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IN SEARCH OF PURELY SCIENTIFIC CULTURE: A NORMATIVE CRITIQUE OF SCIENTISM, KARL POPPER, AND THOMAS KUHN'S DISPOSITIONS

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As science continues to expand its capacity to explain the nature of existence and reality, a new belief system has emerged regarding how humans can acquire pure knowledge, often referred to as Scientism. Scientism posits that science is the exclusive source of knowledge about the world. This belief gained prominence in the early 20th century, influenced by movements such as logical positivism. Prominent thinkers such as Karl Popper, A.O. Quine, Thomas Kuhn, and Ernest Nagel have contributed to the refinement of scientific practice. This article offers a critical philosophy of science, safeguarding it from dogmas, biases and pseudo-practices while engaging with Karl Popper and Thomas Kuhn's notions of "Real-Science" and enhancing the pursuit of a purely scientific culture. The history and philosophy of science owe much to Karl Popper and Thomas Kuhn, who delved into significant aspects of the philosophy of science, including its logic, doctrines, and evolution. Aligned with the viewpoints of Karl Popper and Thomas Kuhn, this paper is structured into five sections. When examined collectively and viewed through the lens of the hermeneutic circle, these sections share the overarching objective of elucidating the essence and methodology of science, providing a critique of scientism, and, as a result, presenting a blueprint for guiding the transition towards purely scientific culture and temperament:

1. Introduction: Science, Scientific Practice, and its logical Foundations
2. Induction and Background Theories of Scientific Practice
3. Socratic Spirit in the Karl Popper's Falsificationism
4. Thomas Kuhn and the Systematic Phases of Scientific Growth
5. Conclusion and an Integrated Way to pure Scientific Culture.

Keywords: Karl Popper, Thomas Kuhn, science, philosophy, sense, process

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В ПОИСКАХ ЧИСТОЙ НАУЧНОЙ КУЛЬТУРЫ: НОРМАТИВНАЯ КРИТИКА СЦИЕНТИЗМА И ДИСПОЗИЦИЙ КАРЛА ПОППЕРА И ТОМАСА КУНА

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Поскольку наука продолжает расширять свои возможности по объяснению природы существования и реальности, возникла новая система убеждений относительно того, как люди могут приобретать чистые знания, часто называемая сциентизмом. Согласно сциентизму, наука является исключительным источником знаний о мире. Данное убеждение приобрело известность в начале XX века под влиянием таких движений, как логический позитивизм. Выдающиеся мыслители, такие как К. Поппер, А.О. Куайн, Т. Кун и Э. Нагель внесли свой вклад в совершенствование научной практики. Эта статья предлагает критическую философию науки, защищая ее от догм, предубеждений и псевдопрактик, одновременно используя понятия Карла Поппера и Томаса Куна о «настоящей науке» и способствуя стремлению к чисто научной культуре. История и философия науки во многом обязаны К. Попперу и Т. Куну, которые углубились в важные аспекты философии науки, включая ее логику, доктрины и эволюцию. Эта статья, соответствующая точкам зрения Поппера и Куна, состоит из пяти разделов. Если рассматривать их как целое, а также через призму герменевтического круга, можно заметить, что эти разделы объединяет общая цель, включающая прояснение сущности и методологии науки, критический анализ сциентизма и, как следствие, описание контуров перехода к чисто научной культуре:

1. Наука, научная практика и ее логические основания
2. Индукция и фоновые теории научной практики
3. Сократический дух в фальсификационизме Карла Поппера
4. Томас Кун и систематические фазы роста научного знания
5. Заключение и интегрированный путь к чистой научной культуре.

Ключевые слова: Карл Поппер, Томас Кун, наука, философия, смысл, процесс

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1. Introduction: Science, Scientific Practice, and Its Logical Foundations

Aristotle, in his renowned work "The Metaphysics," famously stated that all humans inherently desire knowledge (Lear, 1988, p. 7). Beyond this innate thirst for knowledge, human beings have also sought proper, justified methods to acquire knowledge about the world and beyond, which falls under the purview of epistemology. Throughout history, various thinkers have proposed diverse sources and methods for acquiring knowledge, with science being one among them. In recent centuries, the pursuit of knowledge has been significantly influenced by scientific practices. However, it is important to clarify that science and scientism are not one and the same, as we intend to demonstrate by the end of this paper. Science has risen in prominence due in part to its increasing ability to provide rational explanations for natural phenomena, replacing previous reliance on paranormal speculations. In the modern discourse on science, the prevailing idea is that nothing happens randomly or without a systematic framework. Science, in essence, "is a realistic and systematic approach to understanding the natural world, characterized by rigorous methodologies, experimentation, and observation" (Thomson, 1939, p. 6). It acknowledges its limitations, recognizing that it may not be able to address all the questions related to ethics, values, or personal meaning effectively. On the other hand, "scientism is a strict and often an ideological perspective that champions certain exclusive and superior empiricist method for acquiring knowledge, relegating other forms of understanding, like religion or philosophy, as irrelevant or inferior" (Stenmark, 2020, p. 1). Scientism asserts that if something cannot be empirically tested or measured, it lacks value in the pursuit of knowledge. In line with this perspective, our normative composition emphasizes the importance of distinguishing between science and scientism to promote a purely scientific culture. It will depict that while science is valuable for exploring the natural world, scientism's limitation to measurable knowledge has drawbacks. A true scientific culture values interdisciplinary dialogue, diverse methods and recognizes that axiology and metaphysics, which may go beyond empirical measurement, are essential for addressing complex issues effectively. These non-empirical pursuits can also enhance scientific practices. As Matteo Morganti put it about the need of methodological perspective that can allows one to seek the right equilibrium between science, metaphysics, and common sense:

> Science and philosophy both express, and attempt to quench, the distinctively human thirst for knowledge. But what can scientific and philosophical theories tell us about the world, in isolation from each other? And

> to what extent does a sophisticated investigation into the nature of things force us to question commonsense beliefs? (Morganti, 2013, p. 3)

The discourse above exemplifies the philosophy of science, a field that derives fundamental principles and concepts through proper philosophical contemplation. Within this realm, "we explore the foundations, essence, methods, processes, reliability, and implications of science and its diverse disciplines" (Bird, 2006, p. 3). From a preliminary perspective, it becomes evident that science is inherently marked by the systematic examination of worldly phenomena (Sarukkai, 2012, p. 2). Scientists typically collect data through observation, experiments, archival studies, and similar methods, seeking logical relationships among them. However, they do not settle for mere data: scientists aim to draw specific conclusions from the data they customize. They are also keen on discerning which data supports specific theories while disproving others. But how do scientists reach their conclusions, and the process of refutation and theory formation has been a contentious issue (Husserl, 2019). Some philosophers of science debate whether scientists rely on inductive or deductive reasoning. We will explore these perspectives shortly. To engage in this discussion effectively, it is essential to introduce basic terminology from philosophical logic, such as induction, deduction, reasoning, sound, and unsound arguments, and more (Cavailles, 2021). In this section, we will delve into the fundamentals of scientific logic, both in a general sense and as a specific foundation of science, as Karl Popper, one of the thinkers we will discuss, has integrated these principles into his falsificationism. Let us start with the concept of logic itself. Logic, in essence, is the study of reasoning and argumentation (Copi, 2016, p. 7). An argument, which is central to the practice of logic, science, and academia as a whole, consists of two parts: premises and a conclusion. Premises are what we presuppose, and the conclusion is what we derive from those premises (Copi, 2016, p. 6). Let us look at a famous model to make sense of the above terminology:

P 1 = Man is a mortal being
P 2 = Socrates is a man
Therefore, Socrates is mortal.

Here the first two lines are the premises, and the final line introduced by the word so is the conclusion. In this argument, we assume that man is a mortal being and that Socrates, an individual, is a man, and we conclude that Socrates is mortal. As the second piece of terminology, we will distinguish between valid and invalid arguments. "A valid argument is an argument in which the conclusion is being drawn from the premises" (Copi, 2016, p. 7). As per our above example about "Socrates is mortal", it is an example of a valid argument since the conclusion really follows from the premises. It makes sense to draw this conclusion from these premises. Moreover, as an example of an invalid argument, we can take this:

P 1 = Man is a mortal being
P 2 = Socrates is a man
Therefore, Socrates is a Greek

Here, we just cannot draw that conclusion from those premises. Therefore, this argument is not valid; instead, it is invalid. Nevertheless, it is worth noting, "Whether an argument is valid or otherwise has nothing to do with whether the premises or the conclusions are true" (Copi, 2016, p. 7). All the premises and the conclusion of the above argument are true, yet the argument is invalid because the conclusion does not follow from the premises. On the other hand, it is also possible to have false premises and a valid argument. For instance —

P 1 = Man is an immortal being
P 2 = Socrates is a man
Therefore, Socrates is immortal.

This argument is perfectly valid even though the assumption that man is an immortal being, as far as we know, is false. We can now introduce our final piece of terminology: the differentiation between two types of arguments, which scientists frequently employ in their practices, depending on their inclinations or dispositions.

"a) Deductive Arguments
b) Inductive Arguments"[1] (Nola, Sankey, 2014)

A deductive argument is an argument in which "the premises' truth guarantees the truth of the conclusion" (Copi, 2016, p. 8). In deductive arguments, it is impossible for the premises to be true while the conclusion is false. This is illustrated in our previous example: if man is mortal and Socrates is a man, then Socrates must be mortal. Any error in a deductive argument arises from false assumptions. Therefore, if the premises are true, the conclusion is guaranteed to be true, eliminating room for new errors. Additionally, Aristotle's contribution to deductive reasoning allows us to evaluate the validity of an argument solely based on its form, irrespective of its specific content or particulars. You can still see that our example argument is valid now because there is this form—

[1] What does it mean to be scientific? Is there a definitive scientific method, and if so, how can we justify such methods? Although numerous methods have emerged for practicing science, two prominent approaches that science borrows from philosophy are inductive and deductive methods. There is contention among scholars regarding which is the superior approach in scientific inquiry. Following the same, we have planned to discuss them to make sense of our present debate. For example, Karl Popper argued that there is no need for induction in science; instead, deduction is sufficient. To know more about it, see- Nola, R., Sankey, H. (2014). Theories of Scientific Method: An Introduction. United Kingdom: Taylor & Francis.

All A is B
C is A
Therefore, C is B

Where A is Man, B is being mortal, and C is Socrates. Thus, we can put anything we like in the place of those letters, and the argument will remain valid. For instance, let us choose A is Indian, B is Humble, and C is Rama; then we have —

All Indians are Humble
Rama is Indian
Therefore, Rama is humble.

Deductive arguments can be evaluated based on their form, regardless of whether the initial premise is true or false, leading to a conclusion that may not be accurate. This approach allows us to assess argument validity without relying on prior assumptions about the subject matter, aligning with the scientific practice of collecting data before drawing conclusions. In scientific discourse, arguments are primarily inductive, not deductive, where deductive arguments guarantee truth when premises are true, while inductive arguments provide strong reasons to believe the conclusion, though without guaranteeing its truth (Kuhn, 2012, p. 37; Popper, 2005, p. 3). Again, let us look at another example—

None of the medieval texts, which we have studied, argues against the existence of God.
So, no scholar in the Middle Ages argued against the existence of God.

Upon closer examination of this argument, we discern that we are asserting an objective claim grounded in subjective experience, rendering the conclusion likely but not certain. This aligns with the typical scientific approach, where we often have limited data on which we seek to establish a general conclusion. Moreover, in accordance with the reviews of science, it becomes evident that scientific undertakings involve making inductive arguments. As we shall see in the next Section, the induction method is much more problematic than a deduction, "making scientific knowledge more unstable" (Popper, 2005, p. 4).

2. Induction and Background Theories of Scientific Practice

In the previous part, we explained the difference between science and scientism, which is crucial for our main goal of understanding and promoting the idea of a purely scientific culture. Additionally, we delved into the realm of reasoning, particularly focusing on two perennial forms: deductive and inductive reasoning. We explored their practical applications within scientific endeavors and shed light on how scientists employ these concepts to elucidate their theories and viewpoints. We also saw that inductive reasoning is really important for making progress in science. Now, let us explore inductive arguments more closely, with a focus on an important question: How can we determine if an inductive argument provides us with trustworthy information? This is a crucial consideration because when we use inductive reasoning, we depend on certain foundations or background theories to support our arguments, which can introduce some uncertainty (Regt, 2017). This means we cannot use mere Induction to derive theories from neutral data. Takin this problem into account "In the mid-eighteenth-century David Hume argued that practice of inductive reason and successful prediction tells us nothing about the truth of the predicting theory. No matter how many experimental tests a hypothesis passes, nothing can be legitimately inferred about its truth or probable truth" (Howson, 2000, p. 1). In other words, we always rely on some theoretical beliefs, which imply that scientific theories depend not only on observations, but also on presuppositions or even prejudices (Gijsbers, 2009). So again, let us begin with the basics: A deductive argument is valid, meaning if the premises are true, the conclusion must also be true; there is no way around it. In contrast, an inductive argument is valid too, but it does not guarantee the truth of the conclusion. It gives us good reason to believe it, but there's still room for other evidence or observations to challenge it. Here is an example from our earlier discussion: None of the medieval texts we have looked at argue against the existence of God, so it seems like nobody in the Middle Ages argued against the existence of God. But these examples might not fully capture the essence of scientific research; we might need more representative instances that align with core scientific practices. —

All the organisms that we observe or have observed require water to survive and evolve.
Therefore, in future if any new organism emerges, it will also require water.

While this argument may seem flawless on the surface, there are inherent limitations. Our limitations revolve around time, as we cannot predict the future with absolute certainty. Sometimes, these limits extend to both time and space. Consider our earlier example: we observe the present and past, leading to a general conclusion. This is an example of induction, not deduction, because in the future, we might discover new organisms that do not rely on water for survival. It is not just about time and space; inductive reasoning can also miss the impact of persistence, external factors, and factual changes that could alter the conclusion. In essence, no matter how many observations we make, the next one could always be different. Therefore, drawing general conclusions from data always involves induction, which carries risk and does not guarantee logical necessity [2] (Ainslie, 2015). In the last Section, we learned that we could recognize deductive arguments just by looking at their logical form without knowing anything about the content (Malpass, 2017). In this Section, we will see that that is not the case for inductive arguments since this form of reasoning need background theories about the content to assess whether a supposed inductive argument is any good. So let us look at one more example:

I put twenty-two frogs in the freezer for a week.
Moreover, observation suggests that all of them died in the weak
Therefore, all frogs die when they are put in the freezer for a week.

If we look at the logical form of this argument, it is something like this: I did "A" 22 times and every time "B" happened. Therefore, every time I shall do "A", "B" will indeed happen. The question arises – is that a valid argument scheme? In addition, apart from this challenge, every different form of observation results in a different logical form, which makes it difficult to conclude without looking at the content of an inductive argument. Thus, content is the sole subject matter of inductive reasoning, which will always be insufficient to deduce the guaranteed truth. In short, it has nothing to do with the logical form of one inductive argument with another inductive argument. Thus, "what matters is the content of our background knowledge about any case" (Popper, 2002, p. 322). You have to make observations of all possible time and space before we may believe in your inductive argument. Moreover, in order to assess the inductive argument, there are several things that we need to know about the content, which we apply to any specific inductive argument.

Therefore, "it is for sure that there are certain background theories or certain principles about the structure of nature prior to undertaking any scientific investigation" (Popper, 2002, p. 322). These principles or the presuppositions of science are themselves not discovered utilizing the methods of science. So based on these critique questions, is it true that Science makes no use of faith in the attainment of knowledge or rather, are there certain assumptions scientists take for granted, whether knowingly or not, based on faith? Actually, there is nothing to be shy about accepting this fact. However, some scientism supporters are not ready to practice epistemic humility and tolerance, which require an honest submission of one's position and limits. When one examines the scientific method, it appears that scientists must, in fact, accept certain propositions on convictions before they can even commence a scientific inquiry. These propositions, which can be called the "presuppositions of science" (Popper, 2002, p. 323), include such things as a belief in the validity of sense experience and a belief in what is called the uniformity

[2] David Hume has eloquently addressed this issue and challenged our dogmas regarding inductive reasoning. See- Ainslie, D. C. (2015). *Hume's True Scepticism.* United Kingdom: Oxford University Press.

or regularity of nature assenting to the regularity of nature. This means that when scientists find laws of nature, they believe these laws work not just where and when they do experiments but everywhere and all the time. Now, here is the important part about scientism: these beliefs or ideas cannot be proven true using the scientific method. Instead, scientists have to assume they are true even before they start their investigations. For example, if someone says our senses cannot be trusted, how can we rely on what we see during experiments? Or if someone thinks the world does not follow any rules, how can scientists ever find natural laws? As Abraham Kaplan reveals:

> Nowhere in Science do we start from nothing; there is only one place where we can start: from where we are. Science is no miraculous creation out of nothing, no spontaneous knowledge generation from ignorance. When presuppositions are denied a logical status, we remain mired in scepticism (Kaplan, 2017, p. 142).

To illustrate this point, let us focus on one presupposition that exemplifies a proposition about the natural world accepted by scientists but not discoverable through the claims of scientism. This presupposition pertains to the regularity of nature, specifically the concept of the species and individual structure of nature. In scientific practice, it is assumed that different individuals, material objects, and events can be categorized into specific classes based on shared characteristics. For instance, all pieces of wood in nature constitute the "species" of wood, while individual water droplets make up the "species" of water, and so on. Additionally, science relies on the assumption that individuals within the same species will exhibit consistent behaviors under specific conditions. For example, scientists presume that all pieces of wood can burn and that all water droplets can freeze. Importantly, this presupposition reveals a fundamental aspect of the world: individuals of the same species behave similarly. However, it is crucial to note that the truth of this proposition, or the source of this knowledge, does not and cannot originate from the methods of induction and observation alone. This is because, even before the scientific method can be applied, this proposition must be accepted as true, as articulated by Van Nelson:

> In science, we must accept certain presuppositions, such as the regularity of nature, which cannot be established through induction and observation alone. For Science does not have any choice about whether or not to accept the presupposition of the species and individual structure. It must accept it because otherwise, any classification induction and gathering of experience in certain laws would be entirely impossible. For there would be an infinite series of experiences

> without any possibility of connecting one experience with another (Melsen, 2022, p. 10).

By accepting such a proposition, scientists implicitly acknowledge a truth about the world's structure which is not derived from merely scientific operations. Some may argue that these presuppositions are validated by science's success. However, this argument overlooks the distinction between success and truth; being successful does not necessarily prove the truth of these presuppositions. And it's also one of the problems with the "pragmatic theory of truth" that people often overlook when making bold judgments and decisions i.e., success does not guarantee the truth (Moore, 1910). For instance, Tycho Brahe's 16th-century model of the solar system accurately predicted planetary motions, yet we now know it was fundamentally incorrect (Popper, 2002, p. 130). In the realm of inductive reasoning, two critical factors come into play. First, we must consider how likely it is that the things we are studying behave uniformly, recognizing that external factors can alter our conclusions and theories (Whewell, 1847, p. 67). Second, we need to ensure our data is representative of the entire subject matter, not just a specific part. In simple terms, background theories are crucial in science because they guide how we interpret and analyze data. Inductive arguments, which involve generalizing from observations, rely on these background theories. This means scientists cannot claim the absolute truth about a subject until they consider these factors. Subsequently, it is important to understand that scientists are not entirely objective; they view the world through their own perspectives influenced by their background theories. This can lead to bias and may hinder the pursuit of a purely scientific culture. Critics like Karl Popper argue that there is no completely neutral scientist, as everyone has preconceived notions. They believe that drawing general conclusions is essential for scientific progress.

3. Socratic Spirit in the Karl Popper's Falsificationism

In the previous section, we highlighted that inductive reasoning always operates within the framework of background theories. This means scientists cannot simply examine raw data and arrive at neutral conclusions. They invariably analyze data through the lens of pre-existing theories, which implies that science is not solely driven by observation; it is guided, or some might argue, biased by theoretical perspectives. Typically, scientists take certain theories for granted without criticism. However, 20th-century philosopher of science Karl Popper challenged this conventional view. He asserted that the essence of science lies in its critical nature and its refusal to take anything for granted (Popper, 2005, p. 14). According to Popper, scientists seek to demonstrate the falsity of their own theories, which he believed distinguishes true natural scientists from fake or pseudo-scientists (McKinnon, 2019, p. 23). Before delving into Popper's central thesis, it is essential to explore some of his sub-theses that underpin his theory of falsification. Popper's works, such as "*Conjecture and Refutation*" (Popper, 2002) and "*The Logic of Scientific Discovery"*, (Popper, 2005) offer normative guidelines for how sound science should be conducted. His aim was to provide insights not just into practicing scientists but also to those aspiring to engage in scientific practice. "Popper drew from the practices of exceptional scientists like Einstein to construct his normative framework, distinguishing it from what he saw as the shortcomings of figures like Darwin, Marx, and Freud" (Charlesworth, 1982, p. 25). Popper's critical stance differentiates between dogmatic certainty and relativism. He emphasized "uncertain truth" or truth as a guiding ideal, which formed the core of his falsification theory and had significant implications for both societal and academic progress. Popper's emphasis on human fallibility, inherent in his theory of falsification, aligns with the notions of individual and societal improvement and the advancement of academic and scientific endeavors.

The fundamental drive behind Popper's concept of falsifiability is the notion that it provides a criterion for distinguishing between genuine science and non-science, including pseudo-science. This criterion not only aids in the demarcation of scientific endeavors but also guides us toward the pursuit of a purely scientific culture. Popper aimed to challenge a common emotional inclination – our preference for personal, hypothesis-driven results derived from tests and observations, a preference rooted in our aversion to whitewashing outcomes. Falsifiability, as proposed by Popper, is often seen as the demarcation criterion, distinguishing empirical science, and statements from other forms of knowledge, including pseudo-science, metaphysics, mathematics, and logic (Popper, 2002). However, Popper focused on distinguishing real science from pseudo-science, emphasizing that true science relies on consistent knowledge, not just empirical observations. He believed that facts are not self-explanatory and should be seen as theoretical abstractions embedded in their contexts. Popper rejected the concept of "raw data" and argued that we are always theorizing. He was skeptical about repetition-based truth because no two repetitions are identical, and interpretations matter. Popper's key point is that being scientific is not just about data and testing, as tests can have flaws. Instead, true scientific spirit involves maintaining a critical attitude toward data and tests.

For Popper, scientific knowledge grows through falsification, where we learn from our mistakes and avoid repeating them (Popper, 2005). Our understanding of the world, whether we are experts or beginners, is equally prone to fallibility. Science, like philosophy, encourages us to embrace our limitations and marvel at the world's complexities. Karl Popper not only challenges the dogmas of logical positivism but also emphasizes the importance of speculative metaphysics in science. Speculation involves envisioning potential paths constrained by testing and observation. Popper's theory highlights that metaphysics, or speculative thinking, is inevitable in the pursuit of truth. He establishes a normative condition for innovation, emphasizing that progress relies on embracing metaphysics [3] (Ede, Cormack, 2017). While radical conjectures are crucial for problem-solving, they must withstand refutation. Science aims to enrich our meaningful engagement with the world, rather than merely opposing meaningless nonsense as defined by logical positivists. Popper distinguishes between the scientific and non-scientific realms within the domain of meaning. A single falsification can overturn a dogma, theory, or project, whereas verification, at best, establishes probable laws based on evidence. Fallibilism, according to Popper, does not lead to nihilism but rather acknowledges that disillusionment is a common part of exploration. Pursuing knowledge demands rigor in evaluating our instincts and emotions, resembling the redemptive path of knowledge, including scientific pursuit. This embodies the Socratic spirit, promoting epistemic humility, tolerance, and the foundation of falsificationism. In Socrates's words – "I know only one thing that I know nothing" (Xenophon, 2023, p. 7).

Returning to Popper's hardcore and notable criticism, logical Induction, strictly speaking, does not stand for a standard means of truth. It is not only wrong for him but also something, that occurs and exists outside the realm of human cognition. However, at least in academics, since knowledge is all about cognition, thus, at its best, it either stands for a probable means of truth or, at its worst, wholly fails to be called the means of gaining knowledge. In short, Induction justifies scientific laws as 'probable' at most and never provides specific proof. Moreover, Popper was also aware that you could only do Induction if you accepted some background theories. Nevertheless, he also wanted to say that scientists do not really accept any theories since they are always critical of them. So how can we combine those two ideas very simply? As a revolutionary philosopher of Science, Popper critically said that we need to stop claiming that scientists merely use Induction for their discoveries and theory-making. Scientists, in fact, according to Pooper, "only use deduction, and therefore they never need any background theories" (Popper, 2005, p. 291). Popper's suggestion is very radical but also very influential. Therefore, in this Section, we will explore his view that scientists only use deduction and examine why this view is problematic. Here is an example from one of our previous Sections:

[3] The sciences, as understood by the Scholastic philosophers in the Aristotelian sense, were specialized branches of philosophy, and included the seven sciences of mediaeval learning: grammar, logic, rhetoric, arithmetic, music, geometry, and astronomy. When the number of sciences was enlarged, they were classified under the headings of natural, moral, and first philosophy (or metaphysics). To know more about the history and development of science,
see- Ede, A., Cormack, L. B. (2017). *A History of Science in Society: From Philosophy to Utility*. United States: University of Toronto Press.

All the organisms which we observe require water to survive
and evolve.
Therefore, in future if any new organism emerges,
it will also require water.

In our previous section, we discussed how scientists use induction, a form of reasoning based on limited observations, to draw general conclusions. However, according to Popper, scientists do not claim their theories are permanently true because they understand that new observations could prove them wrong at any time. This means they avoid stating that a theory is true, like the idea that all observed organisms need water to survive. Popper argues that scientists remain open to the possibility of new evidence that could challenge their theories. Although our example shows a probable truth, but for Popper, Scientists do not even clean claim that, a theory is probable or likely to be true or anything; instead, "they are only interested in critically testing theories and showing that they may be false in their assumptions" (Popper, 2005, p. 326). In short, the only conclusion that real scientists ever draw is that their theory is always prone to be wrong; in fact, they aim to prove themselves wrong. Popper called this process the process of "Falsification" (Popper, 2005, p. 327).

Adding more to it, falsification is a scientific process aimed at disproving theories by finding variables that lead to changes. If a theory claims all organisms need water to survive, finding one that thrives without it would invalidate the theory. This approach aligns with Popper's idea that scientists primarily use "deduction". Falsification relies on deductive reasoning, as shown in the above example. However, contemporary philosophy of science debates whether science can solely rely on observation and reason, as Popper suggests. Nonetheless, deductive reasoning plays a crucial role in falsification and scientific inquiry. Going deeper, we find an error in Popper's logic of falsification. To illustrate, consider the example of freezing frogs: if the theory that all frogs die after a week in the freezer is true, then every frog in the freezer should be dead after a week. However, this argument assumes that the theory "T" is true if we observe a dead frog. But what if someone removed the frog from the freezer temporarily, or if the freezer malfunctioned during the week? These scenarios show that the theory could still be valid despite the observation of a dead frog, highlighting a flaw in Popper's logic.

To construct a precise argument, we need to consider multiple conditions: if the theory "all frogs are dead after a week in the freezer" is true, and no one removed the frog during the week, and the freezer functioned correctly, and it's indeed a frog, then this frog should be dead since all conditions for a dead frog in the freezer are met. However, since the frog is not dead, Popper would declare the theory falsified. This complex scenario is essential to understand the concept of truth. When we try to prove a theory wrong, we have to make certain assumptions. But can we be sure these assumptions are true? We either use induction or accept them without questioning. In both cases, we do not meet Popper's super-critical thinking standard. Just like induction relies on a background theory, falsification also needs one. So, many philosophers of science think that Popper's ideas, while popular among scientists, cannot replace the standard method of induction. In practice, we cannot avoid using induction in science, as argued by thinkers like Thomas Kuhn, whom we will discuss next.

Moreover, the other problem with Popper's falsificationism lies in its rigidity and the practical challenges it poses to scientific practice. As noted above, Falsificationism categorically asserts that for a theory to be considered scientific, it must be potentially falsifiable, meaning it should make specific, testable predictions that, if proven false, would refute the theory. However, in reality, theories can often be modified or extended in numerous ways to accommodate conflicting observations, making strict falsification difficult. Additionally, applying falsifiability as a demarcation criterion to distinguish science from non-science can be ambiguous in borderline cases. The underdetermination problem persists, with several theories explaining the same observations. Science often progresses by refining and expanding existing theories, which does not align with rigid falsificationism. Historical cases like continental drift show that valuable theories faced resistance and did not strictly adhere to falsificationism. While falsifiability is essential, it has limitations in assessing scientific theories and distinguishing science from non-science. In the next section on Thomas Kuhn's philosophy, we will explore how scientific practice involves a complex interplay, including hypothesis testing, empirical evidence assessment, and theory development. This challenges the simplistic view of science relying solely on strict falsifiability and highlights its dynamic and evolving nature.

4. Thomas Kuhn and the Systematic Phases of Scientific Growth

In our last Section, we discussed Karl Popper's claim that scientists are critical and that only those people deserve to be called scientists who do not just believe in everything they are told or see. Popper claims that they want to see cold hard evidence or otherwise (refutation), and they will come to their own conclusions based on what they comprehend experimentally. Furthermore, that is precisely because scientists are so critical that Science is so successful because they take nothing for granted in scientific practice. They can quickly discover and eliminate any errors that allow them to leave those errors behind and march on towards the truth. This idea of the "scientist as a critical thinker" is so deeply ingrained in our conception of science that Karl Popper even turned it into the critical component of his theory of science i.e., falsificationism. According to Popper, "…in falsificationism, scientists are always busy trying to prove their theories wrong. They are extremely critical; indeed, pseudo-scientists, on the other hand, are always trying to protect their theories; they are not critical at all" (Popper, 2005, p. 68). Subsequently, Karl Popper is critical to the essential element of being a scientist. While many agreed with Popper's ideas, it is important to acknowledge that not everyone did. In the previous section, we discussed some of Popper's limitations, and in this section, we will continue to explore these limitations for a more comprehensive understanding.

From an academic perspective, Thomas Kuhn, an American physicist, historian, and philosopher of science, developed a highly influential account of science that highlights gaps in Popper's theory. Kuhn argued that the idea that science is always in a critical mode is not true, or, to be more precise, it is an illusion. For Thomas Kuhn, quite contrasting to Karl Popper's thesis, Science is usually not critical at all. It is only at specific and exceptional moments in history and process that Science becomes critical (Wray, 2021, p. 65). Therefore, if we believe that Science is always critical, we are mistaking the exception for the rule. As a historian of science, when Kuhn studied the history of science, he did not see a cure succession of events; instead, what he saw was a kind of pattern of alternating phases of different kinds of science that happened at different moments, and which followed each other in a standard way. According to Kuhn, you could see this pattern everywhere in all the sciences or least all in Natural Sciences and throughout history in certain phases. Following are the phases that Kuhn's Writing suggests—

- Pre-Paradigmatic Phases
- The Phase of Normal Science
- The Phase of Crisis
- The Phases of the Scientific Revolution

We will explain the meaning of these terms later on. However, before that, let us understand the procedure of scientific progress in Kuhn's language. Every Science, Kuhn tells us, starts in a pre-paradigmatic phase at some point, and then it will move on to the phase of normal Science. Once that has happened, "that scientific discipline will never return to the first phase" (Kuhn, 2012, p.133). So, pre-paradigmatic science only occurs once in a scientific discipline. However, the other three phases can repeat. From normal Science, we can move to a crisis phase or return to normal Science. From a scientific revolution phase, we always return to normal Science, which is the most common state. To understand Kuhn's theory, let us focus on "normal science" for now and skip the pre-paradigmatic phase. Kuhn's key insight is that scientists often accept established ideas without questioning them. In every scientific field, there are widely accepted concepts, methods, and instruments. For example, biologists universally believe in cells with DNA, microscopes, and modern chemistry. Historians commonly accept India's 1947 independence. Evidence contradicting these beliefs is usually seen as less reliable (Kuhn, 2012). Kuhn refers to all these unquestioned ideas, theories, and methods within a scientific discipline as a "paradigm" (Kuhn, 2012, p. 139).

Kuhn claims that an essential aspect of normal science is a well-established paradigm, which represents a set of shared beliefs that researchers in a discipline rely on for their work. During normal science, Kuhn makes two key points about paradigms. First, he notes that scientists not only accept but also do not critically examine the paradigm because they believe it would be unproductive to do so. Imagine telling a historian that India might not have gained independence in 1947, or suggesting that Latin dictionaries are entirely wrong, and every Roman text means something entirely different from what we think. In this phase, scientists are generally uninterested in questioning the paradigm because having some fundamental beliefs is crucial for scientific progress. Kuhn argues that it is precisely because scientists take so much for granted that they can conduct detailed scientific work. If historians had to question all the basic facts of their discipline, they would struggle to make significant advancements (Kuhn, 2012, p. 139).

We can answer detailed questions about history or any other subject because we have a vast theoretical and methodological background that we take for granted. This allows us to focus our thoughts on specific questions. Now, let us address whether scientists are critical, as per Kuhn's perspective. According to Kuhn, scientists are not excessively critical of their paradigms – the accepted sets of ideas, methods, and concepts within their fields. They tend to accept these paradigms without much questioning, similar to how learners often accept certain facts without critical examination. Kuhn argues that this practical approach helps scientific progress. However, why do we still believe that science involves critical thinking? This belief relates to the other phases of science Kuhn outlines. As mentioned earlier, Kuhn identifies four phases: the pre-paradigmatic phase, normal science, crisis, and scientific revolution (Wray, 2021, p. 9). In our preceding discussion, we focused on normal science, where a well-established paradigm guides scientific activities, and scientists generally do not question it. Now, let us talk about the early stages of science. Imagine a time when there were no agreed-upon rules or ideas in science. Different scientists had their own ways of thinking. For example, historians could not decide how to write history, and physicists were not sure about the best ideas to explain the world. They did not share common concepts or methods. This made it hard for them to work together because they could not even talk about their work in the same way. Instead of helping each other, they often argued about whose ideas were better. This early stage of science did not look like what we think of as science today. It was more like a bunch of individuals doing their own thing. And because they could not agree, progress was slow, and they could not build on each other's discoveries.

In other words, when one set of theories and methods becomes dominant, often due to impressive results or socio-political factors, a paradigm emerges in a pre-paradigmatic discipline, transitioning into Normal Science. Scientists unite behind these dominant ideas, working within the established paradigm without much criticism, allowing them to collaborate on specific problems. It is one of the main challenges in our idea of a purely scientific culture. However, the good thing is that paradigms are not permanent, and Kuhn introduces the concept of anomalies –issues within the paradigm that are hard to solve and do not align with its basic theories. Popper and Kuhn diverge here, with Popper seeing anomalies as falsifications requiring rejection, while Kuhn views them as challenges that can be resolved over time. Kuhn suggests that every scientific discipline always has anomalies, which scientists assume they will address in the future. Kuhn says that "anomalies" are not a problem for a scientific paradigm as long as scientists remain confident that they will be resolved in time. However, scientists may lose confidence in their paradigm when the number of anomalies increases, and their efforts to resolve these anomalies within the existing paradigm yield little success. In such cases, scientists begin to question whether it is possible to address these anomalies using the current paradigm, leading to doubts about its effectiveness (Kuhn, 2012). In addition, when that happens, we have reached the "phase of crisis" (Kuhn, 2012, p. 93). A crisis in standard science occurs when scientists doubt their existing paradigm. In such times, they question if the current paradigm can solve their puzzles. This spark increased critical thinking and consideration of innovative ideas, new theories, methods, and concepts. The longer a crisis lasts, the more critical scientists become. Crises can be resolved in two ways: by solving anomalies within the current paradigm and returning to normal science, or by the emergence of a new paradigm with fresh theories, concepts, and methods to address major anomalies. If the scientific community embraces this new paradigm and abandons the old one, it leads to a scientific revolution, "often referred to as a paradigm shift" (Wray, 2021, p.125). In short, Kuhn's disposition is that while scientific revolutions are notable episodes in the history of science, they are exceptions rather than the rule. Normal science, where scientists work within a stable paradigm, constitutes the majority of scientific work, focusing on solving puzzles without overly questioning the existing paradigm.

5. Conclusion and an Integrated Way to pure Scientific Culture:

After differentiating between inductive and deductive reasoning in scientific practices, exploring the influence of background theories, and engaging in a comprehensive discourse involving Karl Popper and Thomas Kuhn's perspectives on proper scientific practices, we are confronted with an enduring and normative inquiry: What is the right way to conduct science? How can we progress towards "a purely scientific culture" and cultivate a genuine "scientific temperament"? Should we endorse the ideas of Karl Popper, Thomas Kuhn, or perhaps find value in both perspectives? Should we practice only deduction or induction or both approaches? When addressing these enduring questions, it is essential to foster scientific progress by posing pertinent inquiries while avoiding unwarranted hindrances and undue skepticism. This approach enables us to navigate scientific advancements efficiently, avoiding unnecessary obstacles and rigid dogmas that might impede our quest for knowledge. But how can we achieve this delicate balance? Considering the debate between the two, we can suggest that we blend the ideas of both Karl Popper and Thomas Kuhn with some adjustments. Our exploration of Karl Popper and Thomas Kuhn's perspectives on the philosophy of science underscores the value of a synthetic approach to scientific culture. Popper's focus on falsifiability and critical inquiry complements Kuhn's insights into scientific communities and paradigm shifts. A purely scientific culture should embrace both critical scrutiny and shared frameworks, recognizing that they are essential for advancing knowledge. This synthesis encourages a culture that values critical thinking and collaborative exploration, fostering scientific growth and deeper human understanding. This approach entails navigating a balance between faith and reason, deduction and induction, skepticism, and realism, and examining the roles these concepts play in scientific practice. Karl Popper and Thomas Kuhn can assist us in examining the assumptions made in science, helping us understand if scientists rely on non-scientific sources of knowledge about the natural world and to what degree we can have confidence in these sources. Indeed, just as we have synthesized the perspectives of Karl Popper and Thomas Kuhn, recognizing the value of both, we emphasize the need for the consolidation of deduction and induction in science. Both deduction and induction play crucial roles in scientific inquiry, with deduction facilitating logical consistency and hypothesis testing, while induction allows for the generation of new ideas and discoveries from specific observations. In the pursuit of scientific knowledge, it is essential to harness the strengths of both approaches, ensuring a comprehensive and robust scientific methodology. In science, both deduction and induction work together to help researchers refine existing knowledge and explore new frontiers in understanding the natural world.

Karl Popper and Thomas Kuhn have sharply explored the boundaries of belief within the contexts of falsification (in Popper's terms) and scientific paradigm shifts (in Kuhn's terms). Both scholars provide compelling insights that prompt us to consider whether scientists, in their quest to understand the nature of reality, rely on faith and how much skepticism is beneficial in the pursuit of scientific knowledge. Subsequently, it unveils alternative perspectives on progressing toward a purely scientific culture. However, it requires critical thinking, which is at the core of both philosophy and science. This approach enables us to recognize the role of conviction in shaping knowledge claims, whether through belief, assumption, or suspended disbelief. It also clarifies how reason and experimentation lead us from premises to conclusions using argument and logic. Through our composition, we also attempted to demonstrate that while science is an invaluable tool for comprehending the nature of reality because it provides ample room for critical thinking and a wide range of perspectives, the extravagant assertions of scientism seem unsustainable. In line with this perspective, Karl Popper and Thomas Kuhn supposedly advocate that modern science should embrace philosophy to enhance its reliability and success. Their philosophy serves as a counterpoint to those who argue that only certain methods of science provide world knowledge that turns into Scientism. Furthermore, it is crucial to emphasize that philosophy is not in opposition to science but rather to scientism. In our critique, we have endeavored to examine the concept of scientism and scrutinize whether the exclusive methods of science, such as induction or deduction, truly represent the sole avenues for acquiring knowledge about the natural world and human existence. While there is a prevailing claim that scientists only accept propositions supported by evidence, we must cast doubt on the validity of such assertions, as they are what can potentially transform science into scientism. Implicitly, we have illustrated that scientism inherently makes a self-refuting claim, as it cannot be derived from the pure scientific method, leading it into a circularity trap. Analogous to the failed assertions of logical positivism, which held that only propositions categorized as either analytic or synthetic could be deemed true, scientism also falls short of meeting its own criteria. Hence, the aspiration for the development of a purely scientific culture remains an ongoing objective. Our closing remarks emphasize that a truly scientific culture does not adhere to any rigid or dogmatic belief system but thrives in the perpetual pursuit of truth, as elucidated by the insights of Karl Popper and Thomas Kuhn. The holistic concept of culture involves cultivation rather than a rigid journey from one fixed point to another. Through our composition, we have aimed to illustrate that this perspective is applicable to the concept of scientific culture as well.

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