

INTERROGATING PHILOSOPHY OF SCIENCE: METHODS AND NEW TRENDS

AyederoTaiwo Martins

and

Owoyemi Deborah Oluwasola

owoyemi.deborah@eksu.edu.ng

Ekiti State University, Ado Ekiti Nigeria.

Abstract

‘Scientific’ is the currency of the past and present century’s research methodology. Every works, even in humanities and religion has to be scientific in method and structure to be universally acceptable. As such, science becomes the prism to truth and knowledge. But scientific method or methodology generally relies on inductive model to function. Induction in turns had been seriously criticized by scholars and philosophers; chief among them is David Hume in his famous work, ‘*A Treatise of Human Nature*’. Thus, there is the tendency to ignore the undercurrent assumptions and dangers inherent in the methods and goals of certain scientific activity at the detriment of humanity in general. To this end, philosophy, being a second-order discipline reserves the epistemic right to interrogate and query the subject matter, foundation, method and the undercurrent assumptions and presuppositions of science. Chief of our focus in this paper is to interrogate and expose certain undercurrent assumptions and presuppositions in science that often elude the lens of most researchers when adopting scientific method in their field of endeavours.

Keyword: Method, Science, Research, Humanity, Philosophy, Science, Value

1. Philosophy of Science: A Brief Introduction

Philosophy deals with all fields of human knowledge be it Science, Politics, History, Medicine, Psychology, Sociology, Astrology, Geometrics, Mathematics, Logic, Language, Morality, Education, Religion, and even Mysticism. This explains why we have: Political Philosophy, Philosophy of History, Philosophy of Religion, Philosophy of Biology, Philosophy of Medicine, Philosophy of Engineering, Philosophy of Education, and Philosophy of this... Philosophy of that.... This also tells us why philosophy is commonly regarded as the queen of all disciplines. The importance of philosophy is evinced at the peak of academic tutelage with the caption (Ph.D.) Philosophy Doctorate in an area of specialization. Whatever your course of study, be it Robotic Engineering or Rocket Science at the Ph.D. level, you will be awarded the degree (Ph.D. Robotic Engineering) Philosophy Doctorate of Robotic Engineering or (Ph.D. Rocket Science) Philosophy Doctorate in Rocket Science.

Besides, Philosophy *abinitio* permeated all human disciplines. Ancient philosophers were all scientists. The likes of Thales, Anaximander, Anaximenes, Heraclitus, Pythagoras of Ephesus (the originator of Pythagorean Theorem), Euclides (the great Mathematician and the originator of Algebra), Socrates (Plato), and the great Aristotle (the father of Logic) were all scientists. The division of

disciplines was carried out by Aristotle's editor, Andronicus of Rhodes. It was Andronicus of Rhodes who divided philosophy into various disciplines we have today. So, we owed the opportunity to study Philosophy of Science to Aristotle on the watch of Andronicus of Rhodes.

2. What Is Philosophy?

The word Philosophy is derived from two Greek words “*Philo*” meaning “I Love” and “*Sophia*” meaning wisdom. Thus, Philosophy is literarily taken to be the love of wisdom, wisdom here could be interpreted as knowledge. Therefore, Philosophers are lovers of knowledge. It is commonplace in philosophy to hear philosophers say "Philosophy has no universal definition. This is because Philosophy has to do with how we perceive or how we see things. And as such, no two people conceive or see things the same way. Thus, philosophers themselves do not agree on the nature, scope, and definition of the discipline of Philosophy. By implication, Philosophy has therefore been defined or explained in many ways by different Philosophers:

According to Plato, a Philosopher is a man whose heart is fixed on reality.¹ For Aristotle, Philosophy begins in wonder, wonder about the knowledge of the truth....² According to Ludwig Wittgenstein, Philosophical problems emanated from linguistic confusion caused by linguistic bewitchment of our intelligence by ordinary language and the solution is logical analysis and clarification of meaning.³ According to Kolawole Olu-Owolabi, this definition of Philosophy started with David Hume, elaborated by G.E Moore and finally reified by Ludwig Wittgenstein. This conception is purely dedicated to the mission of making clear what is mysterious or fluid. Its essential project is to provide a rational explanation for those ideas that are fundamental to human existence.⁴ For H. S. Staniland, "Philosophy is the criticism of the idea we live by..."⁵. Schwitzgebel defines philosophy as all thought to the person with the right turn of mind⁶. Philosophy has also been defined as the personal search for truth in any field by rational means⁷

¹ Plato, *The Republic*, 475. P.480.

² Aristotle, *Metaphysics*, 993b. P.19.

³ Wittgenstein, L. *Tractatus Logico Philosophicus*, translated by C. K. Ogden

⁴ Kolawole, Olu-Owolabi, *Issues and Problems in Philosophy*, Grovads Network, Ibadan, Nigeria 2007, P.45.

⁵ H.S. Staniland, "What is Philosophy?", in *Second Order*, Vol. Viii No 1&2 2005, P.24.

⁶ E. Schwitzgebel, For all x there is a Philosophy of x, 2012, 3.

<https://schwitzsplinter.blogspot.com/2012/01/htm>. Accessed April 22, 2020.Online.

⁷ Descartes Rene, *Discourse in Philosophical Writings*, Amscombe&Geach (ed.). Middlesex University Press.(1956. Print.

3. Conceptions of Philosophy

To this end, we can now see various conceptions sketched at by various definitions considered above. It is therefore legitimate for us to outline various definitions and classify them under conceptions of Philosophy.

- i. Philosophy as a critical or reflective and contemplative discipline (Rational or Scientific Inquiry)
- ii. Philosophy as a logical or argumentative enterprise (Logic)
- iii. Philosophy is the search for ultimate or fundamental reality (Metaphysics)
- iv. Philosophy as an Ideology (Karl Marx's political theory)
- v. Philosophy as a science of human conduct (Ethics)
- vi. Philosophy as a Conceptual Analysis (David Hume, G.E Moore and Wittgenstein)

H.S Staniland's definition reveals some fundamental ingredients that are quintessential to philosophizing as highlighted in the conceptions of philosophy above namely; the critical, reflective, and argumentative nature of philosophy. Suffice it to say at this juncture that, any human endeavour that is to pass as rigorous, critical, reflective, or scientific as the case may be must manifest the self-reflective or critical nature of philosophy whether in the field of Mathematics, Medicine, Law, Robotic Engineering or Rocket or Nuclear Science. In the light of this, Rene Descartes declares:

An exercise is critical if and only if it avoids any kind of dogma or triviality..it is philosophical if nothing is taken for granted and nothing is accepted without rigorous scrutiny and criticisms and scientific if no assumption is taken without rational probe...⁸

Broadly speaking, Philosophy sets the theoretical basis for all disciplines. It is a theoretical activity aiming, like all theoretical activities, at discovering the truth. It has a subject matter, and specific discipline methods, though it is unclear what exactly they are. Reflecting on the foregoing, it is clear that Philosophy raises pertinent questions about the world, the knowledge of it, and what can be done about it. Philosophical questions can be answered by three construed areas of philosophy; metaphysics, epistemology, and ethics. Metaphysics includes part of philosophy of mind, language, and science. The other part of these philosophies belongs to epistemology, which examines the cognitive contact with the

⁸ Descartes, Op. Cit. 1956, P. 66.

world. Ethics is the normative branch of philosophy covering in part, philosophies of law, social philosophy, and aesthetics.

4. Branches of Philosophy

Broadly speaking, scholars have identified seven areas in philosophy namely: Metaphysics (*the study of ultimate reality*), Axiology (*the theory of value or rather the study of value*), Epistemology (*theory of Knowledge*), Ethics (*the study of Morality, human behaviours, and conducts*), Political Philosophy (*the normative study of a political concept like liberty, freedom, justice, right, authority, political state, political system, equity and jurisprudence*), Aesthetics (*the study of beauty*) and Logic (*the science of human reasoning*). However, to meet the needs of this study, we shall only limit ourselves to the four basic branches of philosophy. Philosophy has four major branches and these branches are:

- i. Metaphysics
- ii. Epistemology
- iii. Logic
- iv. Ethics

5.1 Metaphysics

The word 'Metaphysics' is derived from two Greek words (*meta and physika*). The word 'meta' means beyond or after while 'physika' means physical realm or physical world. Thus, metaphysics means the study of ultimate reality beyond the physical realm. Metaphysics has often been defined as the inquiry into what is after or beyond the grasp of the senses. This definition is born out of the dilemma of Andronicus of Rhodes who edited Aristotle's works; after collecting most of Aristotle's work under the title of "physics", was at a loss about what title to give to others that fell outside the concern of human physical world. He decided later to call the works "after the works on physics" (that is, metaphysics)⁹. Andronicus of Rhodes Dilemma is believed to have motivated Arthur Schopenhauer's view of Metaphysics as the "knowledge that goes beyond the possibility of experience and nature but renders nature possible".¹⁰

Metaphysics is the branch of philosophy that deals with the study of ultimate realities; realities beyond our physical world such as; angels, gods, deities, heavens, spirit, death, destiny, fatalism, pre-determinism, ghost, destiny, dualism, monism, plurality, universality and particularism. Metaphysics can be divided into two main branches:

⁹ S. O. Dada S.O., "An Overview of the Branches of Philosophy", In Introduction to Philosophy and Logic, Newsletter Limited: Yaba, Lagos. 2004, 33.

¹⁰ S.O. Dada, Op. Cit. 2004, P.4.

- a. **Ontological metaphysics:** The study of ontological realities outside the human terrestrial world e.g. ghosts, death, devil, gods, spirit, reincarnation, etc
- b. **Cosmological metaphysics or Universal Science:** This is a branch of metaphysics that studies realities within human universal but beats human imagination namely: weather, climate, aliens, UFOs, earthquakes, volcanoes, hurricanes, galaxies, planetary bodies, metrological study, astronomical realities,, etc.

These two branches of metaphysics offer a more balanced approach to approaching and interrogating metaphysical concerns. A proper definition will therefore see metaphysics as the study of (*the totality of being and existence*), that is, the nature and structure of reality in all its embracing and comprehensive forms. It seems man is perpetually condemned to probe into metaphysical inquiries, even scientific-minded researchers. It is in light of this that Immanuel Kant declared that, the tendency toward metaphysics is an irresistible one:

Man has a natural curiosity to know, he wants to understand and be able to explain what he sees and experiences in the world, and what he sees in this world leads him beyond what he sees to the metaphysical world of what he does not see but wants to explain. The death of a loved one makes him want to probe into the death, life-hereafter, and then heavens and God...He would naturally have to go beyond the physical world to explain the mystical, the mysterious, and the spiritual.¹¹

This is how humans are constantly and irresistibly drawn into the realm of metaphysics daily. Notable among the known classical metaphysicians are: Thales, Anaximander, Anaximenes, Pythagoras, Heraclitus, Parmenides, Democritus and Leucippus, Socrates, Plato, Aristotle, Rene Descartes, Alfred North Whitehead, Leibnitz, Gorge Berkley, Immanuel Kant, Bertrand Russell, Gottlob Frege etc

5.1.2. Metaphysical Questions

Metaphysics deals with questions such as: What is the nature of ultimate reality? What does it mean for something to exist? Why are things the way they are? Does God exist? What is death? Is reincarnation true? What is destiny? What is immortality? Is there life hereafter? What is the difference between appearance and reality?

5.1.3. Metaphysical Doctrine:

- i. **Idealism:** Genuine knowledge is an idea in the human mind (i.e. real knowledge is innate and mind-dependent).

¹¹ S.O Dada Op. Cit. P5.

- ii. **Materialism:** Matter is real. Genuine knowledge is the knowledge of the world we gain through human senses and perception.
- iii. **Monism:** Reality is one and absolute.
- iv. **Dualism:** Reality is of two categories namely: mind and body, spiritual and physical
- v. **Pluralism:** Reality is many and multiplicity.
- vi. **Fatalism:** What would be would be irrespective of human action and inaction...Fate and destiny are preprogrammed.
- vii. **Determinism:** Humans have the power to decide their fate (we decide our fate by our effort) men are gods.
- viii. Appearance and Reality change and permanence.

6. Epistemology

Epistemology has its root in two Greek words (*episteme* and *logos* or *logy*). Going back to history, the Greek words '*episteme*' literally means '*knowledge*', and the '*logy* or *logos*' means the study. Etymologically, epistemology is the theory of knowledge. It is the branch of philosophy that studies the nature, Problem, limit, scope, and structure of knowledge. Epistemology is one of the most important aspects of philosophy since philosophy itself is essentially an inquiry into the nature of human knowledge. And much more than this, central to every philosophical inquiry is the concern about the ingenuity of what we claim to know and how we came about that knowledge.

Therefore, epistemology is mainly concerned with the justification for knowledge (i.e. proof and evidence), and criteria for knowledge (method and means of inquiry).

Epistemological Questions:

6.1. Epistemological Doctrine:

- i. **Rationalism:** This is the epistemological doctrine advocated by Socrates (Plato), Rene Descartes, Bertrand Russell, Immanuel Kant, and other rationalists. According to this doctrine, genuine knowledge is the knowledge acquired through reasoning.
- ii. **Empiricism:** Rationalism is another competing doctrine in epistemology that opposes the rationalist thesis. For the empiricist, genuine knowledge is the knowledge of the external world we acquire via human senses. For the empiricists, seeing is believing. Chief among the empiricists are Aristotle, David Hume, John Locke, George Berkeley, G.E Moore, and others.
- iii. **Skepticism:** Scepticism is another epistemological attitude that subjects every human claim to doubt. Chief among the skeptics are Gorgia, Protagoras, David Hume, etc.

7.1. Ethics:

8. We may consider ethics to be the "Science of Conduct." Ethics includes the
9. fundamental ground rules by which we live our lives. Philosophers such as Socrates and
10. Plato has given guidelines for ethical behaviour. Many ethicists consider emerging
11. ethical beliefs to be legal principles, i.e., what becomes an ethical guideline today is made
12. into a law, regulation, or rule

Ethics comes from the Greek word 'ethos' which means character or ways of behaviour. It refers to a generally accepted set of principles and standards used by an individual, institution, profession, or society in general (as part of social ethics, professional ethics, etc) to guide their thoughts, behaviour, and actions; to determine the goodness/badness or rightness/wrongness of thoughts, behaviour, and action. Ethics is essentially about making the right choices/decisions.

8. Logic:

Logic is the study of the principles and methods of correct reasoning. Put more technically, it is the study of principles and methods of valid inference. It is not, as is it is often supposed that, logic is the science of thinking as such. for thinking can take many forms, such as remembering, intuiting, imagining, and freely associating, which however interesting in themselves, are of little consequence to the logician. Our concern is with reasoning only. All reasoning indeed involves thinking, but all thinking is not reasoning. Some thinking does not involve reasoning. There are two major types of logic namely: Formal or Deductive Logic and Informal or Inductive Logic.

12.1. Philosophy of Science and Nature

Science has positively affected all the facets of human life. In the area of communication, science, and technology have almost turned the world into a global village. Through science, private and public health have been greatly improved. Diseases that plagued and killed thousands of centuries ago have surrendered to the awesome power of therapeutic drugs cultured in laboratories. With the computers, tedious tasks are done with dispatch. We must note that the practical dimension of science also brings along with it some unpalatable consequences that concern the morality of some of the achievements of science and technology especially in their relation to human beings.

For instance, the harnessing of the nuclear power inherent in the atom brings with it the menace of the nuclear weapon of mass destruction and the attendant threat of global nuclear annihilation someday. Today, while many countries like India and Pakistan along with Russia and the United States of America are all in the race to amass destructive weapons of mass destruction (all in the bid to safeguard a global and regional balance of power), other states like North Korea are under pressure to surrender their

stockpiled arsenal of weapons. These weapons of mass destruction raise the moral problem of why countries should be allowed to produce weapons that possess the potential to wipe out human existence.¹²

7.2. Science and Technology: Humanity at Risk

In recent years, Human existence and survival seem to be at the mercy of the progress and development witnessed in the area of science and technology. Science and Technology in turn rely on the advancement and progress experienced in Information and Communication Technology. The new age is best described as the age of Information and Communication Technology (ICT). Information Communication Technology, being a multifaceted, dynamic, and multidisciplinary domain affects almost every aspect of human life including political, cultural, scientific, socio-economic, and even security and military spheres. Advancement in information and communication technology (ICT) and the accompanying impacts on political, cultural, and socio-economic development have led scholars and researchers to consider a new philosophical phenomenon known as the Philosophy of ICT¹³.

7.3. Philosophy and Information Communication Technology (ICT)

Information and Communication Technology as a new scientific trend is shaping the direction of our educational and multinational institutions, and intellectual discourses. This new scientific culture is equally dictating global political and scientific trends creating new realities and new frontiers in philosophical studies. To this end, philosophy cannot play a spectator role in this new thinking but, philosophers must rise as they have done in the course of human history, to play an active role in this new scientific reality. Besides, ICT is fast becoming the prism to 21st-century scholarship and intellectual discourses.

In addition, Information and Communication Technology is quintessential to the advancement and development witnessed in the area of science and technology. A fallout from this culminates the recent development in robotic and cybernetic engineering, medicine, space warfare, and space domain, nuclear supersonic and hypersonic guided weapons that demand philosophical interjections and ethical queries. Of peculiar ethical interest is the demise of (the International Nuclear Treaty) that heralds the new arms race among the world powers, putting human and non-human species on the verge of extinction. Besides, the emerging social media culture. A mutant culture is fast changing our cultural, political, and educational atmospheres creating serious moral, ethical, and cultural issues that demand

¹² Sunday Olaoluwa, Dada, Method of Rational Inquiry, Mac-Anthony Venture: Ado Ekiti. 2017; 66.

¹³ Kiger Kipkurui. N, and Gilbert B.M., Philosophy of Information and Communication Technology in *International Journal of Information and Communication Technology Research*, Vol.4 No.8. Kakamega Kenya 2014, P.1. Available: <http://www.esjournals.org>

urgent philosophical adjudication. Chiefs among these problems are; internet fraud popularly known in Nigeria as (yahoo-yahoo), fake news, plagiarism, fact-finding and fact-checking, online dating, pornography, sex addiction, prostitution, indecent dressing and to mention but a few.

To ignore the role of ICT in the face of the aforementioned societal ills and its accompanying impacts on political, cultural, and socio-economic realities is to do so at one's peril. To this end, it is the task of the Philosophy of science to raise the fundamental question that borders on this emerging culture of social media; an offshoot of the philosophy of science. Here, this paper beeps its searchlight on moral and ethical issues associated with social media, the morality of nuclear weapons, nuclear deterrence, and the danger of the demise of (the INF treaty) which has opened the new arms race in the space domain and the risks that accompany the development of hypersonic weapons.

As a panacea to the impending dangers of ICT as highlighted above that has put both human and non-human species on the brink of extinction, there is the need to encourage researchers in science and technology to focus on striking the balance between human wellbeing and care for nature. To this end, we are hereby advocating the need to prepare a new international nuclear treaty involving the world superpowers including (China, Russia, and the United States of America) that will see to the destruction of existing nuclear and hypersonic weapons and limit the development of new ones. before we conclude our brief discussion on ICT, we must also emphasize the need for the nations of the world to legislate on the use of social media in line with domestic laws to preserve pristine cultural values and to combat the trend of fake news, internet fraud and other related crimes and moral ills.

It is the concern of the Philosophy of science therefore to adjudicate from a normative point of view the limit and temperance of scientific inventions and innovations that could compromise human well-being and may spell the end of human existence. Philosophy as a second-order- discipline also reserves the moral responsibility to interrogate the negative impacts of ICT and social media on our pristine cultural value systems, most especially, the negative impacts of the new social media culture on our children and youths. It is therefore the sole business of philosophers of scientific stance to set cautions against endless scientific quests that are inimical to humankind. This is the primary task of the philosophy of science.

8. What is Science?

The word science is derived from the Latin word '*scientia*' which means knowledge.¹⁴ Science has been defined generally as any systematized, organized, or classified body of knowledge that has been critically tested as being beyond a reasonable doubt. Specifically, Robert Morgan defines it as any

¹⁴ S.O, Dada, Op. Cit. 2017, P. 21.

activity resulting in the knowledge and understating of the world around. However, the problem with these definitions is that they are too all-embracing and hence inadequate.¹⁵

8. Nature of Philosophy of Science

The basic questions that are likely to pop up in the philosophy of science are epistemological, methodological, and normative questions such as; how do we get to know about reality? Can we know for certain? Is scientific knowledge objective and by what principles and methods do we form knowledge? Specific questions in the philosophy of science are like "What is scientific knowledge and how is it different from the other kinds of knowledge?", "With what kinds of methods is science done?", "What are the limits of scientific knowledge?", "How does science develop?", "What is the role of argumentation, logic, confirmations, concepts, and consensus in science?", "Are scientific results objective or subjective?", "What can be proven?", and "What is a law?"¹⁶.

What constitutes science proper are the pure and the applied sciences. Some under the positivistic influence have argued for the inclusion of the social sciences. However, it should be noted that the scientific status of economics, political science, sociology, geography, psychology, and anthropology is highly debatable. The focus of our analysis will therefore be on the natural sciences, namely, physics, biology, astronomy, chemistry, physiology, genetics, and so on whose scientific status is not in doubt. The subject matter of these scientific disciplines is natural phenomena and their properties, natures, and behaviours.¹⁷ In light of the foregoing, science can be redefined as the body of knowledge conducted on objective principles and involving the systematic observation of material objects in the universe.

A cursory look at various characteristics of scientific enterprise will further deepen our knowledge of the nature of science: The following are the basic characteristics that define the true nature of scientific knowledge:

8.1. Concrete Object:

Science deals with material objects, that is, with objects that are particular, observable, and identifiable whether in practice or in principle. We said "in principle" because it is not all objects of science that are directly observable. Objects such as atoms (and atomic particles), genes, and so on are not as open to direct observation as other material objects. Science, in other words, does not deal with

¹⁵ Ibid. P. 22.

¹⁶ Ibid.

¹⁷ Ibid. P. 25.

abstract ideas or beings which are spiritual rather than material. Thus, the concepts of gods, spirits, witches, and ghosts are outside its operational scope.¹⁸

8.2. Value Neutrality and Impartiality of the knowledge of the world:

The knowledge character of scientific knowledge is value detached and neutral it does not accommodate ethnic, tribal, racial, or religious sentiments and prejudices. Scientific inquirers, investigators, and researchers are naturally detached from the objects of their inquiry. A scientist studying the species of plant, animal, fish, insect, stone, or rock is naturally detached from his/her object of inquiry. But this is not the same case with a social scientist like a political scientist, demographer, psychologist, or sociologist that is directly involved or connected to the object of his/her inquiry and may be induced directly or indirectly to alter the result of their inquiry to favour or satisfy certain needs. The scientific procedure provided the same result irrespective of who is performing or employing it.

8.3. Impersonal:

Science is also public in character. This means that the scientific method, techniques, and findings are not accessible only to selected individuals but to the generality of those who are scientifically minded. For instance, the gravitational law, the law of thermodynamics, the law of gravitational force, the law of motion, the law guiding the behaviour of cloud formation, the law responsible for the motion of planetary bodies, and so on are open to public scrutiny and tests by those who can do so.¹⁹

Well-organized and systematized knowledge: Another significant feature deducible from the definitions is that science involves systematization and organization. This is that accounts for the rationality of the scientific enterprise. In other words, science is not just a haphazard collection of facts or an investigation carried out arbitrarily.²⁰

9. Method of Science

Science has been defined as a class of activities that includes observation, description, and theoretical explanation; or knowledge that is gained through experience; or knowledge that has been

¹⁸ Ibid.

¹⁹ Hurley Patrick, A Concise Introduction to Logic, 2nd edition (California: Wadsworth Publishing Co. 1985, 442-443. Print.

²⁰ S.O., Dada 2017, P. 28.

logically arranged in the form of general laws.²¹ Science can also be defined as structured knowledge derived from the facts.²² It is the systematic way of studying the world we live in. The philosophy of science deals with issues such as the foundations of science, its assumptions and limitations, its implications, and what constitutes scientific progress.

9.1. Observation

The first step in scientific investigation is to acquire facts related to a particular thing of interest. To do this we have to begin with observation. The simplest conceivable use of experience consists in noticing something seen, heard, felt, or smelled. This is the meaning of observation: the use of the senses to acquire particular facts.²³ Observation is both a mental and physical activity. This is because to observe, our attention must not only be directed in one direction, we must know that we are looking for something.²⁴ There are two different types of observation in the history of science. These are the accidental observation and the deliberate or directed observation. Let us see what is involved in both types.

9.1.1. Accidental Observation:

These are the kinds of observations that are not initially intended but which when noticed give rise to more conscious observation and later provoke further enquiry. Some important scientific observations have been made accidentally. Becquerl's famous discovery of the radioactivity of uranium compounds arose accidentally from his leaving a photographic plate in the neighborhood of the radioactive material. The same goes for the accidental observation of the falling of an apple which led to Newton's gravitational law.²⁵

9.1.2. Deliberate or Intentional Observation:

It has often been said that the haphazard gathering of facts through observation seldom have much contribution to make to the discovery of generalizations, theories, and principle sought by science.

²¹ Ibid.

²² Ibid.

²³ Op. Cit. P. 35.

²⁴ Ibid.

²⁵ S. O. Dada, Op. Cit. P.41.

According to Jevon, "to observe is merely to notice events and changes which have been produced in the ordinary course of nature without being able to control those changes."²⁶

9.2. Observation and Experiment

In observing, experimentation may be involved but it is not necessarily the case that every observation involves experimentation. Most deliberate observations involve experimentation. So, every meaningful experiment requires deliberate and organized observation. Mellone defines a scientific experiment as "the construction of a typical and crucial case on a plan thought out in advance, to test a hypothesis or decide a question which has arisen". The line of distinction between an observation and an experiment is a thing. If scientific observation is an active and selective process, the resemblance it has to experiment is obvious.

Experimentation has some obvious advantages over observation. Experiment saves researcher a long waiting time to get result unlike natural observation since all factors can be controlled or manipulated to get the desired result. Many phenomena in nature are too minute to be noticed or too soft to be dealt with in ordinary experience. Experiments provide the opportunity of dealing with such objects. It enables the investigator for instance to arrange the processes of such phenomena for intense study.²⁷ Besides, an experiment enables the inquirer to observe a specimen or an object of the experiment under varying circumstances to decide which condition is suitable for certain results and to achieve the desired result.

9.3. Hypothesis

The result of observation and experiment is facts that have been gathered regarding the phenomenon in question. Facts await the litmus test of the hypothesis to validate their veracity. What the researcher does at this juncture is to put his facts together in a coherent manner and begin to think creatively about them. The result of such mental cogitations is a conjectural statement which is called a hypothesis. A hypothesis refers to the formulation of possible solutions to a given problem or the possible explanations of a given phenomenon.²⁸

9.4. Scientific Law

A scientific law is a basic principle, generalization, regularity, or rule that holds universally under particular conditions. Laws are developed from facts or developed mathematically to explain and

²⁶ Ibid.

²⁷ Ibid.

²⁸ Ibid.

predict individual occurrences or instances [29]. Scientific laws summarize the results of experiments or observations, usually within a certain range of application. According to Aigbodioh, a scientific law is "a universal generalization which states an invariant relationship between natural facts, properties or features of things. [30]

In general, the accuracy of a law does not change when a new theory of the relevant phenomenon is worked out, but rather the scope of the law's application, since the mathematics or statement representing the law does not change. As with other kinds of scientific knowledge, scientific laws do not express absolute certainty, as mathematical proof or calculus. A scientific law may be contradicted, restricted, or extended by future observations. We have many laws that have undergone the highlighted scientific procedural methods and are widely accepted. We have Conservation laws, Laws of classical mechanics, Laws of gravitation and relativity, Thermodynamics, Electromagnetism, Photonics, Laws of quantum mechanics, and Radiation law.

10. Inductive Method and Its Problems

Inductive inference is a type of method that many scientists use to arrive at general claims from premises and observed samples. The method of induction is fully captured by various scientific procedures highlighted above. The scientific method begins with observation, experiment, and formulation of a hypothesis and it terminates at scientific law or theory. Historically, however, philosophers such as David Hume have argued that inductive reasoning is unjustified and problematic in many ways. One of the problems pointed out by David Hume stems from the traditional epistemological outlook that 'every event must have a cause(s)'. Hume contested the assumed logical connection between events and attributed causes. he thinks that the only things between events and their causes are nothing but contiguity, uniformity, and succession. So the traditional Yoruba adage that says;

*"Ajekelana, omo kuloni... tani o mop e aje ana lo pomoje... a witch cried yesterday and the baby dies today... who does not know that it was yesterday witch that was responsible for the death of the child..."*²⁹

David Hume denied the veracity of the above claim on the ground that, there are no rational grounds and logical connections between events and their assumed causes. Before Hume created his argument, this inference would seem justifiable so long as the observation was made in a range of cases that represented it. Hume however brings to question, "... how we could be sure that the regularities

²⁹ Retrieved from Oral tradition, "Yoruba's Popular Proverbs on Causality. The Yorubal people reside in the South-West of Nigeria.

that are observed within a representative sample should increase the likelihood that the unrestricted generalization is true".³⁰

Hume's resentment of induction becomes apparent since to justify a claim based on another claim, one will need other claims. That is, to justify an event, we need other events that will serve as the causes of the initial event. This other event in turn requires other events... then we go on in circular reasoning ad infinitum.

This proves that to defend that an inductive inference is justifiable; one must use yet another inductive claim. The epistemic support for inductive inferences is circular. From this, we conclude that there can be no non-circular justification for inductive inferences. This dilemma is known as the problem of induction and leaves us with the issue of whether we can justify inductive reasoning considering the fact Hume has presented us with the problem of induction. Do we conclude that induction needs no justification? Do we side with epistemic internalists who believe one must always have supporting grounds?

This is exactly the problem inherent in the pride scientific method that is now considered as the universal currency in scholarship. So, it is the task of philosophers to always remind scholars and researchers of the problem of induction and possibly suggest other options.

11. Thomas Kuhn's Method of Science: The Paradigm Shift

Thomas Kuhn, an American philosopher, in his famous book *The Structure of Scientific Revolution* (1962) pointed out that science does not always advance in a gradual and stately fashion commonly attributed to it as stated in the traditional method of science as outlined above. He argued that scientific research and thought are defined by "paradigms" or conceptual worldviews. Scientists typically accept a prevailing paradigm and try to extend its scope by refining theories. According to Kuhn, after a scientific discipline matures, its history consists of long periods of stasis punctuated by occasional revolutions of this sort. Thus, a scientific discipline goes through several distinct types of stages as it develops.³¹

Thomas Samuel Kuhn presented an interesting scientific method in his famous book the *Structure of Scientific Revolution*. Here, Kuhn demonstrated his philosophical acumen in his popular dictum "The Paradigm Shift). The popular scientific method or theory he called the thesis... (the old

³⁰ See Carsey, S.S., A beginner's guide to scientific method. Belmont, C. A. Wadsworth Publishing Co. 1994, P. 54.

³¹ Donald Kirkwood Avantn, Problem of Induction, 2022, P. 4. Available online at <https://scholarblogs.emory.edu/>

Paradigm), and the emerging theory or method he called the antithesis (opposing paradigm). And the New method or new theory he called the Synthesis (New paradigm).

11.1. The Pre-Paradigmatic Stage

Before a scientific discipline develops, there are various competing schools, each of which has a fundamentally different conception of what the basic problems of the discipline are and what criteria should be used to evaluate theories about that subject matter.

II

11.2. The Emergence of Normal Science

Out of the many competing schools that clutter the scientific landscape during a discipline's pre-paradigmatic period, one may emerge that subsequently dominates the discipline. The practitioners of the scientific discipline rally around a school that proves itself able to solve many of the problems it poses for itself and that holds great promise for future research. There is typically, a particular outstanding achievement that causes the discipline to rally around the approach of one school. Kuhn calls such an achievement a "paradigm." Normal science is characterized by nearly unanimous assent by the members of a scientific discipline to a particular paradigm. In the *Structure of Scientific Revolution (SSR)*, Kuhn uses the term paradigm to refer to two very different kinds of things.³²

11.3. Paradigms as Exemplars

Kuhn at first uses the term "paradigm" to refer to the particular, concrete achievement that defines by example the course of all subsequent research in a scientific discipline. In his 1969 postscript to *Structure of Scientific Revolution*, Kuhn refers to an achievement of this sort as an "exemplar." Among the numerous examples of paradigms Kuhn gives are Newton's mechanics and theory of gravitation, Franklin's theory of electricity, and Copernicus' treatise on his heliocentric theory of the solar system.ⁱ

These works outlined a unified and comprehensive approach to a wide-ranging set of problems in their respective disciplines. As such, they were definitive in those disciplines. The problems, methods, theoretical principles, metaphysical assumptions, concepts, and evaluative standards that appear in such works constitute a set of examples after which all subsequent research was patterned.

³² Thomas Samuel Kuhn, *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press 2nd edition, with postscript. 153-155. Print.

11.4. The Scientific Community

According to Kuhn, a scientific discipline is defined socially: it is a particular scientific community, united by education (e.g., texts, methods of accreditation), professional interaction and communication (e.g., journals, conventions), as well as similar interests in problems of a certain sort, and acceptance of a particular range of possible solutions to such problems. The scientific community, like other communities, defines what is required for membership in the group.³³

11.5. Normal Science as "Puzzle-Solving"

According to Kuhn, once a paradigm has been accepted by a scientific community, subsequent research consists of applying the shared methods of the disciplinary matrix to solve the types of problems defined by the exemplar. Since the type of solution that must be found is well defined and the paradigm "guarantees" that such a solution exists (though the precise nature of the solution and the path that will get you to a solution is often not known in advance), Kuhn characterizes scientific research during normal or paradigmatic science as "puzzle-solving."

11.6. The Emergence of Anomaly and Crisis

Though the paradigm "guarantees" that a solution exists for every problem that it poses, it occasionally happens that a solution is not found. If the problem continues to persist after repeated attempts to solve it within the framework defined by the paradigm, scientists may become acutely distressed and a sense of crisis may develop within the scientific community. This sense of desperation may lead some scientists to question some of the fundamental assumptions of the disciplinary matrix. Typically, competing groups will develop strategies for solving the problem, which at this point has become an "anomaly," that congeal into differing conceptual "schools" of thought much like the competing schools that characterize pre-paradigmatic science. The fundamental assumptions of the paradigm will become subject to widespread doubt, and there may be general agreement that a replacement must be found (though often many scientists continue to persist in their view that the old paradigm will eventually solve the apparent anomaly).

³³ Khuns Op. Cit. 1970, 44.

11.7. The Birth and Assimilation of a New Paradigm

Eventually, one of the competing approaches for solving the anomaly will produce a solution that, because of its generality and promise for future research, gains a large and loyal following in the scientific community. This solution comes to be regarded by its proponents as a concrete, definitive scientific achievement that defines by example how research in that discipline should subsequently be conducted. In short, this solution plays the role of an exemplar for the group--thus, a new paradigm is born. Not all members of the scientific community immediately rally to the new paradigm, however.

Some resist adopting the new problems, methods, theoretical principles, metaphysical assumptions, concepts, and evaluative standards implicit in the solution, confident in their belief that a solution to the anomaly will eventually emerge that preserves the theoretical, methodological, and evaluative framework of the old paradigm. Eventually, however, most scientists are persuaded by the new paradigm's growing success to switch their loyalties to the new paradigm. Those who do not may find themselves ignored by members of the scientific community or even forced out of that community's power structure (e.g., journals, university positions). Those who hold out eventually die. The transition to the new paradigm is complete.

12. Conclusion and Recommendations

This paper, like any other philosophical piece, posits the common problems inherent in most scientific methods since most of the scientific methods and theories, if not all of them rely on inductive reasoning to arrive at their desired results. While this chapter encourages students to imbibe a scientific spirit and attitude of critical and reflective inquiry, the chapter also offers a reminder that the battle of method, idea, and theory in the intellectual sphere is yet from over. Like Thomas Samuel Kuhn, the next phase of our paradigm shift awaits you. Take the plunge.

Reference

- Aristotle, *Metaphysics*, 993b. P.19. Print.
- Carsey, S.S., *A beginner's guide to scientific method*. Belmont, C. A. Wadsworth Publishing Co. 1994, P. 54. Print.
- Dada S.O., "An Overview of the Branches of Philosophy", In *Introduction to Philosophy and Logic*, Newsletter Limited: Yaba, Lagos, 2004. Print
- Dada Sunday Olaoluwa, *Method of Rational Inquiry*, Mac-Anthony Venture: Ado Ekiti. 2017; 66. Print.
- Donald Kirkwood Avantn, *Problem of Induction*, 2022, P. 4. Available online at <https://scholarblogs.emory.edu/>
- Kiger Kipkurui. N, and Gilbert B.M., *Philosophy of Information and Communication Technology in International Journal of Information and Communication Technology Research*, Vol.4 No.8. Kakamega Kenya 2014. Available: <http://www.esjournals.org>
- Ludwig, Wittgenstein, (1922), *Tractatus Logico Philosophicus*,
- Olu-Owolabi, Kolawole, *Issues and Problems in Philosophy*, Grovads Network, Ibadan, Nigeria 2007, P.45. Print.
- Patrick, Hurley, *A Concise Introduction to Logic*, 2nd edition (California: Wadsworth Publishing Co. 1985, 442-443. Print.
- Plato, *The Republic*, 475. P.480. Print.
- Rene Descartes, *Discourse in Philosophical Writings*, Amscombe&Geach (ed.). Middlesex University Press. (1956. Print.
- Schwitzgebel, E. For all x there is a Philosophy of x, 2012. onlinearticle <https://schwitzsplinter.blogspot.com/2012/01/htm>. Accessed April 22, 2020.
- Staniland H.S., *What is Philosophy?*, in *Second Order*, Vol. Viii No 1&2 2005.
- Thomas Samuel Kuhn, *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press (1970, 2nd edition, with postscript). Print.
- Wittgenstein Ludwig, *Tractatus Logico-Philosophicus*, (translated by C. K. Ogden), London: Routledge and Kegan Paul, 1933. Print