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AN ANALYTICAL REVIEW OF THE RELATIONSHIP BETWEEN SCIENCE AND PHILOSOPHY & THEIR UTILITY IN CONTEMPORARY GLOBAL POLITY CONCEPTUALIZATION OF TECHNOLOGY

Introduction. *The central argument of this study is that for science to meet the challenges of globalization and justice in the 21st century, it needs to be ethically informed, and thus philosophical reflection on and in science is cardinal.*

Problem Statement. *The study focuses on the 21st century trends in philosophical thoughts that influence scientific motivations. To this effect, the research question that the study sought to answer is, 'How and to what extent can philosophy be valuable/influential to scientific advancements in contemporary times?'*

Purpose. *This paper aims to demonstrate that despite some differences between science and philosophy in their origin and methodological conceptions, they do have reciprocal rudiments. The study gleaned this relationship with the view to assess the utility of their relationship in a technologically and fast-paced 21st Century. This study contributes to the literature by providing theoretical perspectives that critique conventional (Western) epistemic stances of scientific knowledge construction and highlights lessons to be learnt through a juxtaposed pool of ideas from all regions of the globe, not just from the West.*

Material and Methods. *The methodology adopted for this study leans on a descriptive and thematic literature approach which builds on qualitative data gathered through academic journals, scholarly books, and online publications. The study review endeavors to focus on the 21st century trends in philosophical thoughts that influence scientific motivations.*

Results. *The study notes that the relationship between science and philosophy has endured for many hundreds of years, and despite their differences which mainly lie in their scope, attitudes, methods, and peculiar challenges, both are keenly engaged in advancing increased human capacity for innovation, ingenuity, and critical thinking. The study concludes — from the prism of the future — that a critical global appraisal and continuous rigorous review of scientific and philosophical activities is essential today more than ever before, if the futures project is to contribute effectively to the (re)construction of sustainable frameworks of scientific production that yield results in an equitable and environmentally sustainable manner.*

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Conclusions. *The study has brought to the fore, a stark reminder that neither science nor philosophy — operating singularly — offers genuine solutions on sustainable growth and development; hence stakeholders can make sense of complex phenomenon from both science and philosophy by critically reviewing their outcomes in a reciprocal manner that appreciates the advances, the gaps, and excesses from both sides. Most significantly, the study has pushed the envelope of comprehending science and philosophy beyond Western constructions that often tend to overlook, and in some cases purposely downgrade orthodox but otherwise valuable scientific insights from subaltern constellations of the global South.*

Keywords: Philosophy & Science, Globalization, technology & innovation, Ontology & epistemology, Sustainable development, Marginalization of the global South.

For science to meet the challenges of globalization and justice in contemporary political, social, and economic lives, it needs to be ethically informed, and thus philosophical consideration on and in science is fundamental. The study review will endeavour to concentrate on the 21st century trends in philosophical thoughts that influence scientific motivations. The research question that the study sought to answer is: In what ways, and to what extent can philosophy be valuable/influential to scientific advancements in the 21st century?

Philosophy and Science have long had a relationship dating back to the beginning of human civilization and often considered as synonyms.

Their practical significance, interdependence and application can be traced to ancient Greece during the time of the pioneer philosophers such as Socrates, Plato, and Aristotle. These philosophers played a seminal role in the transformation and evolution of both philosophy and science. Scholars-philosophers, such as Francis Bacon and Galileo Galilei initiated the process of turning natural philosophy into science [1].

Both fields have many branches of study and make use of reasoning, questioning, and analysis to arrive at conclusions which bear common assumptions. The epistemological underpinnings of science as we recognize it today are believed to have begun in ancient Greece. The history of science from ancient Greeks to the present, is a history of one compartment of philosophy after another breaking away from philosophy and emerging as a separate discipline. To date, the name of some departments in which physics is studied is still called, 'natural philosophy' [1].

Natural science has tended to replace more traditional approaches to natural philosophy. The modern natural science fields, therefore, can be more elaborately described to lie in the life sciences (biology) and in the physical sciences (chemistry, physics, earth science and astronomy). The fields that spanned off from philosophy have left philosophy with a set of distinctive problems: issues they cannot resolve but must be left either permanently or at least temporarily for philosophy to deal with. For instance, mathematics deals with numbers, but it cannot answer the question regarding what a number really is; a physicist cannot answer a question such as, 'what is time'? Explaining exactly what 'time' really means, is a problem which science has left to philosophy.

COMPLEMENTARITY OR COMPETITION?

Scholars offer a mixed bag on the relationship between science and philosophy: fromStephen Hawking's declaration of the official 'death' of philosophy, and his conclusion that scientists have become the torch bearers of discovery in the quest for knowledge; to professor of Astrophysics Geraint Lewis's assertion that physics (science) should only be concerned with predictions and leave 'worrying about reality' to philosophers [2]). There seems to be no consensus among men of letters and academicians on which side the realities about knowledge rests, or whether such realities reside on both sides. Scientists such as Steven Weinberg and Peter Atkins opine that understanding reality is the job for scientists, and not for philosophers, while other scientists such as Paul Diracconcurs with Geraint Lewis's asser-

tion that understanding reality is a job for philosophers rather than for scientists[3].

Philosophers are interested in posing questions and in analysing concepts, whereas scientists are inclined towards heuristics that maximize discovery and focus on details of data gathering and analysis [4]. Both science and philosophy endeavour to discover knowledge by explaining phenomenon- but using different pathways; whereby, philosophy relies on logical argumentation, while science utilizes empirical data [5].

This conundrum is aggravated by the existing differences of positions of meta theories, where the meta theory such as positivism believes that science has no business dealing with unobservable phenomenon and postulating the existence of entities that cannot be subjected to experimental tests [5]. Other scholars argue to the contrary. In-between the two argumentative blocks, there are scientists such as Albert Einstein who argued that philosophy is influential for science to be able to thrive [6].

However, philosophy being the earliest form of science before science 'proper' came on the scene, was above all other sciences (being a pioneer in the field of the sciences) and was held, understandably, in higher esteem since all sciences drew their methodological perspectives from it over many hundreds of years[1]. Mathematics, physics, biology, and chemistry all came out of philosophy — so, philosophical world views have always influenced the formulation of scientific hypotheses. This demonstrates how intertwined philosophy is with science[7].

Researchers such as [8], have asserted that philosophy and science are partners in their explanations to get the 'truth' on phenomenon and there seems to be no clear boundary between them; for example, physics has provided methods of observation and experimentation which have exerted significant influence on many spheres of knowledge [7].

This factor points to one critical explanation: that neither philosophy nor science replaces or reduces the efficacy of the other, nor does either direct the other. Philosophy on its part, only assists with general principles of theoretical and critical thinking; this shows that one cannot isolate philosophy from science and science from philosophy.

This study has adopted a descriptive and thematic literature analysis approach that relied on qualitative data that were gathered through academic journals, scholarly books, and online publications. The themes captured in the study lie within the spheres of the philosophical and scientific evolutions particularly those unfolding in the 21st Century.

Most scholars today such as [9—11] have asserted that contributing to technological and sustainable development is a contemporary task that need to be managed in an interdisciplinary way that recognise the symmetry of the futures agenda. This interdisciplinary notion is also supported by philosophers such as S.B. Krymsky, P.V. Kopnin, and V.A. Lektorsky whose works infer that despite science being instrumental to the advancement of civilisations, science alone is not a sufficient mechanism to provide all answers for human development, hence the need to expand the horizons of knowledge foundations [12, 13].

Other scholars such as Bell (1996), and Saul (2001), Inayatullah (2007) [14] have stated that in the 21st Century, the study of the future(s) in the contextual framework of scientific and philosophical evolutions has moved from predicting the future to shaping the desired futures through an aggressive exploration of technological mechanisms.

Substances of technology and sustainable development generated through social sciences, environmental ethics, and resource economics management have increasingly been brought into the limelight due to increased globalisation. To this end, how then do we strike an appropriate balance between innovations and the need to uphold ethical and welfare values within the global growth context? At the core of this argument are concerns that good (scientific) growth need not only be capital efficient but also needs to be environmentally, ecologically, and ethically sustainable [9]. Instructive in all these arguments is that the essence

of sustainable growth is anchored on inclusive governance across the board. In this context, inclusion means encompassing all ideas from all regions of the world, and not just picking ideas from the West as the current penchant seem to suggest.

PHILOSOPHY & ITS SCOPE

Philosophy may be described as the critical investigation of (pre)suppositions that underpin various arguments with a view of justifying them as moral truths using logic and valid reasoning [1]. Philosophy may also be defined as the study of the fundamental nature of knowledge, reality, and existence whose methods may include rational arguments and critical thinking discussion [15].

The philosophical reasoning and arguments are drawn from human moral values whereby, philosophy is concerned with asking questions about humanity such as those that encompass ethics, and which cannot be answered by natural sciences. For instance, science cannot answer questions about what is 'right' and what is 'wrong'. In this vein, philosophy attempts to answer these kinds of questions that science has no answers for. Questions about emotion, sensation, and thoughts, all remain unresolved in science proper. This challenge is an area left for behavioural science to provide the necessary remedies, and yet previously, such remedies would be expected to be found in philosophy [16].

Mark Risjord has asserted that scholars such as Godfrey-Smith define philosophy as, 'an attempt to ask and answer some very basic questions about the universe and the living organisms within it' [15]. Philosophy is based on reason; and its method utilizes logical argumentation. It uses arguments of principle as the basis for its explanations and entertains both subjective and objective types of questions. This means that apart from simply finding the answers, philosophy also resolves to generate and raise questions before finding out those answers. Philosophy is chiefly involved with thinking, as a way of creating knowledge; it frames the questions and sets the rules of debate.

For instance, the approach and practice of science, including the scientific method, arose out of philosophy. Sub disciplines of philosophy are; logic (thinking about thinking), the study of valid forms of correct reasoning; aesthetics, the study of the nature of beauty; ethics, the study of what is morally good and bad; political philosophy, the study of social governing and justice; epistemology, the branch concerned with questions about knowledge, evidence, rationality, the study of nature, the extent and justification of knowledge; and metaphysics which deals with general questions about the nature of reality which seeks to identify the fundamental kinds of matters that really exist [17]. Questions about epistemology and metaphysics; the nature of things, ethics, the extent, and justification of knowledge are the hall marks of philosophy. In this context, philosophy holds one of the key positions in the system of sciences because scientific theories do have moral implications. Philosophy criticizes science by highlighting the limits and power of science and by ensuring that science does not attempt to transgress those limits under the guise of scientific discoveries. For instance, theories of human society development, which were developed by Karl Marx and Friedrich Engels have improved people's analysis of the natural phenomena as well as the social phenomena [17].

New frontiers in scientific developments have raised moral questions particularly in the areas of artificial intelligence — answers which science cannot provide. While it is possible that scientific innovations of the 21st century could stand on their own without philosophy, the irony is that without a broad knowledge of philosophical underpinnings, scientific developments may potentially belacking in robustness in meeting the ethical and moral expectations of society [16]. One of the key strides of philosophy is its ability to ask probing questions and the ability to understand the status of all subjects and find answers through a moral prism. Also, philosophy insists that dynamics of the universe must relate to human perspectives by way of (e)valuating what the correct principles of reasoning should be.

CRITIQUE OF PHILOSOPHY

While philosophy offers significant benefits, which include the fact that it works as a bulwark of excesses of science, it has some short comings. The key weakness of philosophy seems to lie in its (e)valuation of theories in an abstract manner, whereby, it filters objective reality through subjective realities.

For instance, logic can be applied in any circumstance to show the validity of a statement, but the logical validity of any such statement may not necessarily demonstrate the truth. The logic of this thought process is that if a particular line of argument is true, its conclusion will also be deemed to be true — but you could, for instance, also have a logical conclusion drawn from a wrong premise which would then render such a conclusion faulty. A logical order of reasoning does not in itself guarantee a truthful net result. In this connection, the premise of the argument (itself subjective) is critical to the final determination of what the truth should be [16].

Critics also argue that, unlike science, philosophy does not make progress — this assumption, however, does not have much efficacy. Philosophy does make progress because dialectical analysis generates compelling objections to a given position which leads either to an improvement or to the abandonment of the said position. This then, is followed by a more critical analysis of either the revised position, or of the new position [2]. Nobel physicist Steven Weinberg took the rather unusual step of writing a whole essay entitled *Against Philosophy:* in it, he argued that not only is philosophy not useful to science, but that, in some instances, it can be positively harmful. This allegation stems mainly from logical positivists whose philosophical arguments were originally associated with the Vienna Circle — a grouping that took a rather narrow view of what counts as science [5].

A diametrically opposite view to Weinberg's is the one expressed by Daniel Dennett (perhaps not surprising, a philosopher), in his *Darwin's Dangerous Idea:* 'there is no such a thing as philosophy-free science; there is only science whose philosophical baggage is taken on board without examination' [18]. Other meta theories — mainly against positivist American school of political science (social science) — argues about the impossibility of theory-free observation or philosophy free-science.

Assumptions always presuppose actions — beit, observation, or experiment. Therefore, a doctrine that may seem to imply that philosophy is not useful for science is not only misleading, but is also damaging for education, for society, and ultimately for science itself. Hence, on this anti-philosophical refutation, it can be asserted that: 'to argue that one does not need philosophy, one must actually engage philosophy' [18].

SCIENCE & ITS SCOPE

Science may be defined as the exploration and reasoning gained from observed facts. It is the study of the structure and behavior of the physical and natural world through observation, experimentation, and reliability in the collection of information and data analysis [17]. Science may also be defined as a discipline that develops cumulatively and incrementally, and whose methods can be subjected to both the verification process as well as to the falsification process [19].

These elements form the bedrock of science, and they are mainly grounded in post-positivist theories. Other scholars define science as a systematic study of any phenomenon that can be examined, tested, and any other ways of developing knowledge through observation and experimentation. Sousa [20] argued that:

...the scientific method is composed of the necessary principles for the performance of (scientific) investigations namely, observation or experimentation of phenomena; formulation of hypotheses concerning the phenomena, via induction — the move from the particular to the general; tests to demonstrate truth or falsity of proposed hypotheses, through deduction, i.e., the move from the general to the particular and finally, the verification of or the need to modify hypotheses.

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Hence, science is a study and understanding of natural phenomena, concerned with empirical data, the data that can be observed, tested, and repeated. It is systematic in nature, and there is a specific course of action used which is called, 'the scientific method'. Science bases its explanations on the results of experiments, objective evidence, and observable facts. Science's main purpose is to extract the objective truth out of existing or naturally occurring ideas. Two factors are mainly responsible for the progress that has been made in scientific knowledge. On the one hand, advances in observational techniques and their employment to explore new fields of phenomena result in the steady accumulation of more data of special experience. On the other hand, new theoretical insights are achieved by the development of better and more comprehensive theories [15].

Further, Godfrey-Smith [15] has argued that after the industrial revolution, positivist science gained a high position in society. One of the key proponents of this science was August Comte who spearheaded the theory of positivism by arguing that truth only comes from scientific knowledge, i.e., through direct observation, testing and verification. Science quashed aside religious, theological, mystical, and metaphysical assumptions on the questions about sources and validity of knowledge. Scientists argued that superstitions and supernatural causes as argued by the church could not prove any phenomenon in the context of discovering sound knowledge. Science, they argued, was now the 'new religion'.

Another leading positivist, Francis Bacon, introduced the inductive method of testing and refining hypothesis by measuring, testing, and observing. Bacon's work was supported by John Stuart Mill, both recognising that beyond the facts of sense, experience is one of the key factors in the formation of logical statements [21].

Scientists in the field of physics such as Nicholas Copernicus opposed the Catholic Church teachings which had claimed that the earth was at the centre of the universe. Instead, Copernicus argued that it is the sun that is at the centre of the universe.

Galileo (1564—1642) opposed Aristotle's philosophy on gravity and instead argued that objects fall and hit the ground at the same time despite having different weights. Galileo developed the telescope while Isaac Newton invented the calculus which is a major instrument in science today. The works of Descartes and Einstein in scientific evolution have been equally profound. Einstein was instrumental in changing the way humans relate space with time and helped to deepen the understanding of the link between biology and social conceptions, particularly on the nuanced process of heritance [22].

What makes science distinct and attractive is the ability of scientists to distance themselves from the object that is being observed — this is referred to as objectivity. It can be argued however, that there is no sure way of attaining objectivity due to researcher biasness. This bias takes us back to the basic understanding that scientific assumptions cannot be separated from philosophy; that the evolution of science cannot hold without philosophical underpinnings [16].

CRITIQUE OF SCIENCE

Matthew Brown, a professor of philosophy at the University of Texas at Dallas, has argued that scientists need to reject the idea of the *epistemic priority thesis* in scientific works. According to the epistemic priority thesis, epistemic evidence (i.e., that modal logics alone) are sufficient to guide an inquiry without such an inquiry being re-evaluated during research. In this context, epistemic standards override non-epistemic values in guiding scientific research. In this theory, the non-epistemic values have no role to play in science *proper* [51].

Philosophers such as Karl Popper and Thomas Kuhn argued that observation cannot be a neutral source of information for choosing between theories because what people see is influenced by their paradigms. These concerns are critical because they challenge empiricism in a fundamental way [15].

This position is also supported by illations from prominent Ukrainian philosophers, P.V. Kopnin and V.A. Lektorsky who have warned about the dangers of relying sweepingly on science and ignoring other fields of social phenomenon. The argument of Kopnin and Lektorsky is framed from the context that scientism tends to rest upon a *limited* idea of science as a sum of facts connected according to certain or otherwise *prescribed* logical laws. It can be inferred from Kopnin's concerns that reducing the diversity of human consciousness to the scientific procedures alone is not only a disservice to other fields that provide diversity of thoughts but could in fact be dangerous for scientific growth itself [13].

In a similar thread, I.Z. Tsekhmistro has also provided a refreshing epistemological thought by arguing that, in physics, for instance, the quantum property of the world as an indivisible wholeness is responsible for the implicative logical properties of the structure of the potential possibilities of the quantum system. This revelation represents a fundamental aspect of social reality by stressing that the quantum property of the world is an indivisible unit. This clarity helps the reader to comprehend world phenomenon from a perspective that interconnectedness of various aspects is at the core of what sustain systems [23]. Other knowledge seeking endeavours such as cultures and religion also play complementary, if not, critical roles in knowledge formulation. For instance, the study of the phenomenon of sophianism to which a leading Ukrainian philosopher, S.B. Krymsky was devoted, believed that holy wisdom accompanied by freedom, is capable of nurturing and influencing cultural creativity to an extent that cultural innovations become essential elements that can be used for the construction of civilisations. The context of this cultural construction has a spill-over effect/influence, which means that cultural civilisations need to be understood beyond the state borders as well as beyond the (narrow) scientific conscriptions [12]. Scholars such as M.V. Popovych posit that religion also plays a part as a building block component in the epistemological terrain in the sense that it forms part of the complex, spiritual and intellectual incarnations of culture and society [24].

The major drawback on science seems to lie in the fact that scientists cannot be wholly trusted to be objective because observation is theory laden. One of the most striking practical examples of a critique concerning value-laden suppositions can be illustrated by the rational comments made by the former US Secretary of defence, Donald Rumsfeld: at a media briefing on February 12, 2002, a journalist queried Rumsfeld on why his government was still intent on invading Iraq even when there was no concreate evidence on Baghdad's weapons of mass destruction programs. In justifying his governments' war stance, Rumsfeld suggested that the United States would not relent on pursuing the matter because, 'the absence of evidence is not evidence of absence' [25]. Rumsfeld's comments to the journalist and his subsequent insinuations in his book, *Known and Unknown: A Memoir,* are very instructive, and they hammer Karl Popper's point home: that empirical observation is theory dependent. Theory tells you what to look for and as such, people tend to see what they want to see [26]. Another case in point concerning value-laden inferences can be illustrated by the 1964 Court pronouncements made by the former US Supreme Court Justice, Potter Stewart on a case involving a pornography cinema film: in this case, Jacobellis v. Ohio had sought the Court's interpretation on what constituted 'pornography'. On passing judgement, Judge Stewart argued that: 'I know it when I see it, and the motion picture involved in this case is not that' [27].

These(subjective) views are further supported by Peter Truran who argues that 'seeing is not necessarily believing'... because the instruments used to test hypotheses are themselves a constituent part of the hypotheses. The major weakness of science seems to be its tendency to (deliberately) ignore ethical considerations in its development agenda. According to this line of thought, science tends to rely on the supposition that the end justifies the means [28].

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Heather Douglas, a professor of philosophy at Michigan State University, has argued that science requires ethical values for both direction of research and sound conclusion. Scientists need guidance for theory choice than just logic and evidence alone. One of the façades about science is that scientists are presumed to be sensible moral agents, on the supposition that scientific courses upgrade moral reasoning, hence scientists are usually assumed not to be under threat of force when weighing certain moral consideration. However, it appears that moral responsibility spins on issues particular to professional boundaries and knowledge construction. Some scientists simply do not recognise the legitimate role of values in science on the claim that such values would be damaging to *objectivity* [29].

As David Hume has stated, a human mind is governed by desire rather than reason and as such, people tend to favour their own interests even in circumstances when the benefit to them is relatively trivial and the cost to others very large [30]. Hume's conception was that certain scientific propositions might not be relied upon because they may lack sufficiency in their wider conceptions or that such conceptions may be narrow-minded at best, and at worst, the knowledge obtained from them may not be empirically robust, hence the need for continuous re-evaluation of any given system [21].

Helen Longino, a professor of philosophy at Stanford University, has asserted that values in scientific research are critical elements in those inquiries. While it may appear to some constituencies that science and values are like water and oil which do not mix, professor Longino argues that science cannot be autonomous to normative issues. If the goal of science is to produce explanations of the natural world, then the values and constraints involved in considerations of what counts as *sound explanations* will govern such activities [31].

Foucault [32] has stated that a line is not linear — it can be broken; it can be crossed and can also meander — this demonstrates the contingent nature of life itself and the varieties it offers which may otherwise remain unknown to us, i.e., this scenario provides an illustration of an archaeology of the sciences that unearths old patterns of meaning and lays bare the arbitrariness of our received truths. For instance, when, if ever, is the use of landmines or atomic bombs justified in international relations?

While technology has brought greater development to the world, the same technology is now apparently appearing to be a threat to international peace and security. The case in point is the COVID-19 pandemic which may point to how much technological innovations may have invaded and destroyed the ecosystems which sustain and promote the welfare of all earthly inhabitants [11]. Scholars such as Peter Medawar would argue that scientific conceptions in their orthodox form do indeed have the potential to carry with them the mistaken notions of the nature of scientific thought due to misrepresentations of those thought processes [33].

Imre Lakatos and Paul Feyerabend have argued that science degenerate unless it is theoretically and experimentally progressive. In this context, particular theorems may not necessarily be definitive, only that no counter idea may be available yet — but once a counter idea is found, the theorem may need to be re-examined with a possibility of adjusting its validity parameters[34].

Critical theory reminds us to focus on struggles that reveal in broad outline how an alternative society is already imminent within the current social order. Frankfurt School scholars such as Jurgen Habermas have argued that modernity has made progress in advancing the ethical claim that the legitimacy of social arrangements depends on how far they are answerable to everyone who is affected by them. Moral principles of universality hold out the promise of a global system in which all persons face each other as equals in forms of open dialogue in which no one knows who will learn from whom in advance [35].

Another critical aspect arising from scientific innovations is Globalization. The world has wit-

nessed unprecedented state-of-the-art scientific developments in global finance, information and communication technology and global economics. Multinationals operate on a global scale with satellite offices in numerous locations, many of whom are involved in arm-twisting tactics of weaker states in pursuit of maximisation of profits at any cost[30].Globalisation, with all its technological advancements, is increasingly leaving more people (particularly of the global south) marginalized. Inequalities of neoliberal capitalism such as unfair corporate trade practices, pollution from mining industries and dumping of technological and industrial waste in poor countries have exposed the dark side of technology and globalization particularly for people of the global [36].

Ironically, some of the members of the worst negatively affected states of Africa are engaged in what Friedrich Engels called, 'false consciousness' ...meaning that these members from poor states, otherwise commonly referred to as, 'local traitors' or 'capitalist collaborators' use their privileged political and economic influence through institutional processes to conceal the capitalist exploitation of the ordinary African citizens. This (deliberate) entrenchment and marginalisation of the subaltern populations is what philosophy considers to be unethical and immoral conduct [37].

Alison Wylie, a professor of philosophy of science at the University of British Columbia, has inserted a fresh epistemology to this topic when he argues that in the application of scientific knowledge, the *standpoint theory* — controversial as it may seem — holds the promise of mediating between the excesses generated by long-drawn-out debate over the role of values in science. The key utility of the standpoint theory is its analysis of inter-subjective discourses which argues that the actual authority lies in individual's personal knowledge and the power that such individual knowledge exert. Wylie [38] has put this conversation in perspective by arguing that:

...the standpoint theory's central insight is an inversion thesis which opines that: those who are subject to structures of domination that systematically marginalise and oppress them may in fact be epistemically privileged in some crucial respects. They may know different things or know some things better than those who are comparatively privileged by virtual of what they typically experience and how they understand their (troubled) experiences. The theory offers a framework for understanding how far from compromising epistemic integrity certain kinds of diversity may significantly enrich scientific inquiry.

CAN PHILOSOPHY DEVELOP WITHOUT SCIENCE? OR CAN SCIENCE DEVELOP WITHOUT PHILOSOPHY?

Every scientific discovery is at the same time a step forward in the development of the philosophical methodology. It can also be argued that any object of scientific investigation is simultaneously its effect. The more scientific knowledge develops, the more is the tendency to study the logical ways of getting such knowledge. For while knowledge is crucial for human development, such knowledge should be harnessed by reason and by some form of belief system. In Theaetetus, Plato defined knowledge as the intersection of truth and belief, where knowledge cannot be claimed if something is true but not believed, or believed but not true [39].

Philosophical theories provide scientists with wider scope to resolve the issues arising from their work. This apparent self-awareness from both sides shows how related and connected philosophy and science are, although they raise different questions and differ in the content of their methodological questions. The use of critical thinking on both sides and their nature of critical inquiry such as philosophy's examination of scientific methods — philosophy's integrating of sciences and examining scientific assumptions — and scientific research's influence on philosophical progress and philosophy's guiding nature of the future course of scientific process including philosophy's provision of constructive criticism to sciences shows that science and philosophy are stron-

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gly related and cannot be divorced from each other [8].

The more science we discover, the more philosophical questions that come along with it. In such cases, philosophy will always be there with science to answer questions related with ethics, morality, human mind, economic distributions, and other related questions that come into being with the advancement of science and technology [40].

Science and philosophy are two fields, or families of fields, within the general project of the systematic and rational investigation of the world, distinguished by their subject matter. They use critical inquiry on their way to develop knowledge. In broad terms, philosophy and the sciences are equal partners assisting creative thought processes in explorations with a view to attain generalized truths. It bears repeating that philosophy does not replace the specialized sciences and does not command them, but it aids them with general principles of theoretical thinking, with a method of cognition and worldview. In this sense, scientific philosophy legitimately holds one of the key positions in the system of the sciences [5]. Philosophy and science use reason on their way to develop knowledge. All the sciences, and especially the quantitative ones, rely heavily on the reliability of logical reasoning and deductively valid arguments; the sciences also rely on inductive arguments i.e., the ones which move from finite bodies of data to general theories. The power of philosophy is logic. By using critical thinking and reasoning, philosophers distinguish valid arguments from invalid ones to arrive at certain realms of reality and knowledge [39].

Science is concerned with natural phenomena while philosophy attempts to understand the nature of human beings and their existence. Historical developments of questions that seemed not to be answered by science were answered by philosophy. Philosophy, in this case, helps to address inquiries that ordinarily could not be answered by science. In other words, philosophy can help to show the missing links in the scientific understanding of phenomenon which is being studied. This connection has endured for very many years. It is ironic that while philosophy relies on logic for its theories to hold, scientific theories also emerge from the same logical processes [7].

The theory of knowledge offers the best link between philosophy and science in the sense that epistemological foundations rests both in science and philosophy — this way, knowledge gaps from either of the fields is compensated for by the strengths of the other field. Both disciplines help each other to bring out unpredictable aspects of reality through originality, open mindedness, and sensitivity to new aspects of study. Principally, in the absence of empirical evidence, any theorising would be set aside and put off for discussion, yet philosophy should still not be discounted from the equation because many guiding ideas that lie at the foundation of modern science were first brought out through philosophical perspectives.

The theories of motion, space and time were started in philosophy. Apart from influencing the development of various fields of knowledge, philosophy itself has been enriched by progress in the sciences. However, unethical technological advancement is rejected by moral philosophy. In this context, progress that is consigned only to the protocols of technology and separated from ethics does not have the blessings of philosophy. No single discipline will ever have all the answers; it is only by working together that they both science and philosophy can thrive [7].

PHILOSOPHY FOR SCIENCE

The researchers such as Thomas Pradeu have opined that some philosophers of science use philosophical tools to produce scientific knowledge rather than knowledge about science. Most experimental philosophy deals with philosophical matters with experimental methods, rather than scientific problems with philosophical tools [8].

It is argued that one can do philosophy without science, but it is not possible to do genuine science without philosophy. Philosophy enables science to examine the terms and presuppositions

of science i.e., to critically analyse and clarify what the terms used by science mean, and how they are articulated, and what assumptions they require.

However, the idea that philosophers can contribute effectively to scientific knowledge might be met with scepticism by some. The question that arises is: what is the impact of philosophy on science?

A study conducted by [8] suggest that philosophy does have enormous influence on science. The study revealed that, for instance, that nearly half of the highly visible articles in scientific journals are authored by philosophers. This result is significant both symbolically and practically on the influence of philosophy on science. Further, this also seems to suggest that philosophy and science belong to a continuum than to the proposition that they are different entities.

Philosophy helps science to discover standards for sound theoretical premises, helps in the identification of valid modes of explanation of scientific methods. This offers an epistemology that does not prevent but stimulates scientific progress; to illuminate ethical guidance and discover (broad) goals for science. Also, this points out and articulate the interrelations between concepts that are found in different domains of the natural sciences as well as in the social sciences and humanities. Further, this explains how observations fit in the broader picture of the world and to create a language where scientific results and broader human experience can complement and mutually enrich each other [41].

This means that aside from finding answers, philosophy also resolves to generate questions. It raises questions and screens processes before finding out the answers. Philosophy is mainly involved with thinking and creating knowledge. Philosophy deals with two sets of questions: first, the questions that science, i.e., physical, biological, social, behavioural cannot answer now and perhaps may never be able to answer; second, the questions about why the sciences cannot answer the first lot of questions. One type of question that only philosophy deals with is the normative questions, issues of value — questions about what ought to be the case, what we should do, what is good and bad, what is right, and wrong, what is just, and unjust in ethics, aesthetics, and political philosophy. The sciences are presumably descriptive, or as is sometimes said, positive, and not normative. Many of these normative questions have close cousins in the sciences [17].

SCIENCE FOR PHILOSOPHY

Often, as a tool of philosophy, science answers the questions of philosophy and guide them towards empirical findings. In the history of philosophy and science, the transforming effect of science on philosophy is apparent when we consider ontology: in ancient Greek philosophy, there was a theory of atomism, a world constructed by indivisible material particles [42].

Later, from the point of view of classical mechanics, the world is constructed integrally by particles whose basic properties result from the interactions of forces. ‘Quality’ was considered by modern materialists and physicists as the symbol of the existence of matter, and the ‘weight’ of quality as the standard magnitude of measuring matter. In other words, materialist philosophers all conflated matter with ‘quality’ in science and viewed it as the origin of the world. Next, matter-energy was shown to be a more basic form of reality than quality by electromagnetic field theory, relativity, and quantum mechanics. This new development in science made traditional materialism lose its raison d’être, which led to corresponding transformations in philosophy, the emergence of modern energetics, a new realism, and a new materialist philosophy [43].

OVERLAP AND SUPPORT FOR EACH OTHER

There is an important domain of overlap between the two, in that the subjects of the natural sciences are also subjects for philosophy. De Haro [41] has asserted that, ‘the universe, and possible universes other than our own elementary parti-

cles, and life, are all subjects of concern for both natural science and philosophy'. The scale of scientific work and the social significance of research have gained significant traction. For instance, philosophy and physics were at first organically interconnected, particularly in the works of Galileo, Descartes, Kepler, Newton, Lomonosov, Mendeleyev, and Einstein, and generally in the works of many scientists with a broad outlook. At some point in time, it was commonly held that philosophy was the science of all sciences, and hence their supreme ruler. Today, physics is arguably regarded as the *queen of sciences* [4].

Science and Philosophy have distinction in the subject matter. It is apparent that philosophy studies subjects, such as societies and political organizations, about which the natural sciences have nothing to offer. Science and philosophy cannot be distinguished on the basis of their subject matter alone. The difference is often sought in their formal objects and methodologies: sciences seek explanations in the modes of causal efficacy and material causation, whereas philosophy is interested in formal analysis, goals, and intentionality. This difference in methodology is often summed up by the mantra, 'philosophy asks why-questions, science asks how-questions' [41].

Science has its goals-description, prediction experimentation and control while philosophy aims at interpretation, in finding the purpose and value in life. Science is essentially constituted by principles of universal rationality and those principles are not equal to direct narratives about facts of observation and experiment. They depend on certain concepts, rules, and methods of abstract philosophical thinking to ascend from narrations of facts to principles of universal rationality. We can thus begin to see how philosophy is very much in science, and how science is in the rules of philosophical paradigms. There is an intrinsic, implied philosophical concept in any scientific universal rationality, which can be viewed as the offspring of certain philosophical concepts and concrete narratives combining with one another. The unity of philosophy and science cannot be considered exclusively as an external join, but also as an inner convergence [5].

Science can only give data or methodology while philosophy interprets these results and come up with theories. An increasing number of philosophers, however, are making conceptual contributions to sciences ranging from quantum mechanics to evolutionary biology, and a few scientists are conducting research relevant to classically philosophical fields of inquiry such as consciousness and moral decision-making. Philosophy may help determine what science investigates, and science may support or prove false, philosophy with factual exposure. Winch [44]has argued that:

...the difference between the respective aims of the scientist and the philosopher might be expressed as follows: whereas the scientist investigates the nature, causes and effects of phenomenon and processes, the philosopher is concerned with the nature of reality as such.

Philosophers do their critique using logic, ethics, and metaphysics, whereas scientists use their critique mathematically, empirically, or physically. A philosopher's work, if he is employed at all, often remains in liberal arts academia. A scientist on the other hand, may work on physical applications. Scientists try to ascertain probability, whereas philosophers try to ascertain what may be true logically. Scientists instruct students on 'what is known' (the tenets of science, the size of the universe, the gravitational constant, etc.). Philosophers instruct their students on 'what is not known', i.e., lingering questions, debates, paradoxes [21].

POLICY IMPLICATIONS FOR FUTURE MUTUAL DEVELOPMENT OF APPLIED SCIENCE & PHILOSOPHY: SCIENTIFIC KNOWLEDGE IS UNIVERSAL, AND NOT A WESTERN PRESERVE

Thomas Kuhn argued that at a given time, science tends to be dominated by a particular paradigm until it is challenged by a crisis which then forces

the emergence of a new paradigm. The cycle keeps going on, i.e., from 'normal science' to a crisis, then leads to a revolution and back to normal science [45].

In the 21st Century, technology and globalization have taken centre stage of key human activities across the social, economic, and political spheres in which most adherents of scientific practice see social science and philosophy as analogous to science [46].

Technology has benefited the global population, for instance, through better communication systems and efficient productivity in the supply chain. These scientific innovations, however, produce both the benefits and the inadvertent negative effects. The (unintended) effects could be dire, such as an increase in inequalities and an escalation in the invasion of privacy, for instance, through surveillance systems. Such privacy violations are an infringement of the human rights of ordinary citizens[9].

Critics argue that although technology has provided better infrastructure and continue to offer more innovative options for environmentally conscious choices — affordability of those innovations by marginalized populations remain a huge challenge. Technology has also attracted criticism not only because it gallops millions of funds to sustain it, but also because it is mainly driven by hegemonic politics of capitalistic cut-throat-competition at the expense of social welfare programs such as underfunding in the educational and health sectors. Marginalized and poor populations are confronted with the reality of dealing with the negative effects of technologies that may include climate change challenges such as acid rain, increased droughts, an increase in heat waves, flooding, soil erosion, insect outbreaks, reduced agricultural yields, and an increase in more allergies and other health risks [36].

Stengers [47] has strongly regretted Western hegemonic propensities — the arbitrary restriction of what constitutes 'technology' to measurable items in the built laboratories of the West — this position — in effect — amounts to an epistemological and ontological exclusion of the technological contributions of the subaltern populations of the global south. A prime example is the fact that the vast Western scholarship tends to ignore the systematic tapping of native (global south) plant knowledge that goes to feed imperial and Western techno science [48]. Ironically, these practices ignore the fact that the global south were already technological before colonization. To date, the image of the global south (Africa in particular) in the technological imagination is still Hegelian, i.e., a mindset that portrays Africa as a continent with no development to exhibit [49]. The question that remains is whether, in philosophical terms, Western scientific technology — standing on its own-can adequately up lift the lives of all marginalized populations across the globe [10]. Sieglinde Snapp, a professor of soils and systems ecology, has added her voice to the legacy of colonialism by asserting that science and Western-inclined education is immersed in injustice and exploitation. A study carried out in 2021 revealed, for instance, that only 16% of articles in high profile development journals came from scholars that are predominantly based in subaltern populations while 73% came from the global north scholars [50]. These biases and non-inclusive agendas are further exemplified when she has stated that:

...scientific novelties from marginalized people have been erased, natural history specimens (from the global South) have been taken without consent and genetics data have been manipulated to back eugenics movements. Without acknowledgement and redress of this legacy, many people from minority ethnic groups will not trust science, and certainly will not feel welcome in academia — an ongoing barrier to the levels of diversity that many (Western) universities claim to pursue. Agricultural research is also steeped in colonial attitudes; for instance, many programs focus solely on higher crop yields, rather than including the nuances of resource stewardship such as how using perennial crops improves soil health at the cost of lower yields. By conducting agricultural

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research that involves scholars from the global south, we can better address a broad range of production and sustainability goals [50].

The study highlights science and philosophy coming of age. The paper leads the reader on a tour of early scientific theory and weaves through the historical clashes and collaborations between science and the competing spheres of philosophy, poetry, religion, mathematics, and technology. The study reveals that despite the differences between philosophy and science on the literal definitions or on the origin of words, methodology, subject, and met a theoretical positions, they have a positive relationship.

Each discipline can arguably claim to be the origin of the other. This symmetry is depicted using logic (critical thinking), searching for reality, knowledge, truth, giving constructive critique to support each other, progressing together, inner convergence and overlapping of subjects. Philosophy, which most scholars consider as the base for the origin of science, reinforces science by criticizing scientific theories — this in turn provoke and energize scientists to discover new concepts.

As science advances and new phenomenon appear in artificial intelligence, in genetic engineering and in molecular biology, new moral questions are brought to the fore where philosophy performs its task. It is in this context that this paper has argued that for science to meet the challenges of globalization and justice in the 21st century, it needs to be ethically informed, and thus philosophical reflection on and in science is essential. Both need each other, and mainly for science, philosophy, arguably, maybe mandatory. The study also illustrates that while it might be possible to do science without philosophy, it remains highly unlikely that successful science could be viable without philosophy. Science was built on the strength of philosophy because before any experiment or actions related to the law of causality can be conducted, the application of logic (philosophy) is essential.

In the fabric of reality, philosophy always comes first when we base it on decisions of theories that are logically plausible and physically viable. To look to the past events for a clue of any experiment in science, scientists always need philosophy. For instance, designing a car (philosophy) needs those who can realize it (science). Thus, it can be argued that science without philosophy is lame and philosophy without science is blind. The study reveals in a broad spectrum that for science to be genuine, it needs to be concerned with the parameters on the questions of morality, and human dignity.

More than ever before, scientific evolutions in the 21st Century are — on the one hand — expected to critically strike a healthy balance between technological novelties and sustainability of ethical and environmental management. This critical requirement seems often ignored. On the other hand, philosophy's shortcomings lie mainly on its strict reliance on logic and moral reasoning; this gap, therefore, can only be harnessed by joining hands with science.

There is also some indifference that is habitually exhibited by both philosophy and science to new ways of thinking and to the unfolding practical global realities on the ground. This indifference means that both may not be able to properly see the possibilities in unfamiliar ventures on the horizon that could otherwise potentially lead to the realisation of better constructions of their conceptions.

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АНАЛІТИЧНИЙ ОГЛЯД ВЗАЄМОЗВ'ЯЗКУ МІЖ НАУКОЮ І ФІЛОСОФІЄЮ ТА ЇХ ЗАСТОСУВАННЯ В СУЧАСНІЙ ГЛОБАЛЬНІЙ ПОЛІТИЧНІЙ КОНЦЕПТУАЛІЗАЦІЇ ТЕХНОЛОГІЇ

Вступ. Для того, щоб наука могла протистояти викликам глобалізації та справедливості в XXI столітті, вона має відповідати вимогам етики, а отже, філософська рефлексія на науку та в науці є надзвичайно важливою.

Проблематика. Дослідження спрямоване на аналіз тенденцій XXI століття в філософській думці, що впливають на наукову мотивацію, а саме на пошук відповіді на запитання: «Як філософія може бути корисною та впливати на наукові досягнення в сучасному світі, і яким чином це відбувається?».

Мета. Подемонструвати, що, незважаючи на деякі відмінності у своєму походженні та методологічних концепціях, між наукою та філософією снують певні взаємозв'язки. Дослідження розглядає ці зв'язки задля оцінки корисності їх взаємодії в умовах швидкого технологічного розвитку XXI століття. Для того, щоб наука була здатною відповідати викликам глобальної справедливості, вона повинна мати етичне підґрунтя, тому філософська рефлексія над наукою та в науці має першочергове значення.

Матеріали і методи. Методологія базується на аналізі описової та тематичної літератури з використанням якісних даних, які були зібрані з академічних журналів, наукових книг та онлайн-публікацій. Огляд спрямовано на виявлення тенденцій у філософській думці XXI століття, які впливають на наукову мотивацію.

Результати. Показано, що зв'язок між наукою та філософією існує протягом багатьох століть, і незважаючи на їхні основні відмінності, які включають масштаб, підхід, методику та унікальні виклики, обидві галузі активно сприяють розвитку людської здатності до інновацій, творчості та критичного мислення. З'ясовано, що в майбутньому критична оцінка та постійний ретельний аналіз наукової та філософської діяльності стануть набагато важливішими, ніж будь-коли раніше, якщо майбутні проєкти будуть спрямовані на ефективний внесок у (ре)конструкцію стійких виробничих структур, які сприятимуть справедливому та екологічно стійкому розвитку.

Висновки. Важливо, що окремо наука та філософія не пропонують справжніх рішень для сталого росту та розвитку, отже, зацікавлені сторони повинні розуміти цей складний феномен як через призму науки, так і філософії, критично переосмислюючи їхні досягнення та недоліки з обох боків. Найважливіше, що дослідження розширює рамки розуміння науки та філософії за межі західних концепцій, які часто не помічали або навіть усвідомлено нехтували ортодоксальними, але цінними науковими ідеями зокрема, так званого глобального Півдня.

Ключові слова: філософія та наука, глобалізація, технології та інновації, онтологія та епістемологія, сталий розвиток, маргіналізація глобального Півдня.