use of ordinary language. He believed that agreement would naturally occur if they wrote in a mathematical language. This led him to discover mathematical logic. His admiration for mathematics also prompted him to question the language with which God addressed our ancestor, *Adam*. Since Adam was the father of humanity and there was no common language among all people, Leibniz believed that it must have been mathematics, and in his view, it should still be that way.

Leibniz reported that most people who find pleasure in mathematics tend to avoid metaphysics because they find light in the former and darkness in the latter due to the latter's lack of precision, clarity, and order. However, he argued that light and certainty are even more necessary in metaphysics than in mathematics. Metaphysics is more important than mathematics and deserves even greater precision, clarity, and truth. The reason is that metaphysics encompasses knowledge of God and knowledge of the self, both of which govern our lives and lead to happiness and peace of mind.[24]

Thus, according to Leibniz, attaining certainty in metaphysical matters is essential. In his view, this can be achieved only by applying the geometric method to metaphysical issues.[25]

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[21] Spinoza, Baruch. *ʻIlm al-Akhlaq* [The Ethics]. Translated by Jalal al-Din Saʿīd. Beirut: Arab Organisation for Translation, 2009.
[22] al-Hafni, Abdul Munʻim. *Al-Mawsūʻa al-Falsafiyya* [The Philosophical Encyclopedia]. Beirut: Dar Ibn Zaydūn, Cairo: Maktabat Madbūlī, no date.
[23] Karim Metta, *Al-Falsafa al-Ḥadītha: ʿArḍ Naqdī* [Modern Philosophy: A Critical Overview], 2nd ed., Dar al-Kitāb al-Jadīd al-Muttaḥida, 2001, Beirut, Lebanon, p. 97.
[24] Leibniz, *Selections*, edited by Philip P. Wiener, New York, 1951, pp. 1-2.
[25] Leibniz, *Philosophical Papers and Letters*, translated and edited by L. E. Laemker, Holland, 1969, p. 432.

Leibniz believed that extension could not be taken as a final principle in explaining things because extension presupposes extended objects, just as number presupposes countable objects. Therefore, extension cannot be the essence of things. Leibniz states, "Although the partial phenomena in nature can be interpreted mathematically or mechanically... the general principles of corporeal nature, and even of mechanics, are not geometric but metaphysical. They do not relate to bodily mass or extension but rather to indivisible forms or inherent qualities, which are considered the causes of phenomena. "[26]

When Leibniz realised that the cause of the ambiguous concepts, unclear definitions, contradictory results, unstable principles, and erroneous inferences in the philosophical systems before and contemporaneous with him was the lack of a proper method, he set out to establish a new method in philosophical inquiry that could lead to certainty, clarity, precision, and necessity in the subjects it studied. Since these characteristics are the most distinguishing features of mathematical principles, facts, and propositions due to their method, Leibniz adopted the mathematical method as his guiding framework while developing his new approach. His motivation was further reinforced by the remarkable progress made in the sciences of nature and astronomy by applying mathematical methods.

For Leibniz, the method of geometric proof is merely a special case of a much broader intellectual dialectic. Throughout his life, he searched for the "general character, or general method of calculation, that should be used in all sciences as it is used in mathematics." Through this approach, all the problems can be solved via calculations. From all of this, it becomes clear that Leibniz repeatedly emphasised that his metaphysical philosophy is based "on geometric proofs," as a response to those who resort to their mental images when lacking an argument, particularly the followers of Descartes.[27]

Thus, Leibniz never ceased his attempts to shape his philosophy with a mathematical character through precise definitions of limits, clear premises, and strict deduction. However, he was not entirely convinced by this approach. Instead, he resorted to certain mathematical principles and concepts in constructing and presenting his metaphysical system and in deducing its major metaphysical principles, such as the principle of contradiction, the principle of mathematical continuity, and the concept of mathematical infinity. Overall, he sought to make his metaphysics a form of mathematics, which was the core objective of his comprehensive characteristics.

D. Nicolas Malebranche (1638--1715):

[26] Leibniz, Gottfried Wilhelm. *Discourse on Metaphysics*. In *The European Philosophers from Descartes to Nietzsche*, edited by M. Beardsley. The Modern Library, New York, 1960.
[27] Geneviève Rodrigues Louis, *Descartes wa al-ʿAqlāniyya* [Descartes and Rationalism], translated by ʿAbduh al-Ḥalw, printed at *Mirkab al-Ṭabāʿa Barghāya*, National Publishing and Distribution Company, 2nd ed., October 1977, pp. 118-119.

Malebranche suggested that although the natural sciences are more productive for humanity, mathematics is more specific than it is otherwise. In his view, all sciences are measured by the extent to which they rely on mathematics. Any science that does not depend on mathematics is questionable in its certainty. This led to strong criticism of the human sciences, as they do not rely on mathematics in their investigations. For him, mathematical deduction remains the primary model for every clear and specific idea. He thus states, "Our concept of quantity is sufficient to allow us to perceive all of its possible properties. "[28]

Malebranche significantly impacted the development of Cartesianism, as he integrated philosophy and mathematics, creating a philosophical system that enabled the understanding of nature and the philosophical implications of mathematics in philosophy. Malebranche's theory places great importance on the mind and ideas, offering clear interpretations of the mind and emphasising the need for greater reliance on mathematical calculations. In this context, Malebranche influenced Descartes, reinforcing his position in the history of philosophy. Descartes, in turn, claimed that the mind is the primary agent in philosophy and other fields.

Third, Criticisms Directed at Those Who Assert a Close Relationship between Mathematics and Philosophy:

It appears that not all philosophers accept the use of the mathematical method and its truths in philosophy. This is because mathematics, owing to its precision and clear scope, achieves progress and success, unlike philosophy, which has not seen comparable advancement. Philosophy continues to pose the same questions and struggles to test any truth produced by mathematics. While mathematics can make significant scientific breakthroughs and leaps, such advancements are rare in philosophy.

Immanuel Kant,[29] for example, it is unreasonable to expect mathematics and philosophy to align perfectly, as they are fundamentally opposed in all their essential characteristics. Their core differences lie not only in their subject matter but also in their methodologies.

Philosophical knowledge is attained through concepts alone, whereas mathematical knowledge is acquired through constructing concepts. Philosophy is purely discursive, whereas mathematics is intuitive. Philosophy can study the particular in general, whereas mathematics studies the general in particular.

The precision of mathematics relies on definitions, axioms, and proofs. According to Kant, none can be obtained or achieved in philosophy. The truth in mathematics is quantitative, whereas in philosophy, it is dialectical. Philosophers may change their positions and answers throughout their

[28] *Ibid.*, pp. 117–118.
[29] Immanuel Kant, *Critique of Pure Reason*, translated by N. K. Smith, London, 1950, pp. 576-593.

lives and may even adopt views opposite their initial ones. However, this is not the case for mathematicians.

Mathematics is least in need of philosophical explanations. However, despite its strong confidence, it cannot do without philosophy, which opens new horizons and is the gateway to everyday culture. This is evident when we consider how concepts such as motion, space, chance, and infinity, once solely the domain of philosophy, have recently been incorporated into mathematics. The development of mathematical research since the seventeenth century has produced theories that offer a mathematical description of these concepts.

Hegel[30] also criticised philosophers who used the mathematical method in their thinking, particularly philosophers of the seventeenth century. He noted that Spinoza adopted the deductive method of geometry, as applied by Euclid, which includes definitions, explanations, axioms, and theorems to present his philosophy.

Hegel further noted that Descartes started by stating that philosophical issues should be treated and proven mathematically, as they must possess the same clarity as mathematical science does. Descartes noted that the mathematical method is superior to all other methods because of its nature and clarity.

However, in Hegel's view, this method is a poor adaptation of reflective content, and it finds its proper place only in the sciences that aim to understand specific phenomena. Hegel believed that the mathematical and deductive methods completely misunderstood the nature of knowledge and the philosophical subject, as both mathematical knowledge and the mathematical method are formal in nature. Therefore, in general, they are unsuitable for philosophy.

In his work, *Encyclopedia of the Philosophical Sciences*, Hegel provides a philosophical critique of the mathematical method, arguing that mathematical sciences, by dealing with quantity, engage with a form that lacks content. Quantities can be measured, counted, and expressed with numbers or symbols, but the course of actual reality cannot be treated in this way. It resists fixation and is shaped by a formal approach because it denies any fixed form. The facts and relationships that emerge in this course change their nature at every stage of their development. Therefore, Hegel's critique is fundamentally based on the incompatibility of the mathematical method with his dialectical logic.

Conclusion:

This mutual influence between mathematics and philosophy will inevitably reflect the relationship between philosophy and other sciences. Suppose that mathematics, with its

[30] Hegel, *Lectures on the History of Philosophy*, translated by E. S. Haldane and Frances H. Siman, New York, 1955, vol. 3, pp. 263-264. See also: Herbert Marcuse, *Al-'Aql wa al-Thawra: Hegel wa Nish'at al-Nazariyya al-Ijtima'iyya* [Reason and Revolution: Hegel and the Genesis of Social Theory], translated by Fouad Zakaria, Egyptian General Authority for Authoring and Publishing, 1970, pp. 152-153.

overwhelming confidence in its truths, can barely justify its logic outside of philosophy. In that case, it is even more confident that other sciences will remain engaged with philosophy. They exchange tools, applications, and interpretations, even if science claims to be independent of philosophy. The idea of a complete and closed mathematical system is a philosophical concept, and philosophy can offer insights into it.

Thus, mathematics is considered the tool of all sciences and a universal language, more so than a specific science. Its value is not found in the differences between theories or concepts but in the logical connection linking the fundamental accepted principle to the resulting consequences. For this reason, it is not surprising to admire mathematics since ancient times, nor is it strange that philosophy and science aspire to the precision that mathematics exemplifies and strives towards it. Mathematics facilitates and enhances both scientific and humanistic studies.

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