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Epistemic Justification of Kuhn's Structures of Scientific Development

Evaluation of the Idea of Incommensurability and "Kuhn's Loss" in Scientific Paradigm Shift

Mathew Ngimbi Muasya[1]; James Kabata Wangai[2]; Kenneth Oduori Makokha[3]

[1,2,3] Catholic University of Eastern Africa

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Abstract: Natural science has developed through phases that we shall refer here as the first revolution and the second one. The first revolution saw natural science develop from the philosophy of nature after the invention of scientific method through the collaboration between Galilei Galileo and Keipler. After this revolution, and as Zeigler observes, natural science held that its truth grew in a lineal and cumulative manner towards a fuller truth. Thomas Kuhn, a historian of science and a philosopher, through the study of the history of science developed a concern that scientific development does not progress in a lineal manner but through shifts of paradigms, a progress that starts with normal science, after the discovery of a foundational paradigm, and grows through crisis period to the shift of paradigm into a new one. This is the notion of a second revolution in science. Paradigms relate in an incommensurable way, an idea referred to as incommensurability, and also that as science gains knowledge within a period of paradigm shift, it also loses knowledge, an idea referred to as "Kuhn's loss". This study will investigate the notion of Incommensurability and the notion of "Kuhn's loss" to justify the epistemic truth orientation of the nature of scientific structures put forth by Kuhn. It will defend the position that Kuhn's loss is in fact a gain, and should be referred to as "Kuhn's gain" for it is a criterion for eradication of possible error in scientific knowledge. With the possibility of error in knowledge, the idea of incommensurability is vital for it also avoids a possibility of reoccurrence of error in knowledge.

***Keywords**: Epistemic Justification, Truth, Error, Paradigm Shift, Incommensurability, Kuhn's Loss.*

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I. INTRODUCTION

In the course of Scientific development, there has been a period when the development of Natural Science was observed to be a lineal accumulation towards the fuller attainment of the truth.[1] This favoured the philosophical understanding of truth in its etymological Greek word *ἀλήθεια* – Aletheia, which literally means unhidden.[2] This unhiddenness is determined by being that which slowly unveils itself to the knower. Thomas Samuel Kuhn (1922 – 1996) wrote the work *Structure of Scientific Revolution*, hereafter referred to as *Structures* in this study, its first edition seeing light in 1962, and bringing forth a different view of scientific development that influenced the Philosophy of Science and some other disciplines like Sociology from that time.

In the *Structures,* Kuhn, challenging the classical perspective on scientific development and drawing from a critical analysis of the history of science[3], argued that science progresses through distinct phases. He noted that, in the years leading up to his work, some historians of science had encountered difficulties in upholding the traditional notion of scientific advancement as a continuous process of

[1] David Zeigler, "Evolution and the Cumulative Nature of Science", in Ross Nehmin, ed., *Evolution: Education Outreach* 5, Springer, Newyork 2012, 585.

[2] Martin Heidegger, *The Essence of Truth: On Plato's Cave Allegory and Theatetus*, T. Sadler, trs, Continuum, London 2002, 3.

[3] Thomas Kuhn, *The Structure of Scientific Revolutions III*, University of Chicago Press, Chicago 1996, 1.

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accumulation.[4] Rather than examining the relationship between various theories and discoveries as if they were seamlessly built upon one another, scholars shifted their approach. Instead of focusing on how older science contributed to new theories, they prioritized understanding of the historical integrity of scientific developments within their own time:

Gradually, and often without entirely realizing they are doing so, historians of science have begun to ask new sorts of questions and to trace different, and often less than cumulative, developmental lines for the sciences. Rather than seeking the Permanent contributions of an older science to our present vantage, they attempt to display the historical integrity of that science in its own time. They ask, for example, not about the relation of Galileo's views to those of modern science, but rather about the relationship between his views and those of his group, i.e., his teachers, contemporaries, and immediate successors in the science.[5]

Building on the insight that science does not progress through cumulative growth, Kuhn formulated a new theory of scientific development in the *Structures.* According to him, science grows in phases. It shall be considered in this study the phases of scientific growth: normal science, the scientific crisis period, discoveries of a new paradigm, and the paradigm shift.

Normal science is a phase within the dominance of a paradigm, during which scientific research advances systematically, relying on one or more established scientific achievements recognized by a scientific community.[6] The community in this period greatly trusts the achievement, holding it as the base for solving many, if not all, of its scientific problems. This foundational achievement becomes the reigning paradigm.

During this period, scientists within the scientific community focus on expanding the knowledge of paradigm-established facts, ensuring alignment between these facts and the paradigm's predictions. Their work primarily involves structuring nature to fit within the framework of the paradigm.[7] During the period of normal science, and considering that the foundational belief may not solve all the problems that come forth, the scientific community tries to defend the assumption at all costs, avoiding any anomalies that may affect the reign of the paradigm.[8]

The crisis period occurs because nature presents new facts that cannot be explained within the assumptions of the existing paradigm. As a result, scientists are compelled to develop new discoveries and theories to account for these emerging phenomena.

On other occasions, a piece of equipment designed and constructed for the purpose of normal research fail to perform in the anticipated manner, revealing an anomaly that cannot, despite repeated effort, be aligned with professional expectation. In these and other ways besides, normal science repeatedly goes astray. And when it does - when, that is, the profession can no longer evade anomalies that subvert the existing tradition of scientific practice-then begins the extraordinary investigations that lead the profession at last to a new set of commitments, a new basis for the practice of science.[9]

In the situation of the extraordinary investigation and discoveries, the scientific community starts shifting slowly from the older foundational belief to a new one to accommodate the novelty. This is the period of paradigm shift. The old paradigm loses its strength and is, with time, substituted by a new paradigm.

An important aspect to note in Kuhn's novelty is that an older paradigm and a new one are incommensurable. "The general idea of incommensurability is that the existence of changes in [paradigm shift, calls for change in] perception, world, standards of evaluation or in the meanings of key theoretical terms."[10] Various philosophers have understood Kuhn to associate incommensurability with incomparability, but they are not equal terms.[11] It should not be seen as a progress from a weaker theory to a corrected new theory. He also contended that, following this line of thought, scientific terms undergo shifts in meaning, leading to translation difficulties and a lack of universally accepted standards for evaluating theories.

"Kuhn loss" is the idea that following Kuhn's phases of scientific growth, knowledge is lost as it is gained at the same time.[12] The period of normal science is highly praised by the scientists, while the period of paradigm shift is not welcome. Normal period works in the manner in which scientists want it to work, and it is a period of gain. The period of scientific revolution gains because of new discoveries but loses because new theories emanating from new paradigms will ask and answer some questions that the old paradigm and old theories could not answer, that becomes the anomaly, but the new paradigm may not be able to answer some problems that the old paradigm could answer. The incapacity of a new paradigm to answer questions that were well taken care of by an older paradigm leads to a knowledge loss. This is so because any knowledge that cannot be justified – given reason for – is not knowledge at all.

Among the cases in science that Kuhn states include the change that came with Newton's dynamics, that ignored the question of attractive forces among particles and a problem that was the basis of general theory of relativity. Also stated

[4] Kuhn, *The Structure of Scientific Revolutions* III, 2.
[5] Kuhn, *The Structure of Scientific Revolutions* III, 3.
[6] Kuhn, *The Structure of Scientific Revolutions* III, 10.
[7] Kuhn, *The Structure of Scientific Revolutions* III, 24.
[8] Kuhn, *The Structure of Scientific Revolutions* III, 5.
[9] Kuhn, *The Structure of Scientific Revolutions* III, 6.
[10] Alexander Bird, *Thomas Kuhn*, Acumen Publishing Limited, Chesham 2000, 149.
[11] Bird, *Thomas Kuhn*, 149.
[12] Paul Hoyningen - Huene, *Reconstructing Scientific Revolutions*, University of Chicago Press, Chicago 1993, 260.

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was the case of Lavoisier's paradigm which did not bother with the question on the common behavior of metals, a question that phlogistic chemistry had asked and answered. Last, there is evidence of "Kuhn's loss" between Descarte's vortex theory and Newton's gravitational theory because Descarte's theory can explain why planets revolve in the same direction, while the Newton's theory cannot.

The proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards or their definitions of science are not the same. Must a theory of motion explain the cause of attractive forces between particles of matter or may it simply note the existence of such forces? Newtons dynamics was widely rejected , unlike both Aristotle's and Descarte's theories, because it implied the latter answer to the question. When Newton's theory was accepted, a question was therefore banished from science.[13]

Kuhn's novelty has been discussed and reviewed by various scholars of his time and beyond in each of these aspects. The novelty he brought, however, is widely agreeable and has become the criterion of science to the present age. This study, however, seeks to evaluate the inclination of the structures of scientific development to truth, founded by philosophical epistemology, which is a criterion for truth, especially on matters of incommensurability and "Kuhn's loss". This is so because, a knowledge established in truth cannot be lost. Also, any knowledge – a justified true belief – coheres within the totality of knowledge and in that regard, there should not be a talk of incommensurability between knowledge.

The results of the study will find Kuhn's structures justifiable and that the ideas of incommensurability and "Kuhn's Loss" aid in preventing error and in eradication of any existing error.

II. CONDITIONS FOR THE POSSIBILITY OF KNOWLEDGE

Epistemology has the role of determining the criteria for knowledge, and for that reason being a criteriology[14], it spells the manner in which knowledge is, and should be established, but also it is concerned with giving the criteria for the evaluation of the same knowledge.[15] The evaluation involves justification of knowledge. In the first role of Epistemology stated above, any knowledge is established from being a true belief that is justified. Let us place scientific knowledge under the criteria of Epistemology, to see the gap that could have brought the ideas of knowledge loss and its incommensurability.

➢ *Belief as a Condition for Knowledge*

Belief as a condition for the possibility of knowledge is expressed in the conditional form that "If S knows that P, then S believes that P." In that case, it is, therefore, impossible in any case to claim a knowledge when the knower is not convinced about the knowledge.[16] The rationale for this condition is the possibility of doubt in knowledge. If someone is not convinced in his or her belief, then one is doubtful about them. Belief, therefore, is considered in the test for knowledge to ensure that the knowledge may not be doubtful. Scientific knowledge being propositional, then when one holds a proposition that they have never bothered to investigate whether the proposition refers to what is the case, then the person cannot claim to know that P. This is so because lack of firmness in the belief leads to uncertainty that hampers knowledge. This uncertainty is cleared when one consciously looks for reason to believe that P. This could be by hearing it from another person who has an evidence of it or from experiencing that P is the case.[17]

There are two kinds of beliefs: dispositional belief and occurrent belief[18], both necessary conditions for knowledge, and one based on the other. Dispositional belief is the capacity within to belief even before one is introduced to any kind of proposition. It is an a priori condition for belief and, therefore, for knowledge.[19] This may include the consciousness and the capacity to assent or decline in the faculty of the will and intellect. The occurrent belief on the other hand is the explicit actual awareness of a particular proposition and accenting to it.[20] The capacity to hold the proposition – dispositional belief – leads to the explicit believing. It is, however, important to note that dispositional belief alone cannot lead to knowledge, unless it is actualized by the occurrent belief. For example, if one has a roof that is leaking, and is capable of knowing that the roof is leaking, this person does not know that the roof is leaking until he becomes aware of the particular state of affair.

It is for this reason that we have some people who have particular knowledge and others who do not have it even when they have the capacity to know it. This is so because those who do not know have not paid attention to the particular knowledge to have their insights of the particular cases. The distinction between dispositional belief and occurrent belief reflects a situation in a scientific community. Having accented to a paradigm in charge, does not mean that one will have knowledge of every particular explanation that the paradigm can serve. In that regard, given that the community has no mind, but has particular members, disposed to belief in their theories, not merely because they are members of the scientific community but because they are first convinced individually before they are convinced communally. The community can neither have the dispositional nor the occurrent belief necessary for knowledge.

[13] Thomas Kuhn, *Structure of Scientific Revolution* III, 148.
[14] Joseph M. Nyasani, *Epistemology*, 20.
[15] Nyasani, *Epistemology*, 20.
[16] Solomon Isenyo, *A Critical Analysis of the Three Conditions for Knowledge*, Federal University Wukari Press, Tabara 2020, 131.
[17] Laurence Bonjour, *Epistemology*: *Classic Problems and Contemporary Responses*, Rowmann and Littlefield Publishers, Lanham 2010, 25.
[18] Bonjour, *Epistemology*, 25.
[19] Bonjour, *Epistemology*, 25.
[20] Bonjour, *Epistemology*, 25.

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Apart from the question of consciously and explicitly holding the belief, there is also a question of how strong one's belief is. One may be consciously holding a belief and accenting to it, but being doubtful of it. The stronger the belief, the firm the knowledge. Weak beliefs leads to uncertainty which hampers knowledge.[21] Descartes held that before one accents to any idea as knowledge, they must be certain that the idea is the case. Many philosophers, however, have argued that most of our beliefs and knowledge for that sake, are intuitive and from common-sense which can never attain certainty, also that intuitive knowledge and that of common sense cannot be avoided in any kind of epistemology.[22] This, we say, would be the cause of error in knowledge, but in truth any belief held should be certain as a condition for the possibility of truth. Error gets into the play when weak beliefs are employed in the system of thought. A scientific community would be freer from error if each member would be allowed to freely think outside the constraints of the community and share their thoughts in a communal level, letting it be free that one may go against the paradigm if it does not hold water instead of doing the mop-up works to prolong the reign of a paradigm. This is so because it is rare for all different members of a community to fall in same error within a search for truth.

➢ *Truth as a Condition for Knowledge*

The rationale behind truth as a condition for knowledge is that one cannot know what is not the case. An epistemic proposition that is true must refer to something in reality.[23] The truth is, in fact, determined by the reference to reality, having the correspondence theory of truth as its criterion.

It is widely accepted through all areas of knowledge that truth is the end of any kind of epistemic endeavor. The activities of knowing, however, are occasionally aborted by the lack of truth, either due to error or intended lie. In occasions where truth is not arrived at as the end, falsity is attained. In such occasions, one will believe to know the truth, yet he or she would not be knowing the truth. Such is a failure in knowing, and anyone who ascribes to a truth that is later proved to be not the case, withdraws the claim of knowledge because it is intuitively wrong to ascribe knowledge where the claim in question is not in fact true.[24] The condition of truth and that of justification are strongly tied together because the reason for a belief qualifies it to be true. There is no way that a knower can separate his claim for truth and his reason for his belief.[25]

There is, however, a distinction between the truth and a reasoned belief, and for that reason we hold truth as a separate condition for knowledge from the reason for the truth(justification). This is also what makes it difficult for one to distinguish falsity from the truth in times of error. A reason for truth will be an explanation or demonstration of why the case is true. Falsity may, and most of the time has also reason for. A proposition that carries some falsity may have enough reason why it is the case, yet it is not the case. In that line of thought, falsity can be justified.[26] This is what makes many people live holding a case of position that is not the case. For example, for a long time, many people who lived before Columbus held that the earth was flat until it was proved that it is indeed spherical. There were enough reasons to justify that it was flat then, and the reasons fitted the explanations, but still so, the earth was found not to be flat. In that regard, a reason for, is not always truth. The reason for truth that is truth is, therefore, a reliable reason, while there could be reasons for that are not reliable and may only be realized when new information faces the body of justification, and impeaches the old unreliable reason. For that reason, reason for is relative not transitive and those who search for truth need mental states that are open to revision and correction in matters of reason and truth because there may be congruence between a proposition and explanation of the proposition, yet the proposition turns to be false.

This distinction between a reasoned belief and truth brings in mind the idea of "Kuhn's loss". It is a fact that after the shift of paradigm in scientific development, some knowledge is lost in the sense that the new paradigm may not be able to explain the knowledge or justify it. It brings about incongruence in the relationship between the explanandum and the explanans of the lost knowledge. It has been stated above, an idea borrowed from Leplin that the test for rationality comes forth when new information is presented. If the rationality to explain the new information withstands the new information and the new knowledge coherently fits into the knowledge system, then the rationality for such knowledge is robust[27] and chances for it being true are high because truth does not contradict. Following such, we bring forth an insight that the reason for "Kuhn's loss" could have been due to a weak rationality that may have been caused by unreliable reason. In such a case, therefore, a period of paradigm shift is a great time to test whether a scientific knowledge is robust. The lost knowledge could have been falsity and not knowledge, and the best thing to do in such is to abandon it. In that line of thought, the idea of "Kuhn's loss" is a natural clean-up process in natural science through which it eliminates error.

➢ *Justification as a Condition for Knowledge*

The last traditional condition for knowledge is justification or reason for belief. As already discussed in the previous section, justification and truth cannot be separated distinctively, even though as discussed, there is a difference between "reason for" and truth. Some valid reasons do not lead to truth.

Justification ensures that any knowledge arrived at is not just a matter of guess or luck but a position that the knower may well defend. Guess and luck are not

[21] Bonjour, *Epistemology*, 27.
[22] Bonjour, *Epistemology*, 27.
[23] Bonjour, *Epistemology*, 28.
[24] Bonjour, *Epistemology*, 29.
[25] Jarett Leplin, *A Theory of Epistemic Justification*, Springer, New York 2009, 62.
[26] Leplin, *A Theory of Epistemic Justification*, 61.
[27] Leplin, *A Theory of Epistemic Justification*, 62.

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knowledge.[28] For example, in a situation where there is a test that involves multiple choices, and a leaner by mere guess points out to the correct choice, this learner cannot be said to know the answer to that particular question he or she answered correctly by guess. The intuitive powers of the learner will also make him know that he does not have knowledge on the particular area.[29] It is possible, however, that sometimes in occasions of guessing, a true belief may just be as good as knowledge and in an exaggerative way may be described as so, but epistemically, there is no guess that is knowledge.

Just as in matters of belief that may be weak or strong, justification may be weak or strong. A robust knowledge needs a strong justification. In natural science, for example, in times of normal science, the paradigm in reign is strong enough to explain the details of nature revealed. During that period, science grows and develops because nature fits well in the paradigm and the paradigm gives strong reasons to justify the behavior of nature. Problems arise when new behaviors arise, mop up works are done but still some new behaviors of nature fail to fit in the parameters of the paradigm. Those are moments when the paradigm grows weak and being unable to justify the behavior of nature anymore, a new paradigm is created to replace it. Paradigm being the reason for explaining reality at the moment of its reign grows weak or strong depending on how it can justify every behavior of nature.

Most of the knowledge we have is not obtained from first hand personal insights but is reported. An authority is not sufficient reason for knowledge, but the knower, deontologically, has a responsibility of testing the received knowledge to ensure that there are no errors before claiming it as knowledge.[30] What is required in knowledge is evidence in favor of the truth. An epistemic reason must be truth conducive.[31] An evidence for a scientist or a justification for his or her theory may be forms of instrumental readings and laboratory observations in favor of truth of some particular scientific theory.

III. POSSIBILILITY OF ERROR IN SCIENTIFIC ENDEAVORS

Error is a mistake that is unintentional. It happens through misinterpretation of reality. The intended end of the one who errors is to present rightly, but due to a reason or another he or she ends up presenting wrongly. Even if this happens unknowingly, there is knowledge behind it. The fact that one can realize the error, it means that the person is heading towards the right presentation. It would be absurd to say that one has errored without knowing the right way of undoing the error.

How is error important in knowledge? An error means that one is in the right way towards presenting it right. That presenting rightly is knowledge. Every error is therefore a move towards the right direction of knowledge. It is the right move, however, only when it is realized. If it is not realized, it could be treated as the truth and block the truth.

Some sciences use error as a guarantee for knowledge. That error is treated in an acceptable relationship to the truth in that some margin of error is allowed and is treated as the truth. These are the sciences that do not treat exactness as the only measure of reality. In every scientific experiment, there is a range of results that are grouped as the case. Error in such sciences becomes part and parcel of the correct research and the truth. This kind of error, foreseen, is known as the prospective error.[32] It is not a major concern of this study, however, for a further study it can move truth closer to falsity when it is tolerated for longer with its probable sequences. The error we are concerned with is the retrospective error which were held to be true, and later on were realized as falsity.[33]This kind of error is the threat to knowledge.

There is another dimension of error that helps the growth of the natural sciences. Due to realization of the difficulty of accuracy, Galileo gave a room for error in scientific experimentation.[34] Given that error is tolerated, it leaves a dimension of the limitation of human knowledge. That fact not only consoles the one who has errored, but the limitation gives hope for a possible future falsification of the knowledge acquired that changes the paradigm and the principles of the field of knowledge, which brings about a growth in science.

Having been tolerated in science, and having pointed out to the aspects of the scientific community taking charge over individual scientists, the idea of having justification for falsity has led to the u – turn shifts we have seen in natural science such as the shift from heliocentrism to geocentrism. This occurred due to the distinction created above between reason for, which is justification, and truth. Reason for does not necessarily mean that the situation is the case, that is, truthful.

IV. JUSTIFICATION OF THE IDEAS OF INCOMMENSURABILITY AND THE IDEA OF "KUHN'S LOSS"

The possibility of error established in the study is the justification of the Ideas of "Kuhn's loss" and the idea of

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28 Bonjour, *Epistemology*, 35.
29 Bonjour, *Epistemology*, 36.
30 Leplin, *A Theory of Epistemic Justification*, 22.
31 Bonjour, *Epistemology*, 35.
32 Bart Karstens, "The Lack of Satisfactory Conceptualization of the Notion of Error in the Historiography of Science: Two Main Approaches and their Shortcomings" in Boumans Marcel – Giora Hon – Athur Peterson *Error and Uncertainty in Scientific Practice*, Pickering and Chatto, London 2014, 15.
33 Bart Karstens, "The Lack of Satisfactory Conceptualization of the Notion of Error…", 15.
34 Marcel Boumans – Giora Hon, "Introduction" in Boumans Marcel – Giora Hon – Athur Peterson *Error and Uncertainty in Scientific Practice*, Pickering and Chatto, London 2014, 4.

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incommensurability. This justification follows the criteria discussed here after.

➢ *Justification of the Idea of "Kuhn's Loss"*

Referring back to the words of Kuhn in the *Structures*, also quoted in the section (1.0) of this study as we introduced the idea of "Kuhn's loss", the establishment of the theory of Newton brought a new idea that could not accommodate the explanations that had been given in Descartes's and Aristotle's on the movement of bodies. This is so because in Descartes Vortices, borrowed greatly from Aristotle's philosophy, there were no attractive forces between bodies, an idea that was central in Newton's theory. In that regard, some already established knowledge was lost with the invention of Newton.

The idea of knowledge loss is problematic in any epistemology. The ultimate goal of any epistemologist is to arrive at a knowledge that is well established, that is, truthful and justifiable. It was of great concern how science would have a nature of losing knowledge and even falsifying it.

This study has established the roots of the loss of knowledge. While discussing the three traditional conditions for knowledge: belief, truth, and justification, an insight came while discussing the distinction between a reasoned belief and truth. A reason for a belief is its justification. Justification does not indicate truth necessarily because even falsity can be justified. An issue that is not the case will also have its justification. This is the reason why when the seekers of truth fall into error, they sometimes don't realize the error. If justification and truth would coincide, then no one would not fall into error.

Let us look at the example of the shift from geocentrism to heliocentrism. During the reign of geocentrism, philosophers of nature had all reasons to justify that the earth is at a standstill while the sun revolves around the earth. It was a justified falsity, an error that was realized only when heliocentrism was established because its principles could not accommodate the earth being at a standstill and the sun in motion. The latter case has its models of justification.

Due to that fact that justification or reason for does not necessarily mean that such is the truth, error falls into scientific findings, and scientists may find themselves holding a justified error without their awareness. In the case of Descartes' vortices, there was an error that bodies do not have any forces of attraction, an error that was only realized when Newton brought in the theory that calls for attraction between bodies.

In the manner of scientific justification demonstrated above that is prone to error, paradigm shift is a process through which science cleans itself by shedding off any errors that were held in the name of truth. This study, therefore, establishes that the idea of loss of knowledge in science is not anti-truth but pro-truth in the sense that such called knowledge loss is the clearance of held errors that are easily detected at the moment of paradigm shift. This follows from Leplin's finding that the best moment to test the truth of a hypothesis is when new information is brought forth.[35] "Kuhn's loss" should not even be defined as moment of knowledge losing in paradigm shift but a moment of clearing error, it should in fact be called "Kuhn's gain" because an erroneous knowledge is not a knowledge at all, and if it had never been a knowledge it cannot be lost.

➢ *Justification of the Idea of Incommensurability*

Incommensurability is justifiable for natural science because two paradigms and their truths are not comparable. One is not allowed to justify a former truth using a later paradigm. This is so because of the insisted idea of paradigm shifts based on the notion of the dynamic reality and dynamic knowledge prone to error, whose eradication may reshape the deposit of knowledge. This means that even if two perceptual objects originate from the same sensible object, they cannot be judged using the same criteria because perception is shaped by individual cognitive and contextual factors, making each perceptual experience unique. The sensible object is changing. In some occasions, however, there is continuity of truth and its justification across paradigm shifts. The position of incommensurability is vital, though, because inasmuch as we have the continuity, we also have the discontinuity and the "Kuhn's loss".

V. CONCLUSION

This study has introduced the general structure of scientific development according to Kuhn's *Structures*. The aim of such was to establish the ideas of incommensurability and the idea of "Kuhn's loss" that come along with the period of paradigm shift. The reason for pointing them out was that they seemed to incline the scientific knowledge away from truth. This was so because of the criteria of epistemology that truth is coherent and consistent. A keener study on the conditions for truth has showed it that truth of natural science, just as other truths in knowledge, is prone to error due to the distinction between reason for and truth. For that reason, this study has established the two ideas in Kuhn's structure: idea of incommensurability and that of "Kuhn's loss" as pro-scientific truth and as guards against error.

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