

A Philosophical Analysis of the Structure of Scientific Theories

Samuel Gbenga Ojo
University of Ibadan, Ibadan, Nigeria
ojosamuel42@gmail.com
+2348138124674

Abstract

Natural Science enjoys unparalleled prestige compared to other disciplines in today's society. Scientific theories are not just taken as models after which other theories are to be judged, they are often considered to be something of a different nature to theories in other disciplines especially the Arts and Humanities. Courts, for instance, do not acquit or discharge anyone on the expert witness of a theologian or a novelist for instance, but it does on the witness of scientists. While theories in the sciences are said to be objective, indubitable and verifiable, the theories of other disciplines are said to be assumptions adopted by the practitioners of the discipline or better still, statistical conclusions fused with lots of probability. This paper aims at a philosophical examination of the structure of scientific theories with the purpose of showing what the intricate characteristics theories in science share with theories in other disciplines. Through a look at the various views presented on the structure of scientific theories, the paper argues that scientific theories, like in other disciplines, are axiomatic laws derived from regularities observed in everyday life and nature. And like other theories outside science, they are under-determined. The paper employs an expository methodology in showing that the views and axiomatisation of scientific theories are offshoots of logical positivism, mechanistic materialism and Neo-Kantianism fused together. Just as these philosophical theories have shaped the history of thoughts, they have equally influenced the evolution of scientific theories.

Keywords: Axiomatisation, Logical positivism, Mechanistic Materialism, Neo-Kantianism Under-determination.

1. Introduction

One of the major problems in philosophy of science that justifiably qualifies as the most central is the question of the nature and structure of scientific theories.¹ Although in ordinary English, the term “theory” has come to mean a corpus of rank speculations or hypotheses still open to serious doubt, or at least for which there is as yet insufficient evidence.² Among scientists, “theory” is far from suggesting uncertainty or tentativeness. In the natural sciences, “theory” is used to describe an established sub-discipline in which there are widely accepted laws, methods, applications and foundations.³ Theories are bodies of explanatory hypothesis for which there are empirical supports. This raises a twofold question: First, how does a scientific theory, despite its fixed nature, provide such explanatory systematisation of disparate phenomena which are the object of scientific study? Secondly, what qualifies a set of statements or propositions as scientific theory? Or as Karl Popper⁴ puts it, “when should a theory be ranked scientific?” That is, is there a criterion for the scientific character or status of a theory? While the first is a question about function, the second is about nature and structure.

In this paper, we shall omit the first question because the question of function is embedded in the question of nature. Scientific theories perform the functions they engage on the basis of their ontological status.⁵ So rather than engage the question of

¹ Fredrick Suppe, *The Structure of Scientific Theories* (Chicago: University of Illinois Press, 1967), 3.

² Alan Lacey, *A Dictionary of Philosophy* 3rd edition (London: Routledge, 1996), 179.

³ Alex Rosenberg, *Philosophy of Science: A Contemporary Introduction* (New York: Routledge, 2005), 69.

⁴ Karl Popper, *Conjectures and Refutations* (London: Routledge and Kegan Paul, 1963), 33-39

⁵ Some postmodernist thinkers like Richard Rorty may be seen as having problem with the notion of a particular nature which we see scientific theory as having that needs explanation or that entails it function. “Nature” as used here is not synonymous to “essence”. The notion of “nature” as essence which is available only to the eye of the mind is what Rorty criticized. See: Richard Rorty, *Philosophy and the mirror of nature* (New Jersey: Princeton University Press, 1979). Here, when we say “nature” we mean “build up” which must not

function directly, we employ an expository method in provoking philosophical reflection on the second question through the exposition of the views of philosophers of science on the issue. Based on this, we shall show that although scientific theories appear as if they are products of only empirical data, much of what stand at the base of science are worldviews. They are sometimes inferred from what we often call common sense reasoning and belief systems.⁶

2. Scientific Theories and Scientific Laws: Any Difference?

An enduring misconception which seems to have been accepted about science in the general public is the supposed synonymy of the terms “law” and “theory” in the scientific milieu. For most lay or academic admirers of science whose area of specialization is not science, there seem to have emerged a belief that scientific laws and theories are of the same nature and purpose. We therefore, often experience situations whereby terms like, Newton’s Laws of Motion and Newton’s Gravitational theory are used interchangeably. Although some persons often acknowledge the fact that there is a difference between these two terms, the line of demarcation is often not clearly drawn. If we must however, carve out a meaningful discussion on the structure of scientific theories, it is appropriate that we shed light on the differences so as to avoid the confusion of thinking what we shall discuss here are applicable both to laws and theories.

The word theory is etymologically rooted in the Greek word, *Theories* which means “spectator” or *Theoria* which means “contemplation” or “speculation”. It was used in Latin in the 16th

necessarily be an *a priori* quality. Hence, we may say a race horse is by nature called a race horse because it functions as a race horse and a pen is so called because it ‘lives’ to its function of writing. It can be applied to anything on earth. It is because this question about nature entails function that the Medievals laboured assiduously in finding the purpose of man in order to know its nature. The nature of this computer with which I type entails question about its function but not vice-versa.

⁶ Richard DeWitt, *Worldviews: An Introduction to History and Philosophy of Science* 2nd edition (Malden: Wiley-Blackwell, 2010), 7-16.

century to denote a mental scheme of something to be done. In its English usage, it refers to a supposition or system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained. In lay usage therefore, theory is synonymous to terms like hypothesis, thesis, conjecture, postulate, etc.

Technically, the term theory denotes disparate meanings among scientists. First, it could refer to one or more hypotheses or law like statements regarded as speculative.⁷ Secondly, it could be seen as a law about un-observables like electrons or evolution; it is sometimes called a theory because evidence about un-observables is felt to be inevitably inconclusive. Thirdly, it is seen as a unified system of laws or hypotheses with explanatory force, and lastly, a field of study (e.g. in philosophy: theory of knowledge, logical theory). These senses sometimes shade into each other.⁸ Among these explanations of what theory is, the third definition, which sees theory as a unified system of laws or hypotheses with explanatory force, soothe the philosopher's concern and even the scientist use of theory the more. Theories are attempts at explaining certain phenomenon in the universe based on established laws.

Scientific laws, on the other hand, are statements of fact based on what has been consistently observed. They are generalisations pronounced through inductive reasoning about the nature and observable characteristics about the world. For instance, it is not a theory that water boils at 100°C, it is a law that simply states what has been repeatedly confirmed by observation which other scientists also attest to. It does not ask why water boils at 100°C but simply states what was the case. While theories try to explain the "why" and "how" phenomenon happens, laws simply tell us "what" happens.

Take for instance, the three laws of thermodynamics: (i) energy can neither be created nor destroyed; energy can only be

⁷ This is the sense in which people often mistake theory for law and it is in fact the major reason we are making this clarification.

⁸ Lacey, *A Dictionary of Philosophy*, 178.

transferred or changed from one form to another.⁹ (ii) the entropy of any isolated system always increases, and (iii) the entropy of a system approaches a constant value as the temperature approaches absolute zero. Notice that these laws never give reasons why energy cannot be created nor destroyed, they only state what the case is. Based on these laws and some others seen in physics and biology such as; variation, adaptation and genetics, scientists have propounded the theory of evolution. In conjunction with the first law of thermodynamics, evolutionist theorists say, nothing was created, energy was only transformed into the elements that started the Universe through a big bang billions of years ago.

According to the Big Bang theory, through the constant spread of energy (since the Universe is an isolated system) there was further transformation of elements until amino acid came to be formed and later the first living matter emerged. This living matter, through genetic variation and reproduction, multiplies and then natural selection starts until we started having multi-cellular organisms and so on, it goes. The evolution theory is a conglomeration of many scientific laws, just like Newton's theory, and the relativity theory of Einstein. When we examine these theories, we discover that they are systems of interrelated laws. This is how laws and theories differ in science. Regardless of their differences, they converge in that they are both general statements based on observations.

3. The Structure of Scientific Theories

In the philosophy of science as in other branches of learning, many views abound on the structure, nature and function of scientific theories. While some refer to the axiomatic quality of scientific theories as central to its structure,¹⁰ some others have likened scientific theories to a set of jigsaw puzzle of interrelated beliefs which are often inferred from common sense among common

⁹ This law is otherwise known as the law of conservation of energy or its variance known as the Law of conservation of mass which states that matter can neither be created nor destroyed, they only change from one form to another.

¹⁰ Fredrick Suppe, "Axiomatization" in *A companion to the Philosophy of Science*, ed. W.H. Newton-Smith (Massachusetts: Blackwell, 2000), 9.

folk.¹¹ Notwithstanding these variations, perspectives about the structure of scientific theories have been grouped into three in the philosophy of science. They include, the syntactic view, the semantic view and the pragmatic view. Although these various perspectives are originally descriptive, each view equally deploys a prescriptive stance.¹²

These perspectives, according to Winther Gronfeldt, address the following questions: “What is the best characterisation of the composition and function of scientific theory?” “How is theory linked with the world and which philosophical tools can and should be employed in describing and reconstructing scientific theory?” “Is an understanding of practice and application necessary for a comprehension of the core structure of a scientific theory?” Finally, “how are these three (the syntactic, semantic and pragmatic views) views ultimately related?”¹³ Summarily, it comes down to the question raised earlier in the introduction, “what qualifies a set of statement as scientific theory?” This question sums up all the questions identified by Gronfeldt.

4. The Syntactic (or Received) View

This view about the structure of scientific theories has been dubbed differently in philosophy and science texts. While some writers refer to it as the Received view, others refer to it differently as: The syntactic approach, the standard conception, the statement view, the axiomatic approach, etc. Proponents of this view include scholars like Rudolf Carnap, Ernest Nagel, Hans Reichenbach, and

¹¹ Gronfeldt R. Winther, “The Structure of Scientific Theories” in *The Stanford Encyclopedia of Philosophy*, accessed June 12, 2021, <https://plato.stanford.edu/archives/spr2021/entries/structure-scientific-theories>.

¹² By postulating, for instance, that scientific theories are X, philosophers of science are describing what a scientific theory is (descriptive). At the same time, they are postulating what scientific theory is not, that is, what is not X or could not possibly be recast as X, is not or could not be a scientific theory and would not help us in providing scientific explanation.

¹³ Winther, “The structure of scientific theories.”

other logical empiricists. Like David Hume, these philosophers argue that insofar as scientific theories accurately describe the world, they cannot be known a priori, but they also recognise that some elements of our theoretical knowledge seem to be independent of empirical facts.¹⁴ So, the central question they addressed is about which logical language should we recast scientific theory in, so as to make its empirical stance more suitable for the explanation of the world while giving no room to metaphysical assumptions?

To this question, scholars of this orientation argue that “the structure of a scientific theory is its reconstruction in terms of sentences cast in the meta-mathematical language. Meta-mathematical language is the axiomatic machinery for building clear foundations of mathematics, and includes predicate logic, set theory, and model theory”.¹⁵ According to Fredrick Suppe,

A scientific theory is to be axiomatised in mathematical logic (first order predicate calculus with equality). The terms of the logical axiomatisation are to be divided into three sorts: (1.) Logical and mathematical terms; (2.) theoretical terms; and (3.) observation terms which are given a phenomenal or observational interpretation. The axioms of the theory are formulations of scientific laws, and specify relationships holding between the theoretical terms. ... thus the axiomatisation must include various explicit definitions for the theoretical terms of the form: $Tx \equiv Ox$.¹⁶

A better understanding of the syntactic view of scientific theories can be produced through a historical analysis of how it developed. Although the syntactic view is a product of logical positivism, most scientists who reject positivism accept the view regardless. To understand the syntactic view, one needs to understand what

¹⁴ James Ladyman, “Theories and Theoretical terms” in *Encyclopedia of Philosophy*, 2nd ed. 2006.

¹⁵ Winther, “The structure of scientific theories.”

¹⁶ Suppe, *The structure of scientific theory*, 11.

necessitated the logical positivists to adopt the philosophical position they held.¹⁷

Logical positivism was a reaction to the metaphysical excesses of the nineteenth century especially the one exemplified in the philosophy of Hegel and neo-Hegelian who attempted an explanation of reality through abstract concepts like entelechy, absolute spirit and many others. The bid to eliminate this form of abstract explanation of reality was later presented as if the positivists' interest were of purely philosophical concerns. However, the membership of both the Vienna school and the Reichebach's Berlin school indicated that they were concerned mainly with foundational issues in science which have some philosophical nature. These were issues raised by recent scientific developments of that time. As one would notice, both the Vienna school and the Berlin School were made up of scientists and mathematicians.

The positivists' movement has its distant origin in the 1850s and 1880 Germany. In reaction to the speculation of the Hegelian and the neo-Hegelians, German academia was dominated by mechanistic materialism which was a blend of Comptean positivism, materialism and mechanism.¹⁸ Mechanistic materialism is the view that, science has established the fact that macrocosmic and microcosmic existence obeys, in its origin, life, and decay, mechanical laws inherent in things themselves. This means discarding every kind of super-naturalism and idealism in the exploration of events. There is force without matter; no matter without force. Invariably, there is no room for *a priori* elements in natural science, all scientific explanation should and must be pursued in purely mechanistic terms if it wants to progress.

The emergence of great developments in physiology and psychology led to great challenge for mechanistic materialism and in its turn, neo-Kantianism became a dominant philosophy of science in Germany. The Kantian noumena world was re-enacted stating that there is a sphere of reality which cannot be explained a

¹⁷ We owe Frederick Suppe the bulk of what follows from here on the historical development of the syntactic view.

¹⁸ Suppe, *The structure of scientific theory*, 11.

posteriori, hence, every scientific explanation is laden with *a priori* reasoning. Over time, Machianneo-positivism came to the fore. Ernst Mach formerly held a Neo-Kantian perspective but later rejected it for the view that “science is no more than a conceptual reflection upon facts whose elements are contents of consciousness given to sensation”.¹⁹ By the turn of the century, Germany was laden with three major philosophical views about science and the position one accepts depended more on which school you belong to than to reliability of the position.

The publication of Einstein’s relativity theory and the development of quantum mechanics that was underway showed that both scientists and philosophers have been wrong in their conception of science.²⁰ These two new leaps in science contradicted the three views earlier explained. All that is valid to science was not the empirically verifiable. With the gradual acceptance of these new physics, a philosophical problem emerged: the new physics was incompatible with philosophies of science previously held. What then was the nature of scientific enterprise? What new philosophy of science was to be adopted? Numerous approaches were sort to address this problem but influential among them all were two. First, the attempt to provide a modified neo-Kantianism which could accommodate the new physics and

¹⁹ Suppe, *The structure of scientific theory*, 9.

²⁰ Albert Einstein’s works on relativity, especially the postulation of the Black hole, which was then an abstract concept shook any ground that wants to eliminate supernaturalism. Although through LIGO, scientists can now hear the Cheeping of black holes. You too can listen here: <https://clyp.it/ephqz0rp>, it was in Einstein days a phenomenon arrived at via Mathematical and abstract thinking, hence a methodological issue arises since Einstein’s method was conventional but his findings are not. Therefore, is poses epistemological concerns. Quantum mechanics too was beginning to show decades of scientific experimentations could be wrong through three postulations: first, quantized properties which sees certain properties much like a dial of clicks from one number to another against the view that they proceed on a smooth spectrum. Second, Quantum mechanics claims light behave much like particles bouncing off surfaces contrary to 20 decades’ consensus that lights behave like waves, and lastly, that matter can also behave like waves. All these showed that the prior perception of science is not conclusive yet.

secondly to create a weakened version of Mach's Neo-positivism.²¹ These were carried out by Han Reichenbach (his Berlin school) and in Vienna under Moritz Schlick (the Vienna Circle). They both agreed that Mach was right in insisting on verifiability as a criterion of meaningfulness for theoretical concept but faulted him for not creating room for mathematics. To eliminate meaningless statements from science then, they suggested that theoretical terms are to be explicitly defined in terms of phenomena language. Their position can be summarised in the following words:

Since the laws of theory are formulated using the theoretical terms, this enables one to express the laws mathematically. But since statements using theoretical terms can be eliminated in favour of equivalent statements in phenomenal language, these mathematical laws are nothing other than conventions for expressing certain relations holding between phenomena.²²

This gave birth to the view we stated earlier above that scientific theory is that which derives its structure from its construction in meta-mathematical terms and it is the received view on the structure of scientific theories.

5. The Semantic View

The semantic view is a reaction or modification of the syntactic view. According to this view, theories are "extra linguistic entities which may be described or characterized by a number of different linguistic formulations."²³ Some defenders of the semantic view keep important aspects of the syntactic reconstruction agenda, moving meta-mathematical apparatus from predicate logic to set theory (the set-model type). Other proponents in slight deference to this insist that the structure of scientific theory is solely

²¹ Note that earlier we showed how Einstein and Quantum deviate from consensus. Neo-Kantianism accepts the abstract realities which quantum and Einstein adopted, Mach's view was purely in favour of the empirical against the abstract. A combination of the two seen mathematics and meta-mathematical language that will accommodate only 'meaningful abstractness' was then considered to be the appropriate philosophy for science.

²² Suppe, *The structure of scientific theory*, 11.

²³ Suppe, *The structure of scientific theory*, 221.

mathematical (the state-space type).²⁴ It is their view that the scientific theory must remain in the realm of the mathematical. Whatever it is then that diverge from this, in their opinion has failed to meet the requisite of what constitutes a scientific theory. A central question for the semantic view is: in which language should we recast scientific theory?

In the semantic view, emphasis is laid on the mathematical models of actual science and a distinct line is drawn between mathematics and meta-mathematics.²⁵ Hence, the structure of scientific theory is identified with the “class” or “cluster” of mathematical models constituting it, rather than with any meta-mathematical axioms yoked to a particular syntax.²⁶ As noted earlier in passing, the semantic view of scientific theories can be classified into kinds. The first is the set-model type which says a scientific theory should be thought of as a collection of mathematical models chiefly characterized by set theory²⁷ and the state-space approach which sees scientific theories as largely clusters of mathematical models of which set theory is not included. The semantic view contrast with Syntactic view in that while the Syntactic view sees scientific theories as an edifice of axioms (logical, observational and theoretical) which are to be analysed by a meta-mathematical Language, the semantic view sees scientific structure as a cluster or class of mathematical models; and mathematics, not meta-mathematics, is the medium of its analysis.

For this reason, Patrick Suppes, as a semantic proponent, stated that “the correct tool for philosophy of science is

²⁴ Winther, “The structure of scientific theories.”

²⁵ This best describes the state-space Approach which is the most popular in the semantic View of Scientific theories. The Set-Model often do not draw a line of demarcation between set theory, which is a meta-mathematical language and Mathematics. Hence a leaning on Standard/received view. It is however often grouped with the semantic view in that it argues that set-theory is not a meta-mathematical language rather it is a mathematical model, therefore in line with the state-space that says scientific theories are clusters of models.

²⁶ Bass Van Fraassen, *Laws and Symmetry* (Oxford: Oxford University Press, 1989), 366.

²⁷ This means meta-mathematics is involved and is believed to be part of mathematics.

mathematics, not meta-mathematics”.²⁸ In addition, Van Fraassen, discussing the work of Karl Berth, says, “theories are presented by specifying a class of state spaces with laws of coexistence (synchronic constraints) and laws of succession (diachronic constraints), which together specify the allowable trajectories for systems whose states are represented by parameters located in the state space”.²⁹ So, while in the syntactic, we analyse the relations between the concepts of phenomenal or meta-mathematical language in which a scientific theory is presented, in the semantic view, we analyse only the expressions which are mathematical in nature and what they designate. Rudolf Carnap explains the difference between syntax, semantics and pragmatic analysis better.

If in an investigation explicit reference is made to the speaker, or, to put it in more general terms, to the user of a language, then we assign it to the field of pragmatics (whether in this case reference to designata is made or not makes no difference for this classification.) if we abstract from the user of the language and analyse only the expressions and their designata, we are in the field of semantics. And if, finally, we abstract from the designata also and analyse only the relations between the expressions, we are in (logical) syntax. The whole science of language, consisting of the three parts mentioned, is called semiotics.³⁰

Historically, the semantic approach to scientific theory can be traced to the work of Evert Beth, John Von Neumann Weyl and Patrick Suppes. These scholars, although may be divided on the state-space approach and the set-model approach in the semantic view, they share the belief that understanding of theory interpretation is in terms of hierarchy of models. A hierarchy of models includes: axioms of theory, models of theory, models of experiment, and models of data while phenomena permeate all the

²⁸ Patrick Suppes, “What is a scientific Theory” in *Philosophy of Science today*, ed. S. Morgenbesser 55-67 (New York: Basic books, 1967).

²⁹ Fraassen, *Laws and Symmetry*, 221.

³⁰ Rudolf Carnap, *Introduction to Semantics*, (Cambridge, MA: Harvard University press, 1942), 9.

levels. Put succinctly, the semantic view is the attempt to further mathematise scientific theory on the basis that meta-mathematics is seen also as mathematics. So rather than create a meta-language for the analysis of scientific theory, we describe them as the relations of the expressions inherent in the theory.

6. The Pragmatic View

The pragmatic theory is a kind of compatibilist position between the syntactic and semantic views and it is the view shared in this paper. Scientific theories are conglomerate of beliefs, mathematical and meta-mathematical elements, intentions, practice and conjectures. According to one of its proponents, Nancy Cartwright, the traditional syntactic/semantic view is misconstrued.³¹ Reason is, it presents scientific theory as a deductive and automated machine, that upon receiving empirical input, cogitates and then drops out the sought-for representation. Consequently, the pragmatic view expands the notion of theory to include non-formal aspects, which include elements like metaphors, analogies, policy views, as well as more standard components such as ontological assumptions.³²

Truly speaking, the pragmatic view of the structure of scientific theory is internally and externally complex. It agrees that although mathematical components are often present in scientific theories, they are not a necessary requisite without which a theory of science will be termed unscientific. Scientific theories, accordingly, also consist of rich variety of non-formal components. In other words, a proper understanding of the structure of scientific theory will pay attention to the analysis of the grammar (syntax), the meaning (semantics) as well as the multifaceted assumptions, purposes, values, and practices informing the theory. Hence, the pragmatic view indicate that the syntactic and semantic proponent agree on some fundamental truths about the nature and structure of science, namely; that scientific theories are explicit,

³¹ Nancy. Cartwright, *The Dappled World: A study of Boundaries of Science* (Cambridge: Cambridge University Press, 1999), 184-185

³² Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970), 54.

mathematical, abstract, systematic, readily individualisable, distinct from data and experiment, and highly explanatory and predictive.³³ Proceeding from this, proponents of the pragmatic view argued for the following theses about scientific theory.

6.1 Limitation

The theory structure that are idealised are limited, hence might be too weak to ground predictive and explanatory work the syntacticists and semanticists want it to perform. Note that the two previous views were possessed elements of idealised notions such as phenomenal language and meta-mathematical. These in the opinion of the pragmatists will limit the explanatory power of the theory if theories which are meant for empirical purpose were given idealized structures.

6.2 Pluralism

This thesis states that theory structures are complex and multiple. They could exist in many types and kinds like metaphysical concepts, metaphors, analogies, ontological assumptions, paradigms, culture, natural kinds, policy views and lot more. Invariably, rather than talk about a structure of scientific theories, it will be better to talk about structures of scientific theories.³⁴

6.3 Non-formal Aspects

The pragmatic view equally recognises the non-formal aspect of theories like metaphors, assumptions, values, thought system. Hence, it concurs with the idea that there are non-mathematical elements in every theory of science, no matter how empirical that science claims to be.

³³ B. Flyvbjerg, *Making Social Science Matter: Why Social Inquiry Fails and How It Can Succeed Again*, (Cambridge: Cambridge University Press, 2001), 38-39.

³⁴ The whole idea of Kuhn's revolutionary science and paradigm shift was to argue this point.

6.4 Function

Pragmatic role such as “use” also features in scientific theories. The nature and dynamics of theory structure should pay attention to the user as well as to purposes and values.

6.5 Practice

We cannot really distinguish theory from practice, so the mode of the scientists practice determines the structure of the scientific theory that ensues from such practice. This further buttresses the view of pluralism, since there are myriads of scientific practices, it means that scientific structures of theories will vary from practice to practice.

These are deep commitment of the pragmatic view on science. It is good to note here that the pragmatic view is grouped into two, namely; (i) The Pragmatic View on Science of the Model Type and (ii) The Proper Pragmatic View. While the former insists that we should drop attention on theories and rather focus on models, the latter treats on theories. The model, for the former view, is a better fit to explain the relationship of scientific laws to the world that theories may find difficult to explain. Accordingly, models encourage the plurality that scientific explanation requires. Cartright is an advocate of the model type.

7. Concluding Remarks

In 1666 when Newton was reflecting in his mother’s garden on the stellar problem he had been studying at the university, an apple – so it was said – fell on his head and from this came the Newton laws of motion and his subsequent understanding of the law of Gravity. The scientific world has painted this story and has narrated it as if Newton did lots of calculations and laboratory experimentation before he arrived at those laws and indeed majority in the world believe that was the story. But Newton, Galileo before him, Copernicus, and all scientists theorised from the ambience of their cultural standpoint. Although they only gave emphasis that the men before them never gave to an aspect they claimed to have discovered. Newton, for instance, was schooled in

the Christian tradition where the concept of an unmoved mover is prevalent.

It was his belief that whatever is in motion is moved by another thing which itself must possess the quality of being able to enact force. This, perhaps inspired him to think the apple falling has a law governing it. If apples are falling then, it is logical for him, based on this *a priori* belief that something was moving it, otherwise, it would not have fallen. Thus, he got the first law which states that “every object will remain at rest or in uniform motion in straight line unless compelled to change its state by the action of an external force.”³⁵ If a force is external, it means an object cannot initiate movement on its own except a body outside the object does it. This is a silent appeal to the cosmological arguments presented by Aristotle which Thomas Aquinas employed for the existence of God.

Newton noticed that when these apples fall, they roll. They do not just remain where they fell. He concluded then that a change must have occurred from what he named potential energy to kinetic energy. From this physics he propounded the law of conservation of energy which is a physics variant of the law of conservation of mass stated above. Therefore, from Newton’s belief as a Catholic that every action in the universe has a consequence, every sin has a resultant penance, he formulated the third law, namely; that for every action (force) in nature there is an equal and opposite reaction. Even Newton himself may not be aware of this influence in his thinking but recent studies by the likes of Daniel Kahneman and Amos Tversky have shown that our thoughts and actions are most times influenced by the instinctual self rather than the deliberate thinking aspect. And the instinctual self is formed by our experiences which comprises, religion, culture, books we have read, movies we have seen etc.³⁶ The Newton case is a typical example of how science develops abstractions and definitions just for the case of explanation. It was the mathematisation of these theories by scientists of the syntactic and

³⁵ “Newton’s Laws of Motion,” *Encyclopedia Britannica*, <http://www.britannica.com/science/>. (Accessed July 23, 2021).

³⁶ Daniel Kahneman, *Thinking Fast and Slow* (London: Penguin books, 2011)

semantic views, which is still in vogue in science, that makes these theories look complex and certain. They are not different from the other explanations that has been given in other sciences. No one has a clear answer about the molecules and ions of liquid water but scientist have propounded its existence so as to explain why water boils and freezes.³⁷

Science has been seen as a discipline better than all other forms of knowledge acquisition with a separate stand and method even though there is no much difference between theories in science and theories in other disciplines. Theories whether found in science or elsewhere are clusters of axioms, whether mathematical or linguistic, about certain phenomena in the world.

On this note, we regard the pragmatic view of science as correlative to what we have observed theories of science to be. As noted earlier, theories whether in the humanities or science are groups of axioms, theoretical statements, observational sentences, logical propositions, metaphors and beliefs. To corroborate Grönfeldt, theory is not a single, static entity that we perceive from three different perspectives, as we might represent the earth using three distinct mathematical map projections. Rather, theory itself changes as a result of the perspective adopted in its formulation. Theories are laden, as in the Humanities and Arts, with the prejudice of our personal idiosyncrasies. All our descriptions are open ended axioms with the potentiality for change in the future.

³⁷ It has been a consensus for 20 years now that a molecule of water typically forms three or four hydrogen bonds: 3.5 on the average. Hence, what this statement entails is not that water molecules are not visible but there are divergent views about it and the consensus is based mainly on agreement not really observation. To quote Anders Nielson directly "...but the difficulty of 'seeing' the actual molecules in action meant a dearth of real data. There has not really been new experimental information about water in the last 20 years except for data from neutron studies. The amazing thing is that hardly anything is known about the unique properties of liquid water...nobody has a clear answer to why water is essential to life". Anders Nielson quoted in Stanford University Report: "Stanford and Stockholm university scientists show that water molecules cling together more loosely than previously thought" (April 6, 2004).