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Evaluating the Truth Orientation of Natural Science from the Perspective of Heidegger

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Abstract: Natural science as a distinct discipline emerged from the philosophy of nature with the development of the scientific method by Galileo Galilei and Johannes Kepler. Guided by an empirical approach, it soon refined its subject matter by delimiting inquiry to the physical realm accessible through observation and experimentation. In its formative stages, natural science was conceived as advancing toward truth through a linear and cumulative process of knowledge acquisition. This view, however, was challenged in the mid-twentieth century by Thomas Kuhn, whose detailed study of the history of science revealed that scientific progress occurs instead through paradigm shifts. Kuhn argued that science alternates between periods of "normal science" and episodes of crisis that culminate in revolutionary change. Central to this vision are the concepts of incommensurability and "Kuhn's loss." Incommensurability highlights the difficulty of assessing scientific truth across paradigms, given that paradigm shifts bring about a transformation of the world itself and a discontinuity of truth. Similarly, the notion of "Kuhn's loss" underscores that what is abandoned in a scientific revolution cannot be seamlessly recovered. At first glance, these ideas appear to contradict the conviction that truth cannot become untrue and cannot be lost. This study, however, aims to demonstrate that Kuhn's vision remains compatible with the orientation of natural science toward truth, by showing that incommensurability and "Kuhn's loss" are justifiable through Heidegger's conception of truth as concealment (*Verbergung*) and unconcealment (*Aletheia*).

Keywords: *Natural Science, Truth, Concealment, Unconcealment, Kuhn's Loss, Incommensurability.*

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I. INTRODUCTION

Natural science concerns itself with the study of nature, following the rules spelt in the scientific method. As a science, rooted in the latin *Scio*, *Scientia* aims to attain precise knowledge. *Scientia* corresponds to the Greek *Episteme.* Nature on the other hand, originates from the Latin *natura* and the Greek *physis*, to mean natural dynamism of birth and generation, because *natura* has its roots in the Latin verb *nascor* which means to be born, and *physis* is derived from *phyomai* that is to generate oneself.[1] "Nature is the generation of the things that grow; it is the original and immanent principle of the process of growth, as is also the principle of the first movement of natural beings; from here, nature is also understood as the original material principle of natural things"[2] Thomas Aquinas, referring to Aristotle, retraces the history of the term "nature": it initially meant birth, then later meant the beginning of a generation, and since it is an intrinsic principle, it progressed to mean any intrinsic principle of change.[3]

Having its subject matter as an always becoming reality, the truth established by natural science cannot be static, it always changes with the new dimensions that reality unveils. In the course of scientific progress, a period coming after the first scientific revolution[4], there has been a period when the development of natural science was observed to be a lineal

[1] Lorella Congiunti, *Outlines of Philosophy of Nature*, Stephen Okello, tr., Urban University Press, Rome 2020, 45.
[2] Congiunti, *Outlines of Philosophy of Nature*, 45.
[3] Thomas Aquinas, *Commentary on Aristotle's Metaphysics* V,5,1.
[4] The first scientific revolution is the period that saw the constitution of natural science from the philosophy of nature in the early 1600, after the establishment of scientific method by Kepler and Galileo.

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accumulation towards the fuller attainment of the truth.[5] Later, in what is often referred to as the second scientific revolution[6], Thomas Samuel Kuhn (1922–1996) published *The Structure of Scientific Revolutions*—hereafter cited as *Structure*—with its first edition appearing in 1962. This seminal work advanced a radically different conception of scientific development, challenging the long-standing view of cumulative progress. Kuhn's paradigm-shift model not only transformed debates within the philosophy of science but also exerted a profound influence on related fields such as sociology, history, and cultural studies.

In the *Structure*, Kuhn, challenging the classical perspective on scientific development and drawing from a critical analysis of the history of science[7], argued that science progresses through distinct phases. He observed that, in the years preceding his work, many historians of science had begun to struggle with sustaining the traditional view of scientific progress as a continuous and cumulative process.[8] Rather than portraying theories and discoveries as if they were seamlessly built upon one another, scholars began to adopt a different approach. Their attention shifted from tracing the ways in which earlier science contributed to later theories to emphasizing the historical integrity of scientific developments as they unfolded within their own specific contexts.

Building on the insight that scientific progress is not a matter of simple cumulative growth, Kuhn advanced a new theory of scientific development in *The Structure of Scientific Revolutions*. He argued that science evolves through distinct phases: periods of *normal science*, characterized by puzzle-solving within an accepted framework, and episodes of *revolutionary science*, marked by paradigm shifts that transform the very foundations of inquiry. The two notions of scientific progress favor the dynamic nature of truth based on the dynamic nature of reality. The continuous accumulation did not have any situations of knowledge loss and incommensurability that Kuhn established and that seem to go against the nature of truth that logic established. This is the reason for this study that establishes the two ideas to be truth oriented based on Heidegger's notion of the essence of truth as unconcealment and concealment. While there is discovery in the unconcealment, there is loss in the concealment.

II. KUHN'S NEW VISION OF SCIENTIFIC PROGRESS

This section discusses the new vision of Kuhn in scientific progress that differed from the vision of the first scientific revolution that called for lineal accumulation of truth.

➢ *The Normal Period of Science*

According to Kuhn, normal science is characterized by a stable phase in which scientific progress occurs within the framework of an established paradigm. During this period, discoveries are made that reinforce and expand the prevailing paradigm rather than challenge its foundational principles. Paradigm is created around some achievements that a scientific community has made, and on which they base their studies and development. The success of a paradigm is based on the possibility of solving many problems in their area of research. This phase is called "normal" because, during this period, members of the scientific community encounter relatively few challenges in addressing many natural and societal problems. However, despite its stability, the paradigm does not resolve all existing problems.

In its initial phase, science exists in an immature state, lacking a dominant paradigm to guide research. During this stage, inquiry is marked by competing theories and diverse methodologies. A transition to *normal science* occurs only when consensus forms around a particular paradigm, providing a shared framework within which research becomes more structured and problem-solving takes place. Thus, immature science designates that period in the development of a discipline when no governing paradigm has yet been established.[9] It is a period where there is no consensus among the scientists in a given scientific community, no problems to research, and no facts or methods of research. Once a common viewpoint is reached in solving some scientific problems, science matures to its normal and revolutionary stages. The concept of immature science suggests that each researcher or group of researchers begins without a unified framework, developing their own system of theories, methods, and assumptions. This phase is marked by diversity in approaches, as scientists work independently to establish foundational principles before a dominant paradigm emerges.

Normal science and the scientists of the phase are responsible for actualizing the promises made by a specific paradigm. The actualization of normal science occurs by expanding the paradigm's framework, ensuring that its

[5] David Zeigler, "Evolution and the Cumulative Nature of Science", in Ross Nehmin, ed., *Evolution: Education Outreach* 5, Springer, New York 2012, 585.
[6] The second scientific revolution is the period we refer in this study as the new vision of Kuhn, that challenged the cumulative view of truth to a vision that science grows through paradigm shifts.
[7] Thomas Kuhn, *The Structure of Scientific Revolutions III*, University of Chicago Press, Chicago 1996, 1.
[8] Kuhn, *The Structure of Scientific Revolutions* III, 2.
[9] Alexander Bird, *Thomas Kuhn Philosophy Now*, Acumen, Chesham 2000, 30.

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predictions align with observed facts in reality. This process is often described as a "mop-up" phase, as scientists work to make nature conform as closely as possible to the paradigm's expectations, refining theories and resolving anomalies within its established boundaries.[10] The facts that do not fit in the paradigm's predictions are ignored in as much as they do not cause alarm. There are several examples of paradigms that the history of science can point out to: Aristotle's analysis of motion, Ptolemy's calculations of planetary positions, and Maxwell's mathematization of the electromagnetic field exemplify scientific achievements that not only advanced knowledge but also helped define and consolidate the dominant paradigms of their respective eras. Each of these contributions shaped the trajectory of scientific thought by providing structured frameworks through which natural phenomena were understood and studied.

Kuhn explains that during the period of normal science, scientists are not primarily focused on developing new theories, discovering entirely new phenomena, or questioning anomalies that do not align with the paradigm's predictions. Instead, their work is dedicated to reinforcing and refining the existing paradigm, ensuring that observations and experimental results conform to its framework. The paradigm dictates the course of scientific inquiry, and scientists operate within its boundaries, seeking to validate and extend its applicability rather than challenge it.

- *The Revolutionary Science*

Unlike normal science, Kuhn had another conception of the progress of science that is not as calm as normal science. According to him, science reaches a revolutionary period when anomalies continue to increase, making the reigning paradigm unable to solve problems any further. So, after a long period of trying to save the paradigm, the scientists give up on it and start thinking of a new one. This is the period of crisis and paradigm shift. According to Kuhn, normal science is only successful when it does not meet any novelty that does not rhyme with its criterion of investigation and solving problems. At some point in the development of normal science, and when anomalies accumulate, scientists assume and ignore them. There is a period, however, when the anomalies increase to the point that they can't be ignored further, leading to a crisis.

This idea of revolution in science is the major novelty that Thomas Kuhn brought forth. Many philosophers agreed with the manner of thought, especially those who held that thinkers should not be tied to a specific method. There are, however, thinkers who felt that science is smooth and cumulative and does not have such bumpy moments. Among these include: John Watkins and Imre Lakatos as shall be elaborated in the literature review. Revolutionary science is accompanied by the concepts of incommensurability and what Kuhn describes as "Kuhn's loss."

- *Incommensurability*

The idea of incommensurability was brought forth first by Paul Feyerabend in the year 1962, the same year that Kuhn also talked about it in the *Structure*. According to Feyerabend, incommensurability occurs between theories, meaning that high-level theories must be understood differently based on perception, worldview, evaluation standards, or the meanings of key theoretical terms.[11] Kuhn on the other hand felt that the same reality applies to competing paradigms and not to theories while he first published the *Structure*. He, however, with time changed his position and held that incommensurability applies to theories as well, and so merged with Feyerabend.[12]

Kuhn argued that incommensurable theories are incompatible, citing examples such as Newtonian mechanics versus Einstein's relativity and Ptolemaic astronomy versus Copernican astronomy to illustrate how fundamental conceptual differences prevent direct comparison or integration.[13] Incommensurability is divided into different types, including methodological incommensurability, observational incommensurability, and semantic incommensurability. These different types of incommensurability determine the different aspects that, in turn, determine the various approaches, standards of evaluation, and meaning of terms between and among theories.

Kuhn's idea of incommensurability holds that a scientific revolution brings about a "world change," as scientists begin to perceive and interpret reality through an entirely new paradigm.[14] This was so because two incompatible theories cannot define the same world. The first conception of Kuhn called for a complete world change, but later, he held a partial world change in that there are some terms, for example, water – H20, which have been bearing the same name and referring to the same object almost throughout history. Kuhn later clarified that incommensurability is not majorly on the direct reference, but it encompasses an entire system.[15]

[10] Kuhn, *Structure of Scientific Revolutions*, 24.
[11] Paul Feyerabend, "Explanation, Reduction, and Empiricism", in H. Feigl – G. Maxwell, eds., *Minnesota Studies in the Philosophy of Science* III, University of Minnesota Press, Minneapolis 1962, 28.
[12] Edwin H. – C. Hung, *Scientific Explanation, Theory Structure, Incommensurability and Physical Necessity*, University of Waikato, New Zealand 2006, 62.
[13] Thomas Kuhn, *The Structure of Scientific Revolutions* II, University of Chicago Press, Chicago 1970, 98.
[14] R. Read – W. Sharrock, "Thomas Kuhn's Misunderstood Relation to Kripke – Putnam Essentialism" in *Journal for General Philosophy of Science* XXXIII, Springer, Berlin 2002, 151.
[15] R. Read – W. Sharrock, *Thomas Kuhn's Misunderstood Relation to Kripke – Putnam Essentialism*, 157.

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➢ *Kuhn's Loss*

The idea of "Kuhn's loss" was introduced in the *Structure* and was further elaborated by a German philosopher, Paul Hoyningen – in the work *Reconstructing Scientific Revolutions*. To start with, let us see the position of Kuhn on his own novelty on scientific development.

Kuhn states the following in the *Structure; "*Advocates of competing paradigms frequently disagree on what problems a prospective paradigm must address. Their standards of evaluation—and even their very definitions of science—are not the same. For instance, should a theory of motion be required to explain the cause of attractive forces between particles of matter, or is it sufficient merely to acknowledge their existence?"[16] As examples to the issue, he continued, "Newton's dynamics was initially met with widespread resistance because, unlike the theories of Aristotle and Descartes, it adopted the latter stance. Once Newton's framework gained acceptance, however, that particular question was effectively excluded from the domain of scientific inquiry."[17]

The above quotation illustrates Kuhn's awareness of what Hoyningen later termed "Kuhn's loss"—the notion that, within Kuhn's model of scientific development, the acquisition of new knowledge is accompanied by the loss of certain previously held insights.[18] The period of normal science is often highly valued by scientists, whereas the period of paradigm shift tends to be received with less enthusiasm. Normal science operates in a manner consistent with the expectations of the scientific community, yielding stability and incremental progress—hence it is regarded as a period of gain. By contrast, a scientific revolution introduces both gains and losses. On the one hand, new discoveries emerge, driven by the formulation of new theories within fresh paradigms. On the other hand, these very paradigms leave behind certain explanatory successes of their predecessors. What was once answered can become anomalous under the new framework, as some questions are set aside or no longer find solutions.

Kuhn highlights several examples of this phenomenon. The emergence of Newtonian dynamics, for instance, dismissed the issue of attractive forces among particles—an issue that would later reappear at the heart of Einstein's general theory of relativity. Similarly, Lavoisier's chemical paradigm neglected the question of the common behavior of metals, a problem earlier addressed by phlogistic chemistry. Finally, Kuhn observes what he terms "Kuhn's loss" in the shift from Descartes's vortex theory to Newton's theory of gravitation: while Descartes's model accounted for why planets revolve in the same direction, Newton's theory could not.

III. LITERATURE REVIEW

This section seeks to find out how the new vision of Kuhn was received by his contemporaries and those who came after him and also how their contributions helped him shape the new vision. To start with, let us look at the idea of normal science. Thomas Nickles wrote that many historians and sociologists highly accept Kuhn's idea of normal science. This is so because science is seen to work normally following a sketch and some method.[19] This opinion was influenced positively by the invention of the scientific method. Many scholars did not go contrary with the Kuhn's ideas except his contemporary Feyerabend who felt that science should not be tied to any normalcy and wrote against the method.[20]

One of the most striking insights to emerge from recent discussions in the history and philosophy of science is the recognition that major scientific developments—such as the invention of atomism in antiquity, the Copernican Revolution, the rise of modern atomism (including kinetic theory, dispersion theory, stereochemistry, and quantum theory), and the gradual emergence of the wave theory of light—took place precisely because certain thinkers either chose not to remain constrained by seemingly "obvious" methodological rules, or else violated them inadvertently.[21]

Kuhn and Popper seem to partly agree on the phenomenon of natural science and its manner of growth. The central point of agreement, drawing heavily from the ideas of Kant and Schlick, is that a scientist operates within an organized framework because a structured system of scientific doctrines already exists. This pre-established structure provides the foundation upon which scientific inquiry is conducted, guiding research, interpretation, and problem-solving within the boundaries of the prevailing paradigm. There is also an existence of a generally accepted problem situation.[22] This is more or less the manner of development that Kuhn brings forth in normal science. Kuhn responded that Popper had not understood his meaning of normal science and that he confused between normal and extraordinary sciences.[23] In that regard,

[16] Thomas Kuhn, Structure of Scientific Revolution III, 148

[17] Thomas Kuhn, *Structure of Scientific Revolution* III, 148.

[18] Paul Hoyningen - Huene, *Reconstructing Scientific Revolutions: Thomas S. Kuhn Philosophy of Science*, Chicago, University of Chicago, 1993, 260.

[19] Thomas Nickles, "Normal Science: From Logic to Case-Based and Model-Based Reasoning", in Thomas Nickles, *Thomas Kuhn: Contemporary Philosophy in Focus*, Cambridge University Press, Cambridge 2003, 142.

[20] Paul Feyerabend, *Against Method*, Verso, New York 1993, 14.

[21] Feyerabend, *Against Method*, 14.

[22] Popper, "Normal Science and Its Dangers", in Imre Lakatos – Alan Musgrave (eds.) *Criticism and Growth of Knowledge-Proceedings of the International Colloquium in the Philosophy of Science* IV, Cambridge University Press, Cambridge 1970, 51.

[23] Popper, *Normal Science and Its Dangers*, 52.

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both Popper and those of his school read Kuhn with their preconceptions, and even though Kuhn and Popper had a lot in common, the popperians understood them in the manner dictated by their preconceptions. This he calls a gestalt switch that allows two people or more to look at the very same phenomenon and see different results.[24] Popper, however, disagreed partly with Kuhn on the normal science growth being an advantage stage by stating that even though it is the case that scientists in normal science operate in the manner described by Kuhn in the *Structure,* a stage in which they fight to defend the paradigm and solve as many problems as possible using it, there is a danger in such manner of developing knowledge. The danger stated is:

…the normal scientist, as Kuhn describes him, is a person one ought to be sorry for. (According to Kuhn's views about the history of science, many great scientists must have been 'normal'; yet since I do not feel sorry for them, I do not think that Kuhn's views can be quite right.) The 'normal' scientist, in my view, has been taught badly. I believe, and so do many others, that all teaching…should be training and encouragement in critical thinking. The 'normal' scientist, as described by Kuhn, has been badly taught. He has been taught in a dogmatic spirit: he is a victim of indoctrination.[25]

Before publishing *The Structure of Scientific Revolutions,* Kuhn had already outlined some of his central ideas in a paper titled *The Function of Dogma in Scientific Research*. In this earlier work, he examined how established scientific doctrines serve as guiding principles within normal science, shaping research practices and ensuring the stability of scientific paradigms. He argued that normal science, by its very nature, rests upon a foundation of dogma.[26] Toulmin disagrees with Kuhn on making such contrasts stating that the description of Newton in *Principia,* that an intellectual function is to establish a theory determine meaningful questions and legitimate interpretations within which a natural science will base its research, and on which Kuhn based his idea of normal science, does not mean a dogma but simply that scientific procedures are methodical.[27] In such a reaction, Toulmin did not agree with both Kuhn and Popper on the dogmatic spirit of natural science in the normal period.

Watkins had also an opportunity to interact with Kuhn on the matter of normal science. In a one to one discussion, he claimed to have advised Kuhn to consider revising his ideas to fit the ideas of Popper on how he, Kuhn, described the scientific community. He recounted having advised Kuhn that, instead of portraying the scientific community as a closed society—one that passes through phases of collective instability before regaining consensus—Kuhn ought to have considered Popper's perspective. From Popper's standpoint, science operates as an open society in which no theory, however dominant or successful, is ever beyond scrutiny or immune to challenge.[28] Watkin disagreed with Kuhn on three points; that Kuhn appraised normal science, opposed to extraordinary science as the essence of science, that normal science as described by Kuhn cannot leave a room to extraordinary science, and therefore revolution, and lastly on the issue stated above on how a scientific community should be organized.[29]

Second, there were reactions from the contemporaries on the idea of revolutionary science. Watkins refuted any possibility of crisis and revolution from the picture of normal science that Kuhn put forth. He observes that a theory in a governing paradigm is defended than tested. Kuhn saw science as paradigm-driven, while Popper emphasized continuous testing and falsification. In such manner of Kuhn's thinking, Watkins states that a reining paradigm will not be easily thrown out and that normal science cannot give room to extraordinary science and scientific revolution.[30] Watkins being of the Popper's school believed that science should be continuously revolutionary.

Imre Lakatos observed that the normal period of growth in science is the real science and the essence of any scientific development. The revolutionary science is extra-scientific. According to Lakatos, the failure of Kuhn lies in seeing the period of a critic as the 'abnormal period' because, according to him, that draws us to irrationalism. Lakatos held that what Popper described as a permanent revolution in scientific development holds more water than dividing science into the normal period and the revolutionary period.[31]

[24] Thomas Kuhn, "Logic of Discovery or Psychology of Research?" In Imre Lakatos – Alan Musgrave, eds., *Criticism and Growth of Knowledge-Proceedings of the International Colloquium in the Philosophy of Science* IV, Cambridge University Press, Cambridge 1970, 3.

[25] Popper, *Normal Science and Its Dangers*, 52-53.

[26] Thomas Kuhn, "The Function of Dogma in Scientific Research" in A. C. Crombie, ed., *Scientific Change: Historical Studies in the Intellectual, Social and Technical Conditions for Scientific Discovery and Technical Invention, from Antiquity to the Present,* Heinemann, London 1961, 349.

[27] Stephen Toulmin, "Does the Distinction between Normal and Revolutionary Science Hold Water?" in Imre Lakatos – Alan Musgrave (eds.) *Criticism and Growth of Knowledge-Proceedings of the International Colloquium in the Philosophy of Science* IV, Cambridge University Press, Cambridge 1970, 40.

[28] John Watkins, "Against 'Normal Science'", in Imre Lakatos – Alan Musgrave (eds.) *Criticism and Growth of Knowledge-Proceedings of the International Colloquium in the Philosophy of Science* IV, Cambridge University Press, Cambridge1970, 26.

[29] Watkins, *Against 'Normal Science',* 27.

[30] Watkins, *Against 'Normal Science'*, 28.

[31] Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes", in Imre Lakatos – Alan Musgrave (eds.) *Criticism and Growth of Knowledge-Proceedings of the International Colloquium in the Philosophy*

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Most of the philosophers from the Popper's school of thought held that scientific revolution is permanent, and this was agreed by the majority. The only issue they had with Kuhn is that he broke the permanency by normal science and made it seem more dramatic than it should be, with others holding that the normal progress in science presented by Kuhn cannot give a room for scientific revolution.

On the idea of incommensurability, Saul Kripke and Hilary Putnam developed an opposition towards the idea of the "world change". Their idea, which Kuhn agreed with after is that there are some "natural essences" or "natural kinds" that remain always unchanged in all scientific revolutions.[32] In that regard, the world does not change in totality, but it does partially. This manner of argument defends the prior thesis that in as much as the different theories are incompatible, they can be comparable in the common aspects.

- *Conclusions from the Literature Review*

The literature review has examined scholarly responses to the two revolutions in scientific progress, with particular attention to Kuhn's new vision of science. The review indicates that most scholars who have engaged with Kuhn's account tend to agree with him only partially—often accepting his characterization of normal science while rejecting or minimizing the revolutionary dimension. Kuhn, however, addressed many of these criticisms and consistently maintained his view of scientific progress as an interplay between phases of normal science and episodes of revolutionary transformation. Most of those who refuted the two phases together did so holding that each of the phases has no room for the other. This study considers both the normal phase and the revolutionary phase, aiming at justifying them epistemically in relation to truth. This is so because as Heidegger established, unconcealment comes together with a concealment, and therefore, the unconcealment of the normal period must be accompanied by the concealments of the revolutionary science.

IV. HEIDEGGER ON THE ESSENCE OF TRUTH

In the discussion of the concept of truth, Heidegger has recognized the relationship between truth and being that has been there since time immemorial.[33] He recapitulates in *Being and Time* conceptions of truth starting with the Parmenides view that one follows the truth as that which showed itself in itself.[34] He also discussed Aristotle's association of truth with things in themselves when he stated that the philosophers before him have been guided in their inquiry by the nature of things in themselves.[35] Heidegger, further recognized the definition of philosophy by Aristotle as the " science of truth". Philosophizing in that regard is the exhibition of something and to let it be seen in the regard of the truth.[36] In as much as philosophy is the science of truth, it is also a science that contemplates entities as entities. Such a contemplation that is compelled by the desire for the truth unites truth and being. This unification of truth and being, which Heidegger well agrees about, carries us back to that traditional conception of truth as correspondence that has permeated the development of philosophy throughout history. Heidegger, however, does not generalize the correspondence in the manner of the ancients, but keeping the distinction between Being and being, developed in *Being and Time,* his understanding of the truth of being. In that regard, the truth for entity is not equal to the truth for Being, which was taken generally.

In the analysis of truth since the ancient times to the present, truth according to Heidegger has always followed the idea introduced by Aristotle in the ancient times.[37] This is the idea of truth being an agreement, and then belonging to a relation. Kant's Copernican revolution that left us with the distinct phenomenon, and noumenon, Heidegger states, did not still destroy that conception of truth as a relation between the judgement and the reality (being).[38] According to Kant, truth can be spoken of only in relation to judgment, for judgment is a mental act that presupposes being. Building on this, Heidegger, in *Being and Time*, accepts the traditional view that truth functions as a relation insofar as it is correspondence. Yet he presses the inquiry further, asking: *"What else is tacitly posited in the relational totality of the adequatio intellectus et rei? And what ontological character does that which is posited itself possess?"*[39]

As the starting point of discussing and analyzing that traditional conception of truth as a relation, Heidegger observed that every agreement is a relation, but not every relation is an agreement. There are some relations that do not agree. He gave a mathematical relation of numbers which agrees with equality and that can never be on the same plan as the agreement in truth and knowledge. He states;

What, in general, is meant when we speak of "agreement"? Agreement always entails a relation of one thing to another. In this sense, "truth" itself can be understood as a kind of relation. Yet not every relation constitutes agreement. For example, a sign refers to what it designates, but such indication, though relational, does not amount to agreement between the sign and the object indicated. Agreement is more specific. Consider the case of numbers: the number "6" stands

of Science IV, Cambridge University Press, Cambridge 1970, 93.

[32] R. Read – W. Sharrock, *Thomas Kuhn's Misunderstood Relation to Kripke – Putnam Essentialism.*, 151.

[33] Martin Heidegger, *Being and Time*, J. Macquarrie – E. Robinson, trs., Blackwell, Oxford 2001, 256.

[34] Heidegger, *Being and Time*, 256.

[35] Heidegger, *Being and Time*, 256.

[36] Heidegger, *Being and Time*, 256.

[37] Heidegger, *Being and Time*, 257.

[38] Heidegger, *Being and Time*, 257.

[39] Heidegger, *Being and Time*, 258.

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in agreement with the expression "16 – 10," for they are equal. Equality, then, represents one particular form of agreement.[40]

The ancients viewed the correspondence in the understanding of truth as an equal relation such that what is in the mind related equally to that which is in reality apart from the obvious that one is material and the other immaterial. Heidegger, however, observes that the '*intellectus*' and the *'res'* cannot have such kind of a relation because they do not belong to the same species or the same reality. Their relationship is, therefore, a relationship of 'just as'.[41] On the other side, we cannot understand the truth as an immanent consciousness, and so reduce it to be a matter of the subject without the object. The consciousness of the subject without the object is just empty and nothing can come from that which is empty. Assertions and judgments, carrying the relationship that bring about the correspondence, belong to Being (*Dasein*). The assertions mean that what is stated or thought is the very entity that one has in mind. In that regard, Being points out to entity to uncover it.

In the understanding of the uncovering nature of entities, truth lies in the uncovering of the entities. This uncovering is the essence of truth as Heidegger puts it in a later work.[42] This primordial truth is rooted in the very structure of *Dasein* as being-in-the-world. In its relation to other entities, *Dasein* confers meaning upon them through the ways it employs and encounters them within the world. In this process, *Dasein* discloses the world itself, while entities simultaneously reveal themselves.

The facticity of *Dasein* is bound up with its closedness, which arises from its tendency toward falling. Thus, wherever there is disclosedness, there is also closedness; and in the same way, every act of uncovering (unconcealment) is accompanied by covering (concealment). To be in the truth, as intrinsic to *Dasein's* mode of being-in-the-world, necessarily involves an interplay with being in untruth.[43] Truth and falsity in that perspective go hand in hand and the line between them is very narrow. Heidegger states therefore that it is the responsibility of *Dasein* to explicitly appropriate what has already been laid bare in the uncoveredness[44] and to defend it against any kind of semblance and disguise. *Dasein* ensures the uncoveredness of entities again and again.[45] Uncovering, also referred to as discovering[46]does not mean that the uncovered entity is completely unhidden. Uncoveredness may start from a point of uncoveredness in the mode of semblance and bring the entity into a true uncoveredness.[47] There is a tendency of entities to appear uncovered, yet they are just disguised. This problem of discovery and hiddenness is key in the study, for it concerns the truth. Heidegger gives the responsibility of ensuring true uncoveredness to *Dasein*.

In his further discussion of the essence of truth as unconcealment—conceived as a fundamental role of *Dasein*—Heidegger, in *On the Essence of Truth*, examines the dynamic relationship between the unhidden and the hidden in relation to, and surrounding, *Dasein*. To ground this analysis, he turns to Plato's *Republic*, specifically the Allegory of the Cave, as a point of departure.[48] Heidegger divides the text into three sections, each highlighting distinct characteristics of both unconcealment and concealment. In the first part of the allegory, Socrates asks Glaucon to imagine a group of people dwelling in an underground cave, bound in such a way that they can only face forward toward the wall before them, unable even to turn and see one another. The cave's entrance is extended upward and open to the light, yet the light that reaches the prisoners comes from a fire burning behind them. Between the captives and the fire stretches a pathway, along which a low wall has been built—resembling the screen of a puppet theater that conceals the performers from their audience—behind which figures pass, carrying objects and exhibiting their craft. Along the pathway passes people, some talking, other silent and carrying all sorts of things, and the fire reflecting shadows of the prisoners and the people and things on the wall in front of the slaves. Both Socrates and Glaucon agreed that these prisoners are not capable of seeing any other thing apart from the shadows and their 'real' would remain just the shadows.[49]

In that section of the Allegory, Heidegger discussed the unhiddeness of being. In the first place, he observed that just as Plato talks of the shadows as the unhidden for the slaves, every human person (*Dasein*) stands before the unhidden (*Aletheia*) from childhood onward. This unhidden is the truth that is set day after day before each person, regardless of whether it is the real truth or the truth of the moment. *Dasein*, is defined as comporting oneself towards the unhidden or towards the truth.[50]

Secondly, the prisoners call the shadow the unhidden, and for them it is the real. Glaucon and those of us imagining of the allegory are the ones that know that what is the unhidden for the prisoners is not the real. The reason why they cannot know the distinction between the things and the shadow is that they have no experience of them and that the things have not set themselves before the slaves. Only the shadows have. From this

[40] Heidegger, *Being and Time*, 258.
[41] Heidegger, *Being and Time*, 256.
[42] Martin Heidegger, *The Essence of Truth: On Plato's Cave Allegory and Theatetus*, Ted Sadler, trans., (New York: Continuum, 2002), 20.
[43] Heidegger, *Being and Time*, 270.
[44] Uncoverdness means laying bare, or self-revelation. It should be understood in line with "unconcealment".
[45]Heidegger, *Being and Time*, 271.
[46]Gorner, *Heidegger's Being and Time*, 3.
[47]Heidegger, *The Essence of Truth*, 21.
[48] Plato, *Republic*, VI, 514 a - 517 a.
[49] Plato, *Republic* 514 a 2 - 515 c 3.
[50] Heidegger, *The Essence of Truth*, 20.

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analysis, it follows that human beings are always surrounded by hiddenness to the same extent that they stand before what is unhidden. In this sense, Dasein signifies not only a standing within the realm of the unhidden but also a continual being encompassed by the hidden.[51]Thirdly, it is the case that what is set before one. The unhidden is the being for the one to whom it is set before. The slaves do not know any other truth except the shadows at that point in the allegory.[52]

In the second part of the allegory of the cave[53], the allegory continues that if one of the prisoners is set free and faces the light and struggles against the light to see things in themselves different from the shadows. He might fail to tolerate the severe condition of the sunlight and wish to go back to his comfort zone - the cave and the shadows.[54] There are also some issues drawn from this part of the allegory. To start with, the unhidden has the character of being more or less unhidden. In that regard, there are different levels of what we refer as the truth. The shadows and the things for a normal person apart from the slave are different in terms of their unhiddeness. The things are more real, more unhidden and the shadows are less unhidden. Following the same thought, Heidegger notes that the Truth and truth are not the same such that it is not possible that the truth will be same in every aspect to every person. Everyone does not have the same right and strength towards the truth and so truth differs. It is for that reason that education holds it that some truths may be held from knowledge until its time is right.[55]

Secondly, there are multiple ways of approaching the various dimensions of the unhidden. For the former prisoner, the shadows continue to appear more real—or truer—than the objects themselves, whereas for the one who has released the prisoner, the objects are regarded as more real than the shadows. This is so because the prisoner is prevented by his former way of seeing things from seeing the more real. In that regard, the more unhidden we get to, the closer we get to being. The proximity to being enables the one seeing to do so more correctly, and he or she is closer to the Truth.[56] The reason as to why the prisoner is more comfortable at the shadows level is that they are in agreement with others in the cave, and that life is easier together seeing the shadows and not the real things.

The third stage presents the prisoner being dragged by force outside the cave, having to struggle through the burning from the sun to see things in themselves. At first he would have to be accustomed to the light, then start observing things as reflection under water, then have capacity to have a look at the sky in the night through the light of the stars and moon and then later even look at the things under the sunlight. At that level, he would pity his former way of life and the slaves he left in the cave for calling what is less unhidden to be more hidden.[57] This stage is the stage of freedom. The unhidden requires some force for liberation and personal struggles to arrive at the real.[58]

In the fourth part, the allegory calls for an assumption that if the freed slave happens to go back to the cave in his first position. It would first be difficult to adopt back from the sunlight and also that he would receive hostility from his former community who would feel that he is saying that which is not there.[59] It would, therefore, require each individual efforts to see the things in themselves and once seen from individual bases, then it can be seen in the communal level. The community cannot receive an insight but an individual can. There are various aspects of this discussion of the allegory, and the nature of truth in general from the perspective of Heidegger that will help us to see the reality of natural science according to Kuhn.

- *The Unconcealment Nature of Science and Truth*

This study has demonstrated, through an etymological inquiry into the term *nature*—the foundational concept of natural science—that it originates from the Latin *nascor*, meaning "to be born," and the Greek *physis*, signifying "to bring forth" or "to generate from itself." From this, it was further established that reality is characterized by continuous becoming, for within it lies the very principle of change.[60] The role of scientists is not to make the reality change, but to be able to observe, note the changes and be capable of explaining the changes using their principles. The principles, however, serve short because many times the reality presents a different aspect of its generation that may not be explained using the principles established by the natural scientists. This is so much in line with the discussion of the nature of truth put forth by Heidegger. He established that there is a difference between Truth and truth. The former is the totality of the unhiddeness which may not be attained because reality does not stop to unveil itself, and it is the nature of man to comport himself or herself to the unhidden.[61] There is, and there will always be a tussle of becoming both in reality and in truth and it is so because the truth is tied to the reality (being). According to Heidegger's interpretation of the allegory, the closer we stand to things themselves rather than to their shadows, the nearer we are to truth. Yet, since the epistemic relation between mind and reality is not one of exact correspondence but of degrees—"more or less"—there always remains the possibility of semblance within unconcealment. Consequently, the occurrence of error is an inherent and likely possibility in the process of scientific discovery.

[51] Heidegger, *The Essence of Truth,* 21.
[52] Heidegger, *The Essence of Truth,* 21.
[53] Plato, *Republic,* 515 c 4 - 515 e 5.
[54] Plato, *Republic* 515 c 4 - 515 e 5.
[55]Heidegger, *The Essence of Truth,* 25.
[56] Heidegger, *The Essence of Truth,* 26
[57] Heidegger, *The Essence of Truth,* 26.
[58] Heidegger, *The Essence of Truth,* 29.
[59] Heidegger, *The Essence of Truth,* 30.
[60] Congiunti, *Outlines of Philosophy of Nature,* 15.
[61] Heidegger, *The Essence of Truth,* 20.

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➢ *Cumulative Truth and Scientific Paradigm Shift*

As discussed, Zeingler observed in the nature of growth of natural science that the scientists believed that their findings accumulated truth in a lineal way towards a fuller attainment of it.[62] This was held as the nature of growth of scientific truth until the revolution of Kuhn in the *Structure*. In the work, Kuhn observed that the cumulative growth happens to be the case in the normal period of science but it does not proceed to the revolutionary science. In the period of paradigm shift, there is no continuation in the development of truth, and some truths are even lost when new paradigms take charge because such truths may not fit in the new system of scientific principles. Scientific truth, therefore, grows partly cumulatively and partly through paradigm shift.

In the discussion of the nature of the truth as unhiddeness, even though Heidegger observed that man stands before the unhidden (truth) and is surrounded by the hidden, there is the process of change from the hiddenness to unhiddeness, but the turn from unhiddeness back to hiddenness is not taken as part of the truth dynamics. Once the slave has been freed and sees the reality, it is unbelievable that the seen may turn again to be unseen, or that the man can be satisfied again by seeing the shadows.

The idea is that aspects of "Kuhn's loss" or even aspects of changing truth to be falsity can be a great error in the development of scientific truths. It is allowed in the growth of truth that some semblance may be mistaken for unhiddeness[63] and that truth may be obtained partially, but loss of some truths and change of others from unhidden to hidden cannot be the case unless one held truth was erroneous and therefore not truth. What is lost, therefore, is merely a shadow—an error. In this sense, what is often described as "Kuhn's loss" should more appropriately be understood as "Kuhn's gain," for it marks the liberation of scientists from entrenched prejudices.

➢ *Evaluation of the Idea of Revolutionary Science*

The major characteristic of the revolutionary science, different from the normal science is the period of the paradigm shift. This occurs when behavior of nature changes that it cannot be explained any longer using the theories and principles set in place. The scientific community starts to think outside the existing paradigms and turns towards a new ways of explanations that can hold the novelty in nature.

The journey of change from one paradigm to the next is a difficult one that needs one to be forcefully dragged and compelled to change his manner of seeing the reality. The normal period of science that allows scientists in a community to comfortably think in some manner reveals a certain unhidden that requires a great commitment to change the view. This can be likened to the difficulty of the slave in the second part of the allegory to shift from the cave and the shadows to see the reality and so choose to continue living in the comfort of the shadows. There is always need for liberation from the part of the scientists that they should be prepared towards a possibility of the paradigm shift so that they may keep par with the unveiling of the unhidden.

It is considered in this study that paradigm shift is not necessarily a concept against truth. There is a possibility that it is a natural way that the natural science eliminates error from its system, especially when some truth is lost during the paradigm shift. On the other side, incommensurability prevents a repetition of the same scientific error from one paradigm to the next.

V. FINDINGS AND CONCLUSIONS

This study has discussed the new vision presented by Kuhn in the *Structure*, a vision that established a revolutionary growth in progress of natural science, different from the continuous cumulative view held by scientists at the birth of natural science. From the revolutions of science, ideas of "Kuhn's loss" and incommensurability are justified to be consistent with the nature of truth established by Heidegger. In such consistency, therefore, natural science is truth oriented.

The following findings have been established;

- That the new vision of Kuhn's scientific progress that calls for a revolutionary science is truth oriented.
- There is a possibility of error in a scientific progress because truth as correspondence does not mean exactness between reality and the mind.
- That the idea of "Kuhn's loss" safeguards truth from any errors held prior to the real uncoverdness.
- That the idea of incommensurability prevents a repetition of an error held in a prior paradigm within a successive paradigm.

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[62]Zeigler, *Evolution and Cumulative Nature of Science*, 585.

[63] Heidegger, *The Essence of Truth*, 21.

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