

THE UNIVERSITY OF HULL

**Karl Popper's Philosophy and the Possibility of an
African Approach to Science**

Being a Thesis submitted for the Degree of Doctor of Philosophy

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By

Anthony Idoko Okpanachi

B.A (Hons.) Ibadan, M.A, Nsukka

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Abstract

This thesis makes the philosophical case for an engaged and active African perspective in science studies. The African dimension has been largely absent in an actively increasing research area of science and society, an applied area where philosophy and other disciplinary interests intersect. To be able to do this demands the need to revisit what constitutes an African intellectual tradition. Indeed, a core aspect of the African identity whose epistemic worth and relevance have been denigrated, ignored and dismissed on the basis of ideal standards of reason and rationality set up by the privileging of Western intellectual tradition as typified by modern Western science. Efforts and interventions to advance science development in the African context (Nigeria) have not been successful as a result of the contextual inattention that characterises the approach prevalent today—one based on a justificationist epistemology and methodology. Therefore, I argue that a non-justificationist conceptualisation of reason and rationality—seen as being open to criticism and which takes seriously the results of critical exchanges as advanced in Karl Popper—is more appropriate to the science situation in Nigeria. This exploration helps not only to vitiate cultural tensions but also able to create a new basis for interaction between African and Western knowledge traditions.

Of particular interest in Popper's philosophy—but too often ignored in the literature—is the strong connection between his epistemology of science and his political thought. In pointing out key epistemic principles that flow from Popper's epistemology to his politics, I aim to provide a more robust account of the problem of science advancement in Africa than other approaches. These may be characterized as 'colonialist', seeing the answer as lying in the imposition of Western science and its values, and 'traditionalist', that resist this by championing indigenous knowledge and value systems. Positioning my account between these alternatives, Popper's philosophy is deployed as a framework within which a dialogue between two seemingly incompatible cultures becomes possible. Popper's emphasis on epistemic virtues of openness and humility, underlined by fallibilism and critical rationalism, allows the development of a new model of rationality that is neither absolute nor relative but pluralistic. Thus, although the primary focus is the development of an African science culture, the thesis demands a reappraisal by Western science of its own dispositions and outlook.

This Popperian way of reconceptualising rationality and accompanying epistemic attitudes makes decoupling the entrenched entanglement embodied by prevailing popular models of science less problematic and so makes way for a new approach to science in an African context, where ownership and responsibility can be initiated on a dialogical basis. Such a model does not exclude, devalue, denigrate, oppress, or disrespect. In this way, the global image of science can be recalibrated in a manner that is characteristically ecumenical, authentically pluriversal, truly open, and genuinely decolonised, with each knowledge tradition better disposed to offer its modest contributions to the common pot of science, as all of humanity strives to sort the challenges of development world over.

Epigram

"We need to espouse pluralism among contending disciplines, just as much as among mutually jostling cultures and civilizations: dialogue in place of strife, respect before rejection, reciprocal learning instead of reciprocal hectoring", - Felipe Fernandez Armesto, *A Foot in the River* (Oxford: Oxford University Press, 2015), 243.

Contents

Acknowledgements	i
Abstract	ii
Epigram	iii
Contents	iv
Outline of Chapters	1
1.0 Problematising Science in an African Context with Popper	3
1. 1 General Introduction	3
1. 2 Intellectual Responses to the Problem of Science in Africa (Nigeria).....	24
1.2.1 The Modernist Colonialist Account.....	25
1.2.2 The Post-Colonialist Relativist Response	26
1.3 Karl Popper and The Decolonial-Dialogic Account: Rationale, Relevance and Contribution	27
1.3.1 Popper and the Possibilities of Reconstructing/Redefining Rationality, Science and Objectivity.....	31
1. 4 Background to Science (Modern Western Science) and the problem of Values	39
1.4.1 Colonialism and science.....	42
1. 5 Science and Science Education in Nigeria: Problem, Debate and Proposal	61
1. 6 Possible Contribution.....	69
1. 7 Conclusion	72
2. 0 Karl Popper’s Philosophy (as response to traditional epistemology and methodology of science)	75
2. 1 Introduction.....	75
2. 3 Popper versus Representationalism as a Traditional Problem of Epistemology	81
2. 4 Popper’s Thoughts in Broader Context.....	102
2. 5 Popper’s Reformulatory Strategy in Epistemology and Politics: As a Basis for His Ontological Leap.....	106
2. 6 Popper’s Thought and the Decolonial Intellectual Project	113
2. 7 Virtue Epistemology and the Dialogue of Epistemologies	120
2. 8 Chapter Evaluation and Conclusion.....	124
3. 0 African Philosophical Thoughts: its Context and Relations to the Science Question in Nigeria	128
3. 1 Introduction.....	128
3. 2 African Philosophical Thought: Basis and Relevance	129
3. 2. 1 Understanding the Beginnings of African Philosophy.....	132
3. 2. 2 Trends/Traditions in African Philosophy	135
3.2.3 African Philosophy, Culture and Science Development.....	149
3.2.5 Some Important Principles in African Philosophical Thought	152
3. 3 The State of Science in Nigeria (Africa).....	156

3.3.1	Science in Practice and Science Education in Nigeria.....	157
3.3.2	Some Interventions Programmes for Science Advancement in Nigeria.....	166
3.3.3	Some Problems with African Traditional Thought/Beliefs.....	170
3.4	Conclusion: African Philosophical Context in relation to Science Problem in Nigeria	174
4.0	Towards an African Philosophy of Science Perspective: Dialogue of Knowledge Traditions	177
4.1	Introduction.....	177
4.2	On the Idea of Dialogue, Popperian Dialogue and Other Matters Arising	180
4.3	An Overview of Philosophical and Cultural Context of Science Education.....	185
4.4	Scientism versus Excessive Religiosity: Popper and Philosophy's Relevance.....	188
4.4.1	Relevance of History & Philosophy of Science in Science Education	205
4.5	Transiting from a Universalistic to Pluralistic Approach of Science.....	211
4.6	Knowledge Traditions in a Handshake: From Rhetoric to Praxis of Dialogue.....	217
4.7	Chapter Summary and Conclusion	231
5.0	Envisioning an Open, Decolonised, Truly Global and Eclectic Science Project for Authentic and Holistic Development.....	233
5.1	Introduction.....	233
5.2	The Project of Decolonial Critique of Science	238
5.3	Popper, Positivist Science and 'Philosophy as Metaphysics'	241
5.4	On the Politics of Reason: Science and the Enlightenment Campaign.....	246
5.5	Pluriversal or Planetary Vision of a 'decolonised' Science	258
5.6	Global Science: Pluralism and its Implications for Development	267
5.7	Truth as a Regulative Principle and its import for a Model of Epistemic Dialogue .	271
5.8	Dialogic/Inclusive Global Science in Science Education Context: Praxis for an African Philosophy of Science.....	274
5.9	General Evaluation and Conclusion.....	279
	Bibliography.....	292

Outline of Chapters

This thesis consists of five chapters. Chapter one situates the philosophical context of the thesis by problematising the positivistic orientation as a fundamental feature of the enlightenment epistemology with its boundary-drawing tendencies. It argues that question of the problem of science advancement is both epistemological and political in a way that singles out the Popperian framework as a viable philosophical frame to engage the problem of the question of science in an African (Nigerian) context. It contends that the whole trajectory of modern Western science is not able to elicit enthusiasm, interest, ownership and responsibility because it is entangled within the colonial matrix of power. And so, philosophy's decolonial task is an imperative. My reading of Popper's philosophy consistent with this project therefore provides a critical framework with which one is able engage this hubristic epistemic self-image of modern Western science in a way that predispose to relate with the "other" on non-domineering terms.

The chapter further discusses significant moments of the entire thesis by signposting the key issues and overarching argument of the entire thesis. Important to mention are subthemes associated with a regime of epistemology of Western modern science in the context of non-Western context.

The second chapter examines the philosophy of Karl Popper with two broad goals: a) to critique modern Western science with a view of deflating its epistemic self-image, and b) to provide a platform with which African knowledge tradition can be fruitfully engaged and prepare it for the ultimate aim of answering the question at the point of departure of the thesis; that is, its possibilities and potentials for science especially within the context under consideration.

The third chapter contextualises the discourse by evaluating the intellectual characterisation of Africans. It examines the project of African philosophy as a repertoire

of a knowledge tradition and its relevance for the question of science advancement in the African context. The chapter does this because it brings to the fore the struggle for identity in Africa by means of the definition of reason, a crucial aspect of the possibility of any epistemology. It also examines some of the practical aspects of the science question and the African people. This emphasises the struggle for identity in Africa by means of the definition of reason/rationality and its place in the context of the epistemological crisis of the science question in Nigeria.

The chapter fourth of this thesis provides the philosophical basis for a conversation between these two knowledge traditions by means of the model of Popperian dialogue, based on the epistemic principles of openness, humility, fallibility, amongst others to defend a pluralist approach/attitude/disposition to epistemology. The chapter also examines the pragmatic implications of this new model of relationship in the context of general education and science education particularly. It underscores the role of philosophy and other disciplines in the promotion of the kind of science advocacy and science education.

The fifth and final chapter evaluates the implications of this new approach to science by its call for an open, decolonised, genuinely global, and eclectic account of science. This ecumenical vision of science is one characterised as consummating the dialogic possibility initiated by Popper's philosophy. This image can be likened to a salad bowl image of science, where modern Western science does not exhaust all of the possibilities but acknowledges itself is one of many approaches to science. In this way, not only science but all of humanity is enriched by the possible contributions of many others.

1.0 Problematising Science in an African Context with Popper

Many authors have often cited Auguste Comte to have remarked; ‘savoir pour prévoir, prévoir pour pouvoir’, meaning, ‘to know in order to predict, to predict in order to be able to act’¹

1.1 General Introduction

Science in Nigeria as in many African countries continue to remain low and in very poor state. This is despite attempted efforts to improve science and popularise the culture of science in comparison to significant feats recorded by other nations around the world. The advancement of science remains a challenge in Nigeria. This has had significant implication for other aspects of development important to make society self-reliant, prosperous, facilitate the actualisation of potentials while improving and enhancing human life. My interest in understanding why science has not progressed significantly in Nigeria provoked the conscious attempt to engage in this reflection.

Without going into too much detail at this stage, it is important to note that for a student of philosophy interested in the question of science, the very point of departure is to look into various aspects of philosophy and ideas of philosophers with relevant interests in science and its presuppositions. Thus, a quick scan of such philosophical endeavours concerned with science and its related areas will show that to enumerate all such names may take up too much space in this thesis. My interest is to highlight just a few in the

¹ I have not read Auguste Comte’s original essays to come across the remark but I have encountered it in a number of literatures related to the methodology of the social sciences in its aspiration after the very successful positivistic hard sciences. This is because of the emergence of science or the scientific method as the cultural ideal worthy of emulation. I find the sense of the remark quite apt and illustrative of the kind of problematic that is at the centre of this thesis. This refers to a predominantly positivistic epistemology wherein only what is observable and measurable determines what is to be considered knowledge. Such a view inherently excludes as non-knowledge whatever does meet its set standards. Thus, the need to preface the entire work with Comte’s idea taken this time from, H. Martins, ‘Technology, modernity, politics’, in J. Good & I. Velody (eds.), *The Politics of Postmodernity* (Cambridge: Cambridge University Press, 1998), 158. See also, S. Aronowitz, *Science as power: discourse and ideology in modern society* (Minnesota: University of Minnesota Press, 1988), 121; J. Swann, ‘How science can contribute to the improvement of educational practice’, *Oxford Review of Education* 29, 2 (2003), 253-268.

history of philosophical labour during which ‘science’ evolved, since they are relatable, readily available, and easily accessible texts and literatures. Thus, the works of many philosophers such as Rene Descartes, G. Galileo, Leibnitz, Isaac Newton, Immanuel Kant and a host of others of the modern era were particularly insightful as their intellectual activities transpired when the concerns of ‘science’ were purely within the remit of natural philosophy. However, these intellectual activities are preceded by earlier efforts loosely concerned about the very origin of science, science culture, its fundamental characteristics, and the underlying presuppositions.

Recently, there has been an explosion of studies in different areas of philosophy of science and the emergence of various disciplinary studies of science, to include the history of science, science and technology studies, anthropological, sociological and cultural studies of science and a host others. The intellectual inspiration for many of these disciplinary interests stem from the epistemological preoccupation of science as some form of knowledge tradition with presuppositions that are neither neutral nor value-free. Hence, the question of the extent to which science is different from other forms of knowledge with respect to certain values became largely problematic. The manner in which this claim is reflective of the nature and practice of science in society thus became the starting point of debates and reflections of various kinds. Renowned names whose thoughts are commonplace include Karl Popper, Thomas Kuhn, Paul Feyerabend, and their acolytes to include; Imre Lakatos and contemporary scholars of various leanings too numerous to outline.

Again, in the evaluation of the cultural attitudes to knowledge or science in non-Western societies, such as is the case of the subject matter of this thesis, many take their inspiration from the thoughts of Feyerabend and Kuhn than Popper, a sub-section will furnish us details shortly and also partly demonstrate the contribution I draw upon and specify the contribution I intend to make to the debate and discourse. For now, it is important to point

out that in this thesis however, Popper will be the guide rather than Kuhn or Feyerabend. In addition, this is one of the interesting aspect of this thesis I consider in my estimation to be a novel intellectual endeavour, one that the thesis will satisfactorily deliver upon at the end. Insightfully, Maxwell makes the argument that one of the fundamental concerns of Popper is to account for how science makes progress, and be able to apply this knowledge towards a much more humane, and enlightened social world.² This reading of Popper's concern seems to me to be at the very heart of the drift of the entire thesis because the problem before us is to philosophically examine the problem of science advancement as contextualised in an African context (Nigeria).

The foregoing is important, as it is critical because even though the study of science in society or history and philosophy of science broadly has blossomed in leaps and bounds in other areas, little or nothing from an African perspective is present in such discourses and literatures.³ This is even more acute when we consider the fact that debates at the centre of these discourses do highlight epistemological assumptions and values when societies, cultures and civilisations are compared or evaluated with respect to how these societies or cultures conceptualise and understand nature.⁴ We are to keep this in view while the thesis examines the problem of science advancement in a non-Western context, Africa (Nigeria).

² N. Maxwell, *Karl Popper, science and enlightenment* (London: University College London Press, 2017), x. it is important to note that the project of understanding how science progresses is also connected with the application of this knowledge to the social world towards a much more humane and enlightened world. Here, the point is the value of the relationship between the logic of scientific advancement and the relevance of this logic and understanding for the larger society.

³ Recently, an edited volume of intriguing essays that attempt to distil the questions surrounding the problem of conceptualising Africa as consumer or producer of science, innovation and technology and what that means for development. See more, C. C. Mavhunga (Ed.), *What does science, technology, and innovation mean from Africa?* (Cambridge, Massachusetts: MIT Press, 2017).

⁴ The debates around the possibility of African philosophy and its associated responses is based on certain assumptions. For instance, a text by R. E. Nisbett, *The geography of thought: how Asians and Westerners think different ... and why?* (New York: Free Press, 2003) indicates some underlying assumptions which I will discuss in detail in chapter four of this thesis. However, it is instructive to simply indicate the direction to which much of my thinking in this thesis is directed can be gleaned from this insightful piece by S. G. Arnal, 'Rationality, normativity and practices: towards a more inclusive concept of reason', *Women: A Cultural Review* 14, 2 (2003), 171-181; wherein a fine distinction is made between tacit form of knowledge and explicit or propositional form of knowledge.

At this juncture, it is important to provide a brief clarification of a trend one is likely to notice in the discussion thus far and which is likely to pose a problem of consistency amongst others for the thesis. It is one in which the discussion tends to slip between seemingly different contexts and the dangers thereof. The question therefore, is, on what basis can one discuss science in Nigeria as science in Africa and/or science in the non-Western world? Under what circumstances can they be used interchangeably? And what justifies my exploration and pontification on behalf of these other contexts if they are distinct situations and at what point one is to consider them separately?

As interesting as these questions are, there is a sense in which the common colonial experience provides an incentive for engaging in this sort of reflection. In other words, Nigeria as well as other Africans or non-Western world have in common this similar experience in history and so warrants the interchangeable contextual usage as such. These contexts are connected and interrelated. And so, dealing with them seriatim does not necessarily preclude considering them conjointly when appropriate. Thus, my usage of the terms is more or less flexible. Again, while I acknowledge though the fine details may differ among scholars concerned with this sort of challenge, what is however obvious is the motivation to develop intellectual tradition in response to the same project. And so, what this thesis seeks to do is to provide a framework, of a philosophical kind, which may be applicable in different circumstances of people reacting to the same project – the dominance of a model of science epitomised by Western modern intellectual tradition.

There are numerous examples of scholars whose works focus on challenging the predominance within and outside African philosophy. For example, Ramose Mogobe's "Ubuntu" is a classic reflection of this sort of intellectual response- it characterises the fundamental of what it means to be an African.⁵ Though a South African, he is one of the

⁵ M. O. Ramose, The philosophy of Ubuntu and Ubuntu as a philosophy in P. H. Coetzee and A. P. J. Roux (Eds.), *Philosophy from Africa: A Text with readings* (Cape Town: Oxford University Press, 2002), 230-

leading voices in philosophical scholarship in Africa today, his discussion resonates deeply with many other Africans in their various cultural and societal contexts. Another important example is the profound depiction of Africa, the African and his/her culture by Chinua Achebe in his classic novel, “Things Fall Apart”, cast within the context of the south eastern part of Nigeria; specifically the Igbo in relation to the intruding Western tradition.⁶ This classic remains one of the most important literary work that began modern African literature and scholarship.

On the challenge of development in many African countries, several reasons of the political kind very often are claimed to be responsible for the poor state of science in Nigeria and suggestions made accordingly in how to address the problem.⁷ In my estimation, the (material) reasons of economic and political nature identified in earlier works have not been robust enough, as the problem has remained persistent in spite of the several interventions based on the suggestions arising from the reasons so identified in such works. As Luaer forcefully argues,

... elitist posturing and professional imperialism influences the transfer of scientific knowledge and practices from technocracies to agrarian societies where alternative systems of assessment may dominate. In principle and practice there

238. Reflecting on Ubuntu as a fundamental principle in postcolonial African philosophy, Eze writes that “ubuntu predisposes every person to encounter every other person as human. The encounter is based on equality and on the fact that none of the parties is a means to the other’s end; it is the freedom from dogmatism; it is flexibility oriented towards balance and harmony in the relationship between human beings and between the later and the broader be-ing or nature. This model lays emphasis and basis for a thinking in Africa that does not place a premium on the gaze of the West, a thinking that is not obsessed with providing African alternatives to the West, but rather one that seeks to engage reality and human beings directly. In adopting a fundamental openness to reality, this thinking is ready to borrow ideas even from erstwhile enemies as long as those ideas contribute to human flourishing in Africa”. See, C. Eze, ‘Decolonisation and its discontents: thoughts on the postcolonial African Moral self’, *South African Journal of Philosophy* 34, 4 (2015), 416.

⁶ C. Achebe, *Things fall apart* (London; Heinemann, 1958).

⁷ On the 29th June 2017, the government minister of Science and Technology in Nigeria remarked that lack of policy roadmap was responsible for the poor state of science, technology and research activities in Nigeria. This kind of view to my mind is symptomatic of the very absence of profound philosophical appreciation of the problem of science in the Nigerian context. My point is, there have been series of policy documents from one government to the other without any significant progress recorded in the improvement of these objectives. It is more or less a political ritual for every government in power to commission one policy document after another without the commitment to follow through these programmes in a fashion that is thorough in implementation and execution. Sourced URL: <https://www.thisdaylive.com/index.php/2017/06/29/fec-approves-13-year-science-technology-roadmap-for-nigeria/> [Accessed: 01/07/2017]

is no contradiction between investing in science and technology while simultaneously sustaining a conservative faithfulness to ancestral values and customary knowledge. Rather the chief problem with appropriating the benefits of modern scientific method and integrating them effectively into indigenous African knowledge systems has been that the modern scientific tradition has typically prevented it.⁸

Examples become apparent once we begin to pay close attention to the various science policies and programmes of government and the accompanying science education and general educational options aimed at advancing the state of science in Nigeria. In fact, what we continue to witness is the replacement of one policy with another with obvious supports of international organisations such as UNESCO and others. This has happened as often as we have had change in government in Nigeria. Any model or strategy to be adopted is to suit the specificity of the country's needs and priorities and not the suggestive biddings of others⁹; a state of affairs that has not helped to put in place successful science agenda and the priority that the necessary infrastructure supportive for its sustainability demands. As Akande cites the 2005 UNESCO science report that, "if Africa expects to use science and technology to tackle its pressing problems, it must develop its own scientific and technical capacities. Otherwise, it will be forever beholden to second-hand science that will never quite fit the continent's circumstances".¹⁰

Let us illustrate the point further with concrete examples. Science and technological transfer have featured prominently as a critical strategy in the interventions that various governments have made over the years, an interesting model that has its challenges no doubt.¹¹ However, the associated science policies and educational choices designed to

⁸ H. Luaer, 'Cause and effect between knowledge traditions: analysing statements that address the regression of science and technology in Ghana', *Transactions of the Historical Society of Ghana* 8 (2004), 262-263. As strong as the claim seems, it is one that does not readily avail itself of empirical test.

⁹ M. Laccarino, 'Mastering science in the South', *Embo Reports: Science and Society*, 5, 5 (2004), 439.

¹⁰ O. Akande, 'Africa needs a culture of science', 06/10/2010. Available Online: <http://www.scidev.net/global/policy/opinion/africa-needs-a-culture-of-science.html> [Accessed on 16/03/2016]

¹¹ The theme 'technology transfer' features prominently at the 1979 United Nations conference on Science and Technology for Development, in Vienna. In the estimation of its proponents, the absence of the infrastructural environment crucial for science and technology to thrive, and the huge financial burden it requires, developing countries can benefit from the transfer of technology and products from the developed countries as a way of closing the gap in research and development. Cf. Laccarino, *Mastering science in the*

facilitate this project fundamentally operates on a number of problematic assumptions which is immediately evident amongst others, is the logic that underlies such a project. By this, I mean that there is a presumption of a total absence of some ingredients or elements of the culture of science in Nigeria and so, efforts were made to transfer that which is present from other climes into the environment (Africa-Nigeria) where it is assumed as absent. Hence, with no appreciation of the presence or lack of these elements, it was not long before the entire arrangement collapsed under the very weight of its own contradictions. In other words, it is either many of these efforts were hastily put in place and so not properly thought out or the society in which these lofty activities were implanted did not have the requisite components to optimally benefit their societies.¹² With such experiences there was the realisation of the failings of the technological transfer model in many developing countries in Africa. The need to go back to the drawing board was therefore important and urgent. For, as Laccarino argues, the facts of the internal infrastructural challenges and the need to prioritise science and technology, by aggressively improving the public awareness among citizens (via science education) and getting the stakeholders on board to develop a simple and translatable strategy (political decisions and strategies) easy to implement and execute became apparent.¹³

Very broadly, under the operation of such logic and intellectual predisposition therefore, one can then begin to appreciate the civilizational epistemology upon which colonial transactions in many parts of Africa took place. The continuing effects of such transactions were diverse and extremely pervasive that the formal end of colonialism did not obliterate in any significant manner. Such claims are held by several scholars including W. Mignolo, R. Grosfoguel, A. Quijano, S. J. Ndlovu-Gatsheni and many

South, 437-441; also, M. Vaughan, 'Africa and the birth of the modern world', *Transactions of the Royal Historical Society* 16 (2006), 143-162.

¹² M. B. Brown, 'An African road for development', *Leeds African Studies Bulletin*, 62 (1997), 13-40.

¹³ Laccarino, *Mastering science in the South*, 438-439.

others who continue to engage discourses of coloniality and decoloniality.¹⁴ In some sense, then, the problem of science advancement in an African context touches on the notion of the coloniality of Western modern science because of its prevailing domineering and dominating inattention to the contextual factors within which it operates. Care must have to be taken so that this contestation I pursue herein is taken to be a move to defend Afrocentricism¹⁵ in any form; which of course, is the logical conclusion of the over adulation of African values and practices, reflective of the second intellectual response of the African experience vis-à-vis the West. It goes without saying that this relativistic position seems to be also guilty of the very problem I have identified with the nature first intellectual response, that is, the colonialist view point¹⁶ - a total capitulation of African heritages. The counter extreme response that argues for the total rejection of everything Western is not helpful either as it is not a realistic position. The way out is the middle ground; the pragmatist position that emphasises the Aristotelian view of virtue which lies in the middle. Coetzee captures it more graphically while reviewing the task for African philosophy within the context of the analytic tradition of philosophy thus, “African philosophy is challenging the dominance of the Western epistemological paradigm in Africa. *In my father’s house*, Appiah (1992, 72) laments the fact that it is too late for

¹⁴ Here coloniality is used, a nuanced term with deeper meaning far different from colonialism as popular in the literatures. Cf. A. Quijano, ‘Coloniality and modernity/rationality’, *Cultural Studies*, 21 (2-3), 2007: 168-178; W. Mignolo, *Local histories, global designs, coloniality, subaltern knowledge and border thinking* (Princeton, New Jersey, Princeton University Press, 2000); S. J. Ndlovu-Gatsheni, ‘Decoloniality as the future of Africa’, *History Compass*, 13, 10 (2015), 485-496.

¹⁵ See more, P. G. Zachary, “Africa’s weariness toward science impedes research and development”. Available Online: <http://www.csmonitor.com/World/Africa/Africa-Monitor/2010/1122/In-Africa-wariness-toward-science-impedes-research-and-development>. [Accessed on 30/01/2016]. In the terse piece, Zachary who blogs quite often about many African issues argues that the continuing political and moral appeal of Afrocentrism and the rise of evangelical Christianity constitute huge challenges for the promotion and support of science. These feed into the anti-science values such that more inputs will achieve much less than proponents expect.

¹⁶ It is not uncommon to view a position as Eurocentric, it is problematic, same way a position can be seen as Afrocentric and it is problematic as well. For more on Afrocentrism, see, M. K. Asante, *Afrocentricity: the theory of social change* (Chicago: African American Press, 2003).

Africa and Europe to forget about each other- perhaps philosophers should note this and make the best of the dialogue which this fact has thrust upon them.”¹⁷

At this juncture, it is important to quickly clarify the distinction between Popper’s concepts of fallibilism and falsifiability/falsification to underscore how I am deploying fallibilism in Popper as the key to unlock his philosophy of science in conjunction with his political philosophy in way that makes this intervention and exploration rather novel and salutary. This is important because there is need to show the relevance of Popper to dealing with the problem at hand. The human person is at the centre of the problem of knowledge with all the flaws and limitations that comes with it. In Popper, there is a sense in which epistemic humility is central given the fact that fallibility of the human condition makes it incumbent to acknowledge and embrace the age-old Socratic cliché that calls all to self-knowledge as an important building block in any intellectual endeavour or undertaking with the self and more importantly, as it relates with the other. This fallibilist basis of Popper’s epistemology coupled with his political philosophy that characteristically extols the open society makes for openness and dialogue as a useful philosophical tool with which to create the space for epistemic exchange and engagement that is respectful, non-dominating and progressive.

In Popper’s terms, “the problem of induction arose essentially from a mistaken solution to the problem of demarcation – from the mistaken (positivist) belief that what elevated science over pseudoscience was the ‘scientific method’ of finding true, secure and justifiable knowledge, and that this method was the method of induction; a belief that erred in many ways than one”.¹⁸ The enlightenment science presented itself a debunker of myth in favour of a literal, true description of the world. For as it is further described,

¹⁷ P. H. Coetzee, ‘A note on Eze’, *Philosophical Papers*, 30, 3 (2001), 225.

¹⁸ K. Popper, *Unended quest: an intellectual autobiography* (New York & London: Routledge, 1992), 55; K. Popper, *Conjectures and Refutations: The growth of scientific knowledge* (London: Routledge & Kegan Paul, 1969), 53.

“enlightenment rationalism is the belief in universal laws of human nature and in an all-embracing scientific method for accumulating truths...”.¹⁹ Ironically, this self-characterisation itself amounted to creation of a new myth- according to present-day science studies, which sets itself the task of demythologising science, a task that positivists believed they had already achieved with their attack on metaphysics.²⁰ In Fuller’s view, “positivism though can be said to be dead as a movement, its ghost continues to haunt Western science and philosophy to this day”.²¹

The project of the Vienna Circle, for instance, was to develop a philosophical understanding of science that would allow for an expansion of the scientific worldview - particularly into the social sciences and into philosophy itself. The project was immensely successful, because positivism was widely absorbed by scientists and non-scientists interested in increasing the rigour of their work.²² In fact, as Holton avers, proponents of positivism view their understanding as definitive of rationality.²³ Reflecting on this, Ravetz argues

... we can recall that the Viennese endeavour had a very middle-European flavour. In its struggle against what it claimed were the existing politically-motivated dogmas of theology and metaphysics, it advanced its own version of dogmatic and simplistic version of Truth through science. In this respect it participated in a stylistic tradition going back to Descartes (with deductions of all truths from God’s essence), and Galileo (proclaiming ‘the conclusions of natural science are true and necessary’). The harshness, indeed arrogance, of their doctrines in natural philosophy was related to that of the expression of the mathematical sciences which were their exemplars. This survives still, most noticeably in teaching, but also in popularisation. Nowhere do the assertions of such sciences (as traditionally served) make a place for criticism; as Popper has observed, the uncritical attitude fostered by teaching in the ‘normal science’ mode is a danger to science and to civilisation.²⁴

¹⁹ M. Hollis and S. Lukes (Eds.), *Rationality and relativism* (Oxford: Basil Blackwell, 1982), 3.

²⁰ T. Nickles, ‘Philosophy of science and history of science’, *Osiris, Constructing Knowledge in the history of science*, 10 (1995), 138-163.

²¹ S. Fuller, *Philosophy, rhetoric and the end of knowledge* (Madison, Wisconsin: University of Wisconsin, 1993), xvi.

²² S. Sismondo, *An introduction to science and technology studies* second edition (Chichester: Blackwell Publishing Ltd, 2010), 1-2.

²³ Cf. G. Holton, *The scientific imagination: case studies* (Cambridge: Cambridge University Press, 1978).

²⁴ J. Ravetz, ‘Ideological commitments in the philosophy of science’, *Radical Philosophy*, 034 (1984), 10.

Popper's contestation of the positivistic programme resuscitates metaphysics as an important aspect of science. Popper's libertarian commitment reflects in the republican ideal of science for its ability to grow. This commitment brings his epistemology and politics into some form of interaction wherein there is emphasis on the role of philosophy qua philosophy. By this, Popper indirectly avoids the trap of "shooting himself in the foot", by, rehabilitating philosophy as a respectable and relevant discipline with legitimate problems to tackle. Here, the imitative tendency by number of disciplines methodological wise to copycat the hard (natural) sciences can learn important lessons. In fact, Popper reflects on this sort of intellectual practice to be one underpinned by very imperialistic and methodological excesses of the hard sciences, akin to what the proponents of Logical Positivism set out to do, a project which is not quite helpful even for science itself and other disciplines because of its implications for issues of epistemic plurality, enriching inclusivity and dialogic contributions.

Speaking to the context of Africa, the important question then is, how does this positivistic conceptualisation of science relates to social reality? Evidence in the literatures suggests as much as regards the important intellectual role this conception of science plays in the cultural relationship between Africa and the West. The importance of this relationship at various levels for Africa and Africans is central to this thesis – how a dominant model of epistemology relates with the cultural and intellectual tradition within which efforts are made to promote and advance modern science - a point that I will not dwell upon at this point but will receive adequate attention as the thesis progresses. Suffice it to note very briefly that quite a number of attention dedicated to examining the challenges of development in Africa underscore the emphatic point that many models and frameworks of development with respect to Africa are underpinned by this logic and

hence remain inherently problematic as their vacuous relevance and impact clearly demonstrate.²⁵

Broadly, Popper was of the view that the confirmatory penchant and absolutist convictions about knowledge and truth (carried over from the hard sciences) and therefore their predictive competences deployed in the social sciences to addressing social reality were doubtful and ill fashioned.²⁶ We can stretch this further by being curious and asking, - the extent to which these crucial issues raised in Popper's philosophy can be applied and made relevant to African context? So, are there philosophical or epistemological lessons that we can glean from the view of Popper that "... those among us who are unwilling to expose their ideas to the hazard of refutation do not take part in the scientific game"²⁷ for the larger question of scientific development in the context of Africa? According to De Langhe, "in Popper we find one type of progress as evidence of scientific change. As falsification is analogous to biological evolution, random conjectures and selective refutation ... by abandoning unfit theories, science is a gradual and cumulative process of adaptation to that standard".²⁸ By this, science becomes better for it as the efforts to find better explanatory hypothesis, theories or models guarantee its advancement and improvement in many ways.

²⁵ Such popular theories as the Modernisation, Dependency, Neo-liberal theories and the so-called African 'home grown' frameworks to include; the Lagos Plan of Action, Structural Adjustment Programmes as well as NEPAD – New Partnership for Africa's Development. All of these models are in fact co-extensive with the highlighted Eurocentric models as they embody in one form or the other neoliberal orthodoxies which have underpinned various developmental frameworks in Africa and so rather than resolve, they, in fact sustain the crisis of development in Africa. See M. O. Ajei, *Africa's development: the imperatives of indigenous knowledge and values*, Ph D Thesis submitted to the University of South Africa, 2007; A. O. Olukoshi, *Governing the African developmental process: the challenges of the New Partnership for Africa's Development (NEPAD)*, Occasional Paper, Centre for African Studies, University of Copenhagen, 2002.

²⁶ K. Popper, *The poverty of historicism*, (London: Routledge edition, 1994). It discusses scientific method of the social sciences. He however has some good observations for the discipline of economics unlike the others.

²⁷ K. Popper, *The Logic of Scientific Discovery* (London & New York: Routledge, 1992), 280.

²⁸ R. De Langhe, 'A Comparison of two models of scientific progress', *Studies in History and Philosophy of Science*, 46 (2014), 94-99.

Thus, to account for the problem of science advancement we can take clue from Popper. The problem of science in Nigeria seeks to demonstrate how this notion of science in the shadows of Popper's interventions straddles both the hard sciences and the soft (social) sciences as a relevant consideration for addressing the challenges that bedevil Africa (Nigeria). One of these is science and technology, a strategic hub of developmental challenge facing Africa, the subject matter of this thesis. The task before us therefore, is to examine and evaluate the problem of science advancement in Nigeria, which ultimately, contributes to the larger debate on the crisis of development on the continent as well. It does this by focusing on a specific aspect, that is, science rather than the general and larger issue of development. It is able to do this by paying very critical and close attention to a formulation of this same problematic aptly captured as Needham's classic philosophical question – why modern science happened in the West and not somewhere else?²⁹ To recap the problematic therefore is to attempt a reconstruction of this same question – how best do we make modern science happen/take root in Nigeria? In this way, one is able to again horn home the context of this present undertaking.

This thesis therefore is interested in demonstrating how philosophy can contribute towards dealing with the problem of science advancement in the Nigerian (an African) context. My contention is that the problem of science advancement in Nigeria (an African) context is also due to questions concerning rationality and our understanding of science and the connections between these and development.³⁰ We can situate this within the history and philosophy of science as applied in an African context. In other words,

²⁹ J. Needham, *The Grand titration: science and society in East and West* (Toronto: Toronto University Press, 1969), 16, 190.

³⁰ M. E. Kabay, *Science and non-science: an epistemological conflict*. Available online: <http://www.mekabay.com/opinion/science.pdf>. [Accessed on 02/07/2016]

this thesis makes a case for epistemic space for contribution that comes from the African perspective largely absent in the growing works and literature in science studies.³¹

It seeks to particularly highlight the immaterial grounds (the prioritisation of knowledge and science and what this entails – that is, what constitutes knowledge/rationality) to be a much more fundamental factor than the material reasons of the problem of science in Nigeria often emphasised. For example, issues of funding and leadership failures are very often thought to be wholly responsible for the poor state of science in many African countries. For instance, Laccarino rightly suggests, “even if developing countries decided to increase their research and development, without adequate planning it would still be difficult for them to conduct and support research in an efficient way. Science is a complex activity that requires support from a sophisticated infrastructure, a good educational system and the social acceptance of budgetary choices- factors that are not necessarily a given in most African countries”.³² So, the question then is, what constitutes good educational system in an African setting? This way of looking at the problem of science in an African context, this thesis is able to engage the basic epistemological issues and the material manifestations at the social and political levels in ways much more comprehensive than we have had. The emphasis on epistemological factor as a crucial issue in the development and advancement of science in Africa is also given credence by Taiwo who regards the material-developmental deficiencies (for example, food, water and other basic material challenges) across Africa as a knowledge problem he christens

³¹ This interesting project is not only an epistemological challenge but a methodological one, argues Mavhunga. See C. C. Mavhunga (Ed.), *What do science, technology, and innovation mean from Africa?* (Cambridge, Massachusetts: MIT Press, 2017), x. In asking what archives we defer to and the approach to archive that, Mavhunga opines that Africans or those who take the African mode of ratio seriously provide the leeway. In my project however, Popper as a Western philosopher is not only useful but very appropriate because his proviso serves to achieve a two pronged goals at once; while it undercuts the hubris associated with western model of epistemology, it also calls into question and demands openness on the part of the African ratio and epistemic heritage so as to be facilitate the dialogue of both.

³² Laccarino, *Mastering science in the South*, 437.

the “Africa’s knowledge imperative”.³³ Turner strongly makes the point that, “if the rise of modern science is associated with the origins of capitalism in the Seventeenth Century, then science is typically held to be intimately related to the growth of citizenship and democratic politics”.³⁴

While I was thinking about the state of science in Nigeria, I happened upon and listened to a TED talk titled, *The Great Divergence: the West and the Rest* by Niall Ferguson. Six important items were identified and called ‘apps’, as familiarly evident on some mobile phones. Ferguson in fact, called them, ‘the killer apps’! The list includes; ‘Property Rights, Competition, Scientific Revolution, Modern Medicine, Consumer Society, and Work Ethic’. These were the broad issues identified by Ferguson as responsible for the great divergence between the West and the East. According to him, however, events in contemporary society have seen the emergence of what he calls, a “re-convergence”, as the great divergence is over because any society, which develops the requisite institutions and ideas is capable of becoming a powerful civilisation. I found the ideas rather fascinating and as speaking to the major problem this thesis seeks to reflect deeply upon. Very striking was the rhetorical question Ferguson posed about Africa in relation to the killer apps, particularly, the problem of advancing science and technology. Ferguson rhetorically poses, “Is Africa able to download the *apps* and get the sequencing of the download wrong?”³⁵

Now, what was very striking for me was Ferguson’s emphasis on the indispensability of ideas as ultimately responsible for contributing to the building of institutions. In other

³³ O. Taiwo, *Africa must be modern: a manifesto* (Bloomington, Indiana: Indiana University Press, 2014). Also presented in a TED talk with the title: ‘why Africa must become a center of knowledge again’.

³⁴ B. S. Turner, ‘State, science and economy in traditional societies: some problems in Weberian sociology of science’, *The British Journal of sociology*, 38, 1 (1987), 3.

³⁵ N. Ferguson, TED Talk, *The great divergence: the West and the Rest*. This theme was the central focus of his work, *Civilisation: The West and the Rest* (London: Penguin Books, 2012). The rhetorical question draws attention to very crucial point that has always been at the basis of the how Africa and her problems are understood within popular Western epistemological scholarship which is largely paternalistic. A position I consider to be very problematic.

words, the point suggests that knowledge and ideas as products of a worldview, descriptive of the fundamental principles or metaphysical framework of a people upon which the progress of science within such a society can be located. And so, it can be said to be an important aspect in the making of a civilisation. The precise question of how the downloading of the science culture (i.e. efforts to advance science) in Nigeria has fared therefore becomes a central inquiry in this thesis. On this point, Fergusson's thought seems to resonate with Needham's question reconstructed in the context under review – that is, why has the culture of Western modern science not advanced significantly in Nigeria as elsewhere?

This poor state of science has kept Nigeria on the periphery, more or less, a passive participant in global scheme of things. This may continue except something positive urgently happens; about which, is the sort of question central to the present exploration undertaken in this thesis. No wonder, - Moghalu argues that for African nations to benefit and actively participate in contemporary globalisation, African nations cannot but urgently develop a mental outlook relevant to their various contexts.³⁶ What I intend to argue therefore is that an appropriate philosophy of science able to resolve the tension and advance science in Nigeria particularly is not only urgent but pertinent as well.

The question of science advancement in Nigeria appears to be simple and the supposed response to such a simple question is likely to suggest corruption or some other socio-political reason as responsible for the many troubling challenges of development across Africa generally and Nigeria particularly. As troubling and as serious as this political reason is, a deeper reflection however reveals that such a simplistic answer merely scratches the surface, as corruption itself seems to be a function or manifestation of a much more fundamental tension, of which science in Nigeria suffers the collateral

³⁶ K. C. Moghalu, *Emerging Africa: How Global Economy's Last Frontier Can Prosper and Matter* (London: Penguin, 2014).

damage. After all, Olorunade suggests that “public misunderstanding or poor scientific literacy works its way through the social, political and economic structures to inform the poor funding of science and lack of commitment to prioritise scientific criteria setting up research priorities and programmes. If the populace is to appreciate the general nature of scientific endeavours or its potentials contributions to a better way of life, then the public must possess some degree of scientific literacy”.³⁷ This is partly because many interventions to improve the culture of science in Nigeria have not been capable of yielding proportional results.

Why does it seem that the culture of science is yet to permeate through the entire society and engender consistent persuasion to demand accountability of themselves and leaders and thus grow investments in science and technology? Why is it that many trained professionals and experts will ordinarily relapse into a consciousness that continues to undermine the ability to entrench a culture where science prevails? Why are scientific means to solving problems and developing policy options do not have so much appeal as credible and reliable means in Nigeria? Could the prevalence of an overwhelming commitment to some forms of irrationality have any role and thus able to provide possible insights to understanding some of these questions? Is there any link between lack of commitment to make science work as something able to attend to societal needs on a large scale has anything to do with the resignation to a disposition of helplessness and fatalistic attitude wherein capricious forces and operations dominate? These are among the many troubling questions that show something deeper than the simplistic answer of corruption or any political factor as solely responsible for the poor state of science in Nigeria. There is therefore the need to interrogate the more profound metaphysical and epistemological setting of the typical African in how he/she understands him/herself, others and the

³⁷ S. A. Olorunade, ‘Scientific literacy in Nigeria: the role of science education programmes’, *International Journal of Science Education* 10, 1 (1988), 151-158.

environment in which he/she inhabits. These do play indispensable role in the whole programme of efforts to improve the commitment of investments to make science advance across the society. Thus, in a clime where there is the flourishing of the culture of superstition, excessive religiosity accompanied by dogmatic attitudes vis-à-vis the epistemological attitude that comes as well from a rather successful model of knowledge, that is, Western modern science, the need to evaluate both within Popper's ideation of society that is closed and open will be a worthwhile venture – especially the values of the open society. The benefits of this intervention are far-reaching and crucial.

Interestingly, insights in this regard includes frameworks in sociological discourses on knowledge/science. Perhaps, - philosophy as a discipline will offer some insights into providing a much more robust account of the problem of science in Nigeria. For instance, there have been some concerted attempts to revamp and reposition interest in science and science culture in societies where we take for granted the state of science advancement through the instrumentality of philosophy and history of science.³⁸ Such efforts do indicate the kind of critical intervention that philosophy, if well understood, can inspire and motivate within the context of Africa (Nigeria).

One major area is the role of education in promoting the culture of science noting with Wellington that “no one element of the range of aims for science education should be over-emphasised at the expense of others. A variety of menu of aims (diversity) is required, partly in order to make science attractive to a range of learners”.³⁹ This is also touched by this question of science advancement in Nigeria and so, I will reflect

³⁸ The revival of the teaching of the history and philosophy of science is a major intervention according to experts in science education. It is able to revitalise interest in science culture to counter the growing culture of anti-science in many Western/developed societies. If such societies consider important repositioning science pedagogy to engender renewed interest in science/science culture, then less developed societies cannot but take cue from such efforts and be much more aggressive and purposeful in doing that and more. For instance, M. R. Matthews, *Science Teaching: The Role of History and Philosophy of Science* (New York: Routledge, 1994). The work evaluates the many sided issues of science education in advanced societies and how to improve the culture of science.

³⁹ J. Wellington, ‘What is science education for?’ *Science and Technology Education* 1, 1 (2001), 23-30.

theoretically on this as the thesis progresses. The societal appreciation and prioritisation of science will be evident in its educational environment within which the promotion of science culture is to occur. Thus, the need to re-evaluate the educational context of science learning and teaching in Nigeria becomes an imperative. In this regard, the thoughts of Popper are illuminating as well. In fact, one key area Popper had foundational attention and reflected all through the course of his philosophical engagements was the concept of human learning. Learning happens from without through the process of elimination of error within the trial and error dialectics evolutionary system in Popper's epistemology.⁴⁰

Science or modern science culture as taught and promoted in Nigeria is characteristically in tension with the culture of the people it has largely denigrated over the years. The modern/Western science promoted in the educational and societal settings is not only in tension but also in competition with the traditional/cultural presuppositions of some of the epistemic heritage of the people.⁴¹ A vivid example of this sort of tension is the recurring debates between creationism and evolutionism. The classical cases of the example are not only evident in the United States of America but in other countries as well. While it may not immediately be urgent to engage the merit or demerits of claims and counter claims, suffice it to point out quickly that there is often a Popperian dimension amongst others in outlining the criteria for the question of demarcation that arises here. What does and does not count as science is the result of the power struggle between the evolutionists, who control the scientific establishment, and a marginalised intelligent

⁴⁰ S. Chitpin, *Popper's approach to education: A cornerstone of teaching and learning* (New York: Routledge, 2016).

⁴¹ O. Taiwo, 'Colonialism and its aftermath: the crisis of knowledge production', *Callaloo: On Post-colonial Discourse: A Special Issue*, 16, 4 (1993), 891-908. In the piece, Taiwo analyses the fundamentally exclusive nature of colonialism in the light of state of the university as an epistemic site for the production and consumption of knowledge to show that the cultural nature often ignored in the socio-political emphasis are evidences of distortions occasioned by the historical encounters Africa has had with the West. Such analysis for Taiwo remains crucial in the appreciation of the place and role of institutions that emerged plays in the quest for development across the African continent today. In fact, Taiwo goes ahead to argue that the roots of the contemporary limited development of the mode of knowledge production in Nigeria can be traced to the impact of these processes.

design/creationists group with a large religious following.⁴² However, the point to emphasise for now is the disposition of Western modern science to acknowledge its epistemic status and the implications thereof. Little wonder, Taiwo, a renowned African philosopher argues, “the African place in modernity remains a conflicted heritage”.⁴³ Because of this conflictual state of affairs as well as the rather poor and low returns of governance in many of these societies, the science culture does not appeal much. Thus, the people are open or exposed to manipulation by the excessive religious claims, which feed upon the overwhelming metaphysical outlook of the cultural/traditional views held by the people. In the face of desperate situation caused by bad leadership and corruption, the people resign to fate and live by the values other than science-driven. In other words, religious, metaphysical explanations thrive flourishingly at the expense of the potentials of human agency and personal responsibilities. This is why Taiwo further argues that we need to pay close attention to history in understanding why modernity has not taken hold in Africa. After all, the real markers of modernity to include subjectivity, agency and progress were not part of the colonial agenda in Africa as was with modernity in its enlightenment project where it flourished.⁴⁴

My inclination is to argue that this ‘metaphysical outlook is itself not totally averse to the promotion of knowledge tradition’⁴⁵ but its denigration and christening pejoratively has compounded the tension between the people’s knowledge tradition and Western/modern

⁴² Interview with Steve Fuller on the side-line in London at the 2009 workshop in memory of Professor Mariano Artigas organised by the Thomas More Institute and the research group on science, reason and faith (CRYF) of the University of Navarra. Sourced from: <https://www.youtube.com/watch?v=uFw8jpV56dY> [Accessed on 21/08/2018]

⁴³ O. Taiwo, ‘African and her challenge to modernity’, a public lecture given at the Department of Language, Linguistics and Philosophy, Faculty of Humanities and Education, The University of West Indies, Jamaica, May 15, 2009, 15.

⁴⁴ Taiwo, *How colonialism preempted modernity in Africa* (Bloomington: Indiana University Press, 2010), 16.

⁴⁵ B. Hallen and K. Wiredu, *Science and African Culture*. Available online; http://www.princeton.edu/~hos/Workshop%20II%20papers/Hallen_Wiredu.doc.pdf. [Accessed 11 July 2015]; G. Holton, in the work, ‘The scientific imagination: case studies’, presents a number of examples to demonstrate the place and role of some form of intuitive thinking and values in sciences and among scientists/practitioners.

science tradition. For there is a difference between the superstitious and the metaphysical/religious. According to Majeed, the former is irrational while the latter cannot be exhaustively considered to be irrational because some aspects are rational.⁴⁶ It has not therefore encouraged wholesome and harmonious internally motivated grounds for the people to come to terms with their identity and experience of reality while attempting to imbibe the culture of science.⁴⁷ According to Lajul, “the explanation for the rejection of mythological answers to fundamental metaphysical questions stems from the Western mind-set that truth can only be acquired through criticality and rationality, that anything outside human reason is a liability. So, beliefs and emotions, among other things, cannot be relied upon in the deliverance of the true knowledge on which human society can be built”.⁴⁸ The challenges of appropriating the culture of modern science in Nigeria are therefore enormous within such cultural context. Perceptively, the tension between modern science as a model of explanation and reliable access to understanding reality

⁴⁶ H. M. Majeed, ‘Religion and the problem of rationality: insights from Akan religious thought’, *Thought and Practice* 6, 2 (2014), 1-22.

⁴⁷ K. S. Taber, B. Billingsley, F. Rigga and H. Newdick, ‘To what extent do pupils perceive science to be inconsistent with religious faith? An exploratory survey of 13-14 year old English pupils’, *Science Educational International*, 22, 2 (2011), 99-118. This study in the UK shows clearly the clash or tension this thesis indicates as fundamental to the problem of science in Nigeria. The paper reviews at several levels pupils’ perception on the nature of relation between religious beliefs and science and the impact of such on science learning and teaching. The paper found an overwhelming reason that show the tension between religious beliefs and scientific perspectives. The practical dimension of this research is re-echoed by Keith et al because there are ongoing concerns about the need to produce scientifically literate citizens for modern societies; and about attracting young people into science-based careers, engaging in this sort of research under focus shows therefore the practical relevance of this project. On the relevance of the metaphysical outlook or assumptions in the science situation in Africa, scholars have underlined the indispensability of their consideration of the presuppositions and import for science teaching and learning. See for instance, M. B. Ogunniyi’s two papers; ‘African Traditional Worldview and Modern Science’, *International Development and Research Centre (IDRC)*, 1984 and ‘Adapting Western Science to Traditional African Culture’, *Journal of Science Education*, 27, 7 (1986), 661-669. I. O. Abimbola, ‘African Worldview and School Science’, *Journal of the Science Teachers Association of Nigeria*, 16, 1 (1977), 15-28. These scholars and others have argued how assumptions as regards causality, nature of the world and human relationship with the world are likely to come up unlike in the Western setting where the basic assumptions of modern science are traditional.

⁴⁸ W. Lajul, African metaphysics: traditional and modern discussions, in I. E. Ukpokolo (Ed.), *Themes, issues and Problems in African Philosophy* (Springer, 2017), 23-24. Lajul introduces an interesting nuance on how we can conceptualise mythology that will sidestep the pejorative meaning it often connotes in the literatures. He distinguishes between mythology and beliefs in mental categories that do not correspond to reality. The former refers to belief in the existence of realities that may be perceivable yet to be verified mentally or experimentally, in ways that some scientific discoveries and inventions were mythological before they became verifiable. Hence, building a world system that acknowledges realities that are both verifiable and those that are not verifiable is not contrary to reason but rather can play supplementary role to reason.

necessitates among other issues, the need to re-examine the demarcation question of the nature of science and non-science/pseudo-science.

1. 2 Intellectual Responses to the Problem of Science in Africa (Nigeria)

The nature of the intellectual relationship Africa has had with the West epitomised in what is considered as satisfying the conditions of standards of rationality is fundamental to the problem of science in an African context. Moreover, this has been at the centre of interests that such a problem evokes among scholars. As a result, two schools of thought can be broadly deciphered, schools of thought I will broadly refer to as the colonialist-modernist account and the postcolonialist-relativist model. The thesis advances a new model thoroughly inspired by Popper, which the thesis refers to as the Popper-Dialogic model akin to the Aristotelian aphorism that virtue lies in the middle position. It serves as one that charts the middle course and one which answers the question of the problem of science in a way that is politically and epistemologically satisfactory than any of the identified account above. These two broad models serve as exemplars of the predilection that several intellectual interventions tend to justify. I will christen these rather broadly for the purpose of this present endeavour in ways that fairly capture the essence of the models of explanations or accounts to demonstrate the lacuna that my proposal in this thesis seeks to demonstrate and seal up. I will briefly highlight the basic feature of the two intellectual accounts since the focus is not to belabour the details but show sufficient grounds that the thesis argues for a new model as inspired by Popper.

1.2.1 The Modernist Colonialist Account

This particular account is popular and prevalent as many experts in the history of science, society, and empire have made immense contributions in this regard⁴⁹ but given that my immediate interest is not entirely historical safe when historical details underscore some philosophical issues relevant to my project, I will not spend too much time examining it. This account underpins works and positions that have concluded about the blind alley to which any insistence on the prospects of an African approach to science leads and so recommends some sorts of total rejection of all that is African. This is exemplified in Asouzu's piece on "science and African metaphysics",⁵⁰ in which the author argues that the adoption and prevalence of an African metaphysical worldview is solely responsible for the poor state of science in the continent. Therefore, the way out of the conundrum is to embrace all that is Western. In addition, Inokoba et al hold a similar view by their characterisation of the African worldview as metaphysical while the Western worldview is scientific.⁵¹ Such sweeping generalisation of Africa and the worldviews of the African was a key dimension of the intellectual motivation that influenced the entire colonial project on the African continent. Some scholars have reflected on this problem which seems to be a dilemma – how does one justify an exclusive introduction of Western-based scientific knowledge in a cultural context based on indigenous epistemology.⁵² Since no culture has a monopoly of knowledge production, the predominance of Western epistemological paradigm is therefore as a result of historical and contingent factors. For when Chilasa et al (2003, 4) state that it is through education that we are able to learn

⁴⁹ D. W. Chambers & R. Gillespie, 'Locality in the history of science, colonial science, technoscience, and indigenous knowledge', *Osiris* 2nd Series: Nature & Empire: Science and the colonial enterprise, vol. 65 (2000), 221-240.

⁵⁰ I. I. Asouzu, '*Science and African metaphysics: a search for direction*', presented at the 20th World Congress of Philosophy, Boston, (10-16 August, 1998), 1-2.

⁵¹ P. K. Inokoba et al, 'The African metaphysical worldview and its prostrate condition of backwardness', *Journal of Human Ecology*, 29, 1 (2010), 24-25.

⁵² See, A. Breidlid, 'Culture, indigenous knowledge systems and sustainable development: a critical view of education in an African context', *International Journal of Educational Development*, 29 (2009), 140-148.

about our cultural heritages and our values, and in fact the means through which these values are transmitted through generations, they have an educational process in mind which in fact is deeply rooted in the epistemological reality of the local people.⁵³ The results are quite evident in several ways that I will not belabour any further since one of the thesis' chapter is wholly dedicated to elaborating the way and manner an African appreciates, understands and explains his or her experience of the world.

1.2.2 The Post-Colonialist Relativist Response

It is important to note that in response to the colonial intellectual tradition that had huge impact on different segments of society across Africa, there were some sort of desperate efforts to present as alternative, anything other than that which can be traced to be of colonial or of Western heritage. In this regard, from politics to arts and other aspects of society, there were deliberate and concerted intellectual efforts to resuscitate African practices, values and epistemes that suffered the onslaught of an overwhelming colonial programme. Thus, there are works that underscore the viability and relevance of the African approach to science. This is descriptive of way in which they (Africans) make meaning and sense of the external world. Their mode of understanding and explanation⁵⁴ of how nature operates, to the degree that 'anything goes' mantra becomes the operational principle. In other words, the cultural attitudes and practices of the people considered functional, no matter how limited, are rated to be of the same equal epistemic value and status with other models of scientific practice. Inherent in this kind of project is the charge of relativism that this thesis is particularly careful to avoid. For instance, Ojong uses the Feyerabendian model as a basis to project the cultural context of African orthopaedic practice as an example of this kind of intellectual response to the colonial heritage which

⁵³ Chilasa et al, cited in Breidlid, *Culture, indigenous knowledge systems and sustainable development*, 142.

⁵⁴ L. O. Ugwuanyi, 'Critiquing Sub-Saharan Pan Africanism through an appraisal of postcolonial African modernity', *Theoria: A Journal of Social and Political Theory* 64 (2017), 58-84.

we cannot but deal with in the discourse of medical science in Africa.⁵⁵ No doubt, as laudable as the irredentist effort of Ojong and others may be, it is important we keep in mind and sight some important matters. For instance, while one acknowledges and notes that pride in projecting African epistemes, traditions, values, and identity are worth pursuing, this thesis is of the view that any reactionary response to the problem will have to be realistic because of the danger of falling foul of epistemic injustice one accuses the Western model of rationality or science of being guilty of. Again, there has been constant reminder of the tendencies to overestimate the values we can recover from our heritages and so be wary of excessive romanticising of the past or what the potentials of our present values and heritages. After all, the present epistemic situation demands we begin to take seriously our contemporary state of affairs Coetzee describes as one where neither the Africa nor the Europe can forget about the other, the challenge is therefore to make the best of the dialogue that has been thrust upon them.⁵⁶

Thus, a very broad reading of the aforementioned two trends show how very problematic such projects might be. Particularly, the Popper-Dialogic model is able to vitiate the battleground where the postmodernist and modernist intellectual exchanges have continued to dissipate energies while the problem remains unresolved. This thesis is able to transcend this as a much more viable model with mutual appeal on both sides of the divide; that is, Western modern science and an African approach to science which will ultimately enrich an eclectic and a global image of science I envisage that Popper's proviso will be able to negotiate.

1.3 Karl Popper and The Decolonial-Dialogic Account: Rationale, Relevance and Contribution

⁵⁵ Ojong, *A philosophy of science for Africa*, 13.

⁵⁶ Coetzee, *A note on Eze*.

I explore Karl Popper's philosophy to interrogate the knowledge traditions in view of facilitating dialogue between them and estimate that this is germane for the advancement of science in Nigeria. Thus, Popper's philosophy plays a double-edged role 1). It serves as a critique of the Western approach to science, to predispose it for openness to dialogue and make it accommodative and 2). It serves to refurbish the battered image of epistemic claims of the African approach to science which seems considered largely esoteric; that is, it is one not so open, with a view to retooling it for dialogue. Recall, the Polanyian distinction between explicit knowledge – easily conceptualised into propositions which is reminiscent of justified true belief of Plato's epistemology on the one hand and a form of knowledge less susceptible to being formalised into propositions, that is, tacit knowledge.⁵⁷ For example, from the linguistic level of formulating these claims into open and simple linguistic forms, to the disposition to expose these claims to the severest of critical tests, Popper's proviso is contextually relevant. Again, it serves to provide the philosophical connection with the socio-political concerns for the science challenge. I defend this view because of the strong connection there is between Popper's philosophy of science and his political philosophy. In other words, the link between Popper's epistemology and politics touches on an important aspect of the question of science in African context and taking both sides in one together hopefully makes the thesis's task more comprehensive and total.

To briefly demonstrate the possibility of the kind of dialogue Popper's philosophy is able to negotiate between these two apparently different approaches, I will draw on an example given by Popper to show some transformation that can occur in a dialogical encounter between two apparently different traditions of knowledge or belief systems held dearly

⁵⁷ Arnal, *Rationality, normativity and practices: towards a more inclusive concept of reason*; A. Bala & G. G. Joseph, 'Indigenous knowledge and Western science: the possibility of dialogue', *Race and Class* 49, 1 (2007), 39-61.

across societies, cultures and peoples. The story is originally adapted from Herodotus'

History. It goes thus;

Darius the First, king of Persia wanted to teach the Greeks who lived in his territory some lessons. It was the custom of the Greeks to burn their dead. The Greeks were all summoned and Darius asked; what payment they would consent to eat up their fathers when they die. They answered; nothing on earth would induce them to do so. Then Darius summoned the Callatians, who do eat their fathers, and he asked them in the presence of the Greeks, who had the help of an interpreter, for what payment they would consent to burn the bodies of their fathers when they died. And they cried out aloud and implored him not to mention such an abomination.⁵⁸

The details of the story may be disgusting and gruesome but the message the story seeks to present is what is more important and intended to highlight for the purpose of this thesis. The reactions and responses the story elicits from the participants who witnessed the event can be various. While not exhaustive, it was fundamentally a meeting of two very contrasting frameworks within which different people operated. There was a form of dialogue and exchange. The experience will have occasioned deep reflection on the minds of some participants. The lesson Popper draws from the story told by Herodotus is that every civilisation is a product of clash of cultures (meeting of different frameworks). In fact, Western civilisation eulogistically categorised as a rationalist civilisation owes so much to the Greco-Roman civilisation and the very long history of culture clash that accompanied it.⁵⁹ With this claim taken for granted, what is more as regards the state of science in Nigeria and what the encounter promises for science broadly in a global context when the approach advanced in this thesis is embraced.

The end goal in view is a picture of science that can be likened to a proverbial 'common pot' where different approaches have something to contribute. This vision of science is consistent with the dialogical tradition of science that is much more comprehensive to the history of modern science and the hopes it bears for the future of science cannot be over

⁵⁸ K. R. Popper, *The myth of the framework: in defence of science and rationality*. Edited by M. A. Notturmo (London: Routledge, 1994), 36-37.

⁵⁹ Popper, *The myth of the framework*, 38-39.

emphasised. For this planetary/pluriversal picture of science to work, no epistemic approach or knowledge tradition should be undermined, excluded or stifled, the percentage of their contributions notwithstanding.⁶⁰ In other words, I have not set out to argue for epistemic equality in terms of the value but that each tradition deserves the benefit of a doubt and opportunity to make its contribution from its substantial depth. The entire humanity will be more enriched as different approaches engage in dialogue and partner to better understand and interpret nature/reality and live much more humanely. Overall, it is a reiteration of the call to revisit the nature of the philosophical attitude towards non-Western knowledge claims and traditions. The attitude seems generally to be one of excessive doubt. Quite a number of people have and continue to insist that there are manifest structures of power in the West's scientific community that persist; besides there is still the problem of perceived cultural and theoretical supremacy in many domains.

By this thinking, the thesis will preserve the vision of science as a common heritage of entire humanity. A picture of a global and eclectic image of science that is not only attentive, but also sensitive or responsive to the various traditions of epistemologies of different people in partnership and cooperation to make life fulfilling for all, expanding the horizon of knowledge (to be more responsive) while preserving the universe for the good of all. On this note, A. Bala states:

it is important to note that it is not the ideal of a universal science that is at the root of the problem, but the misdirected assumption that modern science is universal. Indeed the universal ideal of science can coexist with the notion that many local traditions of science have contributed and can in future contribute to universal science. Universal science would then develop through a dialogue between many local traditions of science, each helping to define the scope and limits of others. However, if modern (Western) science is treated as universal *per se*, then it becomes impossible to take critical perspectives on it from the context

⁶⁰ While examining the legal technicalities of patents and patency rights against the backdrop of the global context of the appropriation of plant genetic diversity from the South to the North as entrenched within a social structure of inbuilt biases against non-Western cultures, Mgbeoji underscores some of the epistemological issues that underpin the debate. See more, I. Mgbeoji, *Global biopiracy: patents, plants and indigenous knowledge* (Ithaca, New York: Cornell University Press, 2006).

of other traditions of knowledge, and it only leaves scope to one-sided critical perspectives of other traditions from the vantage point of modern (Western) science.⁶¹

This remains one of the major challenges posed to African philosophical tradition from the perspective of analytic philosophy because of its pretensions to outline or define the limits or horizon of humanity and rationality as a decontextualized enterprise. This is very problematic in the views of Coetzee and Eze and rightly so because amongst other things it tends to deny its history.⁶²

To come to terms with this sort of vision requires standard personal ethics that Sceski outlines to include humility, open mindedness, honesty, and courage. These are not a pre-critical basis for criticism, as Popper seem to imply but instead are the logical consequence of identifying rationality with criticism.⁶³

1.3.1 Popper and the Possibilities of Reconstructing/Redefining Rationality, Science and Objectivity

Popper's contribution to philosophy of science is significant for this thesis in a number of ways. Firstly, the manner in which Popper understands science to progress has very illuminating lesson even in our time.⁶⁴ The idea that theories are refuted or falsified rather than verified or confirmed conceives the notion of falsification to be synonymous with criticism or better still critical rationalism. When criticism becomes the hallmark of the human activities either as carried out by the scientists in their unending quests to seek out the possible refutation of their hypothesis or claims, or when others adopt this critical strategy in other spheres of their lives, the benefits cannot be over emphasised.

⁶¹ A. Bala, *The dialogue of civilizations in the birth of modern science*, (New York: Palgrave Macmillan, 2006), 191.

⁶² Coetzee, *A note on Eze*.

⁶³ J. H. Sceski, *Popper, objective knowledge and the growth of knowledge* (London: Continuum International Publishing Group, 2007), 16. These epistemic virtues are important highpoints of Popper's epistemology and interestingly many commentators on Popper do not often highlight them.

⁶⁴ See, J. S. Chitpin & S. Chitpin, 'Questioning clerkship: applying Popper's evolutionary analysis of learning to medical student training', *International Journal of Educational Management* 31, 3 (2017), 332-342.

Secondly, Popper's concern about the provisionality and limitedness of scientific knowledge echoes the need for the redefinition of scientific knowledge/theories and associated epistemic attitude of Western science. In other words, the fallibilism in Popper calls to question the kind of claims that Western science makes as well as the epistemic attitude of hubris that very often but subtly underpins this very successful model of knowledge. When one realises how limited and error prone one's ideas could be; it can go a long way to broaden how the claims of knowledge of reality of other traditions or knowledge systems should be approached and appreciated. More so, Popper's idea of critical rationalism that characterises his idea of falsifiability/testability/refutability of any scientific theory and how it is to be formed is capable of opening up the space for the kind of philosophy of dialogue I advance in this thesis to take place. Popper's epistemological proviso that all epistemic claims are to be perpetually ready and open to the severest of tests aimed at refutability/falsifiability is not only enlightening but critical to the predisposition of Western modern science in a non-Western context with its knowledge tradition where it is expected to take root and advance. For any theory or scientific knowledge yet to be refuted does not confer irrefutability and thus cannot claim certainty of absolute qualifications. In fact, it is to be noted that this sort of view guarantees that one is safe from the temptation of a closed mindedness that claims of certainty very often warrant.

Furthermore, Popper's radical reconstruction of the major epistemological question is capable of revising our approach towards the empiricist and rationalist traditions of knowledge. The wrong question focused on unravelling what the credible sources of knowledge are have been the focus of the proponents and champions of both rationalism and empiricism over the years, a task that has been misdirected for far too long, in fact, for centuries. The various sources of knowledge so represented by the fine details of both traditions operate within the context of an authoritative inductive epistemology upon

which what passes for science is demarcated from what does not pass for science otherwise, referred to as non-science/ pseudoscience. Therefore, the picture of science arising from such an epistemological frame is thoroughly positivistic, observation-inclined and experiment dependent only (the inductivistic logic that relies on past experiences to justify the present). This logic or epistemic outlook is totally different from Einsteinian approach of looking to the future to make predictions about the state of affairs. On this score, science is demarcated as empirical whereas what does not pass the test of empiricism or not understandable and unexplainable in empirical terms is termed metaphysical, magical, non-science or pseudo-science. And we cannot ignore how overwhelming this has become in operation and practice of science education in many contexts. According to Arinowitz, “Western modern science fundamentally understands science to two procedures: mathematical calculation and experimental validation of results... neither philosophy nor religion fulfils either of these criteria. Modern science demarcates itself, not by reconstituting the object, but by defining rationality in a specific way”.⁶⁵ To further buttress this point, Sceski forcefully argues,

the great mistake characteristic of Western philosophy is the tendency to conflate truth with justification, since the received view is that a theory can only be cognised as true when it is has shown itself to be true, that is, it is justified by having satisfied a criterion of truth identified in light of how we acquire evidence for the theory at issue. Thus empiricists seek an empirical criterion, and rationalists demand an apriori criterion for truth. This practice of correlating the manner truth is discovered with a criterion of truth is motivated by a fear of error that has consequence of thinkers seeking to justify their theories by means of some of unwavering foundation.⁶⁶

This has been the overwhelming definition of the ‘metaphysics’ and epistemology of science that has dominated the debate whether or not there can be ‘other’ approaches (an African approach to knowledge of nature/reality in this instance) as it relates to broad

⁶⁵ S. Aronowitz, *Science as power: discourse and ideology in modern society* (Minnesota: University of Minnesota Press, 1988), 8.

⁶⁶ Sceski, *Popper, objectivity and the growth of knowledge*, 7.

issues of science. This is partly because to relinquish some of its pretensions to universality seems not to be an easy one to grapple with.

However, with the radical reformulation of the epistemological question following Popper, the table can be turned in a way that we can take seriously the distinction Popper makes between the ‘context of discovery’ and the ‘context of justification’, and the radical way by which Popper is sharply contrasted with those whose main aim is to eliminate metaphysics (and of course philosophy). Here too, Popper’s commitment to philosophy parts ways with sociological commitment in science studies reflected in Kitcher, Fuller and others of the sociological programme on knowledge. Of all matters, Popper’s notion of tentativeness does not deny the fact of objective truth or reduce it to the context of historical and social factors as is the case with the many proponents of this school of thought. Restoring and giving space to metaphysics is not only realistic project to support, it is instructive on the epistemic potentials there could be in addition to the gains it offers Western modern approach to science over time.

1.3.2 The Science Question as both Political and Epistemological⁶⁷

Studies in science studies and in other related areas are beginning to pay greater attention to the larger picture of the issues that the problem of science advancement in society generates. More than anything else, interest in science and related disciplines have continued to attract discussions at different levels in the society globally. For example, Harding acknowledges that in fact, the political and the cognitive constitutes the focal concern of two basic analytical responses to Western science and their technologies on

⁶⁷ The ‘Rhodes Must fall’, ‘Science Must Fall’, examples that happened in South Africa and has generally influenced calls to revisit curriculum in many contexts and the in fact the hated contestation that followed is a marker to this fact. Roy goes ahead to challenge all that care and caution must be exercised so we do not throw away the baby along with the dirty water. See more, R. D. Roy, ‘Decolonise science – time to end another imperial era’, *The Conversation UK*, April 5, 2018. In concluding the piece, Roy states that decolonisation promises to make science more appealing by integrating its findings more firmly with questions of justice, ethics and democracy. Perhaps, in the coming century, success with the microscope will depend on success in tackling the lingering effects of imperialism.

the Third world societies.⁶⁸ Hence, matters of objectivity, fair representation, epistemic justice and other interesting topics continue to reflect on how we appreciate science and expand our knowledge of the world around us.

It is therefore increasingly becoming obvious that far from being a neutral concept, there are interesting dimensions of science and the kind of knowledge it embodies reflects and represents. There has been a growing engagement of the public with matters related to science. Some of these aspects are manifest in the various commitments of the various schools of thought we can identify in science and technology studies; from colonial or postcolonial, feminists, sociological or cultural experts in school science, to science education leanings interested in showing and emphasising the interconnectedness and interrelationships there are among the epistemological, political as well as other aspects of science. It is against this backdrop that questions such as, ‘whose science?’, ‘who sets and determines the science curriculum?’, among others become relevant and illustrative of the many issues that the question of science in society is capable of evoking especially when it is assessed in the context of non-Western societies. At the centre of such interests therefore are questions of competing beliefs and worldviews that science embodies and seeks to overthrow and replace. A concrete and popular example is the tension between creationism and evolutionism in a number of societies around the world. In some ways, the questions raised above may be political in nature but fundamentally, they are also epistemological in the sense that question of patents and related issues associated with it, for instance, that are beginning to prop up as a result of the activities of pharmaceutical firms in different parts of the world in the search for solutions to some ailments, not only have the privilege of power to determine who defines what is knowledge and what should

⁶⁸ S. Harding, ‘After Eurocentrism: challenges for the philosophy of science’, Proceedings of the Biennial Meeting of the Philosophy of Science Association: Symposia and Invited Papers 2 (1992), 311.

be taught but also who is capable of knowing and detailing the contents of epistemology which are important as well.

1.3.3 Popper's Epistemic Formulae as a Panacea for Resolving Epistemic Tension

While giving an account of the epistemological setting witnessed as a result of the changes in Africa, Jimoh argues that there is an epistemological crisis in Africa. This according to him is as a result of the opening up of the African traditional thought to a wider world of learning and the movement of new methods of learning from one cultural area to the other. This came with two profound phenomena; psychological violence and literary revolution.⁶⁹ The typical way experts in the field of science education characterise this challenge is border crossing experience (collateral learning and prevalence of cognitive dissonance) by students in a science learning environment in non-Western societies.⁷⁰ This is particularly problematic for science education in Africa. Popper's philosophy serves as worthy criticism of the epistemology of the enlightenment of which Western science is the natural heir can help us navigate this challenge especially when we take seriously some of the principles earlier identified. In some way then, Popper's philosophy serves to deflate the excessive epistemic hubris of Western science that is necessary to make for the possibility of engaging in conversation/dialogue with an indigenous knowledge system, a constitutive part of the people in Nigeria and elsewhere. For as Laccarino argues, "science is part of culture, and how science is done largely depends on the culture in which it is practiced".⁷¹

The disposition and self-image of Western science within the African context can therefore be said to have played an important role in its slow advancement as it has rather

⁶⁹ Jimoh, *An African theory of knowledge*, 128.

⁷⁰ G. Aikenhead, 'Science education: border crossing into the subculture of science', *Studies in Science Education* 27 (1996), 1-52.

⁷¹ M. Laccarino, 'Science and culture', *Embo Report: Science and Society*, 4, 3 (2003), 220-223, 220.

created a tension and conflict between these traditions of knowledge; that is, between the Western approach to science and an African tradition of knowledge. As a result, efforts and interventions to promote science and its culture have not yielded very positive results in terms any significant advancement. Further interventions stand the danger of not yielding much if this posture of Western approach to science and its pedagogy is not revisited. In fact, the extent to which it has denigrated the possibilities of the epistemic potentials of the African epistemic heritage determines the level of the tension there is within the cultural context it is expected to advance and develop. In other words, the manner in which it operates has led to counter-productive ends. It is more of a monologue as this epistemology of Western science has rather been dismissive, exclusionary, and dominating of course operated with predatory tendencies.⁷² This implies that lack of openness to any form of interaction premised on dialogue and possible benefits which the other approaches are capable of offering is important to the issue at hand. What can be more illustrative of this than Popper's honing of an epistemic virtue that demands openness in the acknowledgement of the possibility of error and possibility of listening and learning from the 'other' when he eloquently states, "I might be wrong, you might be right but with effort, we can get nearer the truth".⁷³ That is, to always remain open to the possibility of or idea that one's beliefs could be wrong is a sure guide towards advancing closer to the truth.

⁷² S. Goonatilake, Scientific expansion (And contraction) *Review (Ferdinand Braudel Centre)* 5, 3 (1982), 413-436. A thoroughly argued philosophical mapping of the practice and trends that characterise the efforts for the production of knowledge within the context of the reified categories of opposites of the global structure of dominance and subalternity. The quality of knowledge production in the global south remains largely non-creative and imitative while it relies on the knowledge clearing structures of the Global North for legitimisation.

⁷³ K. R. Popper, *The open society and its enemies*, Vol. II (London: Routledge, 1945), 249. Except of course, the disposition of modern science adopts the dogmatic stance and close up while insisting on the absence of learning anything from a different tradition of knowledge. This dogmatist position is often read into the notion of normal science of Kuhn. See for example, R. Bailey, 'Science, natural science and science education: Thomas Kuhn and education', *Learning for Democracy*, 2, 2 (2006), 7-20. However, it remains controversial as some will vehemently oppose such interpretation as not truly reflective of Kuhn's *The Structure of Scientific Revolution*.

An aspect of the kind of epistemic attitude on the part of Western science in question is that, it goes beyond the epistemological level to also affect the identity of the people. This is because the epistemology so used here is a critical aspect of the cultural identity of the people in question. It also includes the people's ability to have any conceptualisation of reality/nature. Therefore, the dismissive disposition of the Western approach to science creates a sense of inferiority complex for Africans as regards the African cultural experience, heritages, and the understanding of reality. Such aggravates the tension situation that militates against the advancement of science as the needed commitment cannot be elicited by this sort of relationship. At any rate the best we get will be reactionary and which is unhelpful to the culture of science. This thesis insists that there is valid epistemology that is indigenous to the society and cannot be continuously abused, denigrated as it is the case in Nigeria embodied by the epistemic disposition of the Western modern science. The over bearing negative aspects of this indigenous epistemology notwithstanding are exploited by some experts and practitioners to serve some negative ends. In defence of the foregoing, Makinde writes,

in every society there exists a strong desire to know about causes and effects and, more especially, about the future. If in any society as different from Western societies there exist a method of knowing or means by which causes are discovered and reliable predictions are made, we shall call it a science irrespective of whether or not such a science is open to empirical investigation. Because of the limited nature of human knowledge, we have no reason to dismiss one kind of knowledge just because it is not open to empirical investigation. Such a dismissal will amount to an empiricist dogma, pure and simple. Sensory experience is not and cannot be the only measure of all things and all knowledge.⁷⁴

However, it must be asserted that several aspects of the activities to which Makinde refers are formulated in linguistic schemes not open to understanding or translation into common language and thus contested as esoteric but others challenge its contestation as such as mere means of storage/preservation. The debate about the esoteric nature of these

⁷⁴ M. A. Makinde, 'African philosophy and African science', M. A Makinde (ed.), *African Philosophy: The Demise of Controversy* (Ife: Obafemi Awolowo University Press, 2007), 441-448.

epistemic heritages rages on; I am sympathetic to think it is largely that way because of its constitutive nature. Perhaps, Popper's ideas on openness, use of simple language in the formulation of scientific theories and the role of critical rationalism to be consistently practised may further the space within which these epistemic heritages can be interrogated in view of greater appreciation of what they can offer.

Popper basically defined epistemology as the theory of scientific knowledge. Accordingly, scientific theories are always tentative and hypothetical. The relation of Western science with this sort of ideas with respect to epistemic values of certainty, rationality, and truth along with the accompanying epistemic attitude thereof are central in Popper's thoughts. These are some of the philosophical reflections with huge implications for the dialogic model to be engaged in this thesis. While Popper insists science pursues truth, it may not possess it, it however pursues it and gets nearer the reality of truth through consistent elimination of error, and so, the path of improvement is always sure and certain.

1. 4 Background to Science (Modern Western Science) and the problem of Values

The term science evokes various meanings. It ranges from a special and credible model of knowledge to a form of knowledge which has a rational/certain foundation, possesses truth, it is relevant, and universal. Thus, science presupposes certain values. The values are of various kinds. While some are epistemological, some are ontological (metaphysical), others are of the methodological kind. So, when one makes reference to the idea of science or justify a claim to be scientific, these principles/values are implied in one form or the other. In most cases, a dominant naturalistic epistemology is implied. It is these principles and the ideological implications of these principles that are of interest to philosophy of science. In other words, philosophy of science is interested in evaluating

and assessing the philosophical presuppositions/assumptions and associated epistemic attitudes that underpin the activities of scientists and experts while carrying out experiments (the gathering of data and evidence to underscore causality and the laws of nature) or developing theories or models (to test hypothesis or to prove their epistemic worth in respect of reality/nature - to explain, understand, and predict or control nature). Given the enormous successes recorded by these efforts, we are not unaware of the attempts to apply the mathematical tools to explain and describe social reality or the approximation of the natural sciences by the social sciences in exclusive manner sometimes. Thus, Elshakry argues, "... the scientific revolution sealed off the West from the rest and helped to set the agenda for how the discipline itself would subsequently view the world, as a new emphasis on a universal and unilineal history of science merged with post-war modernisation theories. This way, emphasis shifted in favour of technical knowledge against natural philosophical knowledge".⁷⁵ This seems to account for why some forms of knowledge of matter more than others.

Since science embody certain values, different disciplines now focus and study the values associated with the rise and practice of science. In this regard, many who may themselves not be scientists or engaged in the practice of science are interested in examining the culture of science within society. Sometimes, this effort and attempt has met with very stiff opposition and has led to credibility crisis not only for philosophy but many other disciplines interested in the study of science in society. However, the relevance of such studies to the discipline of science and to scientists has remained a contentious theme. For instance, this is well captured in the remarks of one the greatest physicists of the last

⁷⁵ M. Elshakry, 'When science became Western: hagiographical reflections', *Isis* 101, 1 (2010), 108.

20th century, R. Feynman that “the philosophy of science is as useful to scientists as ornithology is to birds”.⁷⁶

The best exemplar of science, the gate keeper of knowledge is the Western modern science, which, claims to corresponds much more closely to the underlying realities of the universe than those of any society, past or present⁷⁷ is used here advisedly because I seek to tease out in this thesis the fundamental character of science and draw their implications for the task of developing an appropriate model of approach to science I consider to be crucial and critical for the problem under review. In this regard, it is important to point out the fact that the formalisation of what constitutes science, scientific problem or scientific solution is to follow laid down rules and procedures regarded as methods. These are encoded within professional and public understanding of science, such as the peer review processes of publishing houses and institutions (scientific community), or generally descriptive of what S. Fuller, the American Warrick sociologist-philosopher who began the research programme in social epistemology calls as the “governance of science”.⁷⁸ So, the received texts and contents of school science reflect these standards too.

In response to this development, there have been a growing intellectual debate between two prominent traditions of scholarship; one, the Global North representative of the structural and institutional programmes that embody the dominant and hegemonic form of what is regarded as conventional model of ratiocination, science, and knowledge systems⁷⁹; second, the Global South reflects intellection and traditions of knowledge production from the periphery and the disadvantaged or subaltern positions. These

⁷⁶ See, B. Trubody, ‘Richard Feynman’s philosophy of science’, *Philosophy Now: A magazine of ideas*, 114 (July 2016).

⁷⁷ Elshakry, *When science became Western*, 99.

⁷⁸ S. Fuller, *The governance of science: ideology and the future of the open society* (Buckingham: Open University Press, 2000).

⁷⁹ G. J. Somsen, ‘A history of universalism: conceptions of the internationality of science from the Enlightenment to the Cold War’, *Minerva* 46 (2008), 361-379.

debates have been at the heart of literary exchanges and engagements in science and technology studies, and postcolonial studies of science (the South Asian scholarship), intersectionality debates, feminists philosophy of science and of course, other areas of studies.⁸⁰ My contribution to the literature is a reading of Popper that belongs to both traditions yet in a unique way because I employ Popper's philosophy as a two-edge sword in the critique of both traditions in view of overcoming the limitations in both.

1.4.1 Colonialism and science

It is almost impossible to talk about the colonial programme without science. In other words, the notion of the modern world as projected by the enlightenment had with it the expansionist programme of which colonialism was an important phase. In fact, as Mignolo insists, modernity and coloniality are two sides of the same coin.⁸¹ It must however be quickly added that there is a difference between colonialism and what the decolonial scholars refer to as decoloniality. While the former broadly refers to a phase that seems to have come evident by the visible absence of political or juridical administrative structures in erstwhile colonies, the latter persists in the underlying structures of global designs and arrangements.⁸² That science is constitutively part of the colonialism that happened in much of Africa is in no doubt. After all, science is considered as one the highest intellectual achievements of the enlightenment.⁸³

Though I will not focus on the nature of scientific knowledge as natural philosophy in the pre-enlightenment era and associated intellectual contributions and debates, it is also important to note too that my major focus in this section is to show why the philosophical intervention of Popper deployed herein to argue for a framework for an appropriate

⁸⁰ See, S. Harding, *Objectivity and diversity: another logic of scientific research* (Chicago: University of Chicago Press, 2015).

⁸¹ W. D. Mignolo, *The darker side of Western modernity: global futures, decolonial options* (Durham: Duke University Press, 2011).

⁸² For these scholars, while formal colonialism has largely ended, the enduring structures of hierarchical power in various forms that persists afterwards even in contemporary times define coloniality.

⁸³ P. Palladino & M. Worboys, 'Science and imperialism', *Isis* 84, 1 (1993), 91- 103 (92).

philosophy or an approach to science makes sense within the literature generated on the matter. More than that it also demonstrates that there is need to revisit issues (for example, the ideological foundation of colonialism and science; that is, the claim and assumption that the innate capacity of Europeans made all the difference)⁸⁴ which very often are glossed over in Western philosophical thought as problematic for philosophy as well as other efforts to advance science in the African (Nigerian) context. In other words, these issues in my estimation are very critical and must be given the attention they deserve within philosophy and other disciplines involved with science and technology studies. One of the many unique ways of doing this is what this thesis hopes to achieve by a reassessment of the philosophy of Karl Popper and a demonstration of the significance of Popper's philosophy both in its discontinuity in the history of philosophy and its continuity with the decolonial task of philosophy as championed by the African philosophers as well as decolonial thinkers.

For example, the contributions of Bacon and Descartes set the tone for the epistemology, methodology and ontology of science of the Western world. As Tarnas argues, in their respective manifestoes of empiricism and rationalism, the long-growing significance of the natural world and the human reason, initiated by the Greeks and recovered by the scholastics, achieved a definitive modern expression. Upon this dual foundation, philosophy proceeded and science triumphed: it was not accidental to Newton's accomplishment that he had systematically employed a practical synthesis of Bacon's inductive empiricism and Descartes' deductive mathematical rationalism, thereby bringing to fruition the scientific method first forged by Galileo.⁸⁵

⁸⁴ M. Adas, 'Contested hegemony: the Great War and the Afro-Asian assault on the civilising mission ideology', *Journal of World History* 15, 1 (2004), 39-40.

⁸⁵ Tarnas, *The passion of the Western mind*, 280.

For as Badin argues, following “Galileo’s mechanics, early modern mechanical philosophy provided the metaphysical framework in which ‘matter in motion’ underwent a process of reduction to mathematical descriptions and to physical explanations”.⁸⁶ Consequently, the deployment of the instrumentalist/utilitarian view of truth which underlies Bacon’s dictum, “knowledge is power” as fundamental frame of interpretation and appreciation of every other it encounters. As was evidently manifest in how the various cultural values and heritages it encountered in other societies were categorised based on the assumed universal standards as seen and defined by it in an exclusive fashion. Once modern science emerged and the universal salvific mission of the Catholic Church waned, science and Western civilisation became the ideal and standard by which all others were to be converted as it has successfully traversed the historical development in a fashion that the global order depended on its values and its claim to be able to assure humanity’s fulfilment.⁸⁷

In fact, Harding asserts that “the primitive other was produced along with the advanced, civilised, rational ‘self’ of European culture; Western anthropology, philosophy and science joined hands in this project”.⁸⁸ On Tilley’s part, experts in anthropology played very significant role in the colonial programme. In the bid to use the African setting to professionalise inadvertently led to the illumination of Eurocentric and contradictory assumptions contained within colonialism. By this they helped to bring to the forefront questions of African’s agency, autonomy, and knowledge. The epistemological legacies

⁸⁶ A. Badin, ‘The monstrosity of Matter in Motion’: Galileo, Descartes, and Hobbes’s Political Epistemology’, *Philosophy Today* 60, 1 (2016).

⁸⁷ Tarnas, *The passion of the Western mind*, 321; Also, S. Fuller, adds that the emergence of positivism and sociology from Comte was predicated on the growing secularisation of Europe as the universal authority of the Catholic Church was to be replaced. The authority was to be found in the unification of the sciences, the final product of which would be an overarching science-sociology- that would draw on the resources of other sciences to administer to society’s needs. See, *Kuhn vs Popper: The struggle for the soul of science*, 23. In some sense, the whole mission in Africa of the three C’s of ‘civilise’, ‘Christianise’ and ‘colonise’ by the emerging global power found its proper intellectual context.

⁸⁸ S. Harding, ‘After Eurocentrism: challenges for the philosophy of science’, *Proceedings of the Philosophy of Science Association, Symposium and Invited Papers*, 2 (1992), 312.

were not always benign, but the many states in the African continent even after attaining political independence have been forced to confront these issues as living ones.⁸⁹

The growing relevance of instrumental empiricism was taken up in a chapter titled, *Francis Bacon: First Philosopher of Science: A non-Western view* to show how prevalent this disposition of Western approach to science dominates the operations and identity of science. The paper outlines and evaluates Bacon, Kuhn, Husserl and Needham and concluded that in spite of the liberal views of these thinkers of diverse philosophical orientation retained the Baconian view of science that practically demonstrates the instrumentalist and materialist orientation of science. Thus, the seed sown in Bacon's epistemology of the scientific method was considered pivotal and able to access absolute truth; on the basis of this, dominate other traditions of knowledge. Quite unsurprisingly, the exploitative and capitalist exploitation of science looks at nature and the other in the light of functionality and from a utilitarian end dimension.⁹⁰ In other words, Bacon's cliché 'knowledge is power' is given an unprecedented support. Nandy notes how helpless the world and people are with respect to this identity of science upon the assessment of Heidegger popular critique of technology but who insisted that nothing can be done about it as the worldview is not to be challenged apart from an awareness of the inherent dangers such a view portend.⁹¹ According to Tarnas, Bacon's measure of the validity of knowledge as the derivable practical usefulness of knowledge provided the normative grounds for the utilitarian, material salvation of humanity which modern science was characterised.⁹²

⁸⁹ H. Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (Chicago: The University of Chicago Press, 2011), 30.

⁹⁰ A. Nandy, 'Francis Bacon: first philosopher of science: a non-Western view', A. Nandy, (ed.), *Science, hegemony and violence: a requiem for modernity*. (Oxford: Oxford University Press, 1988), 24-67.

⁹¹ Nandy, *Francis Bacon: first philosopher of science: a non-Western view*, 51.

⁹² Tarnas, *The passion of the Western mind*, 273.

With such background, advocates of the successful feats of modern science declare *ex cathedra* the epistemic status of other disciplines in the humanities; philosophy has always been vilified on such account.⁹³ Failing to pay attention to some obvious challenges developments in modern physics pose for instance, the zealots of modern science propagate an image of science able to do all things. This image of science is manifest in the science curriculum and science education in many ways. In fact, many experts in science education allude to this positivistic or reductionist image of science as the dominating model of science popularised. Thus, the quantitative experimental science lays exclusive claims as inherently possessing rationality and objectivity.⁹⁴

However, this self-image is constrained by new developments in physics. But before this time, the philosophical thoughts of Hume and Kant were already pointers to the dead-end to which any exaggerated view of modern science *vis-a-vis* the human person was headed. The larger philosophical context of the views held by Hume and Kant was to prepare the ground for Popper's epistemological intervention. In brief, Hume had pushed the empiricist tradition on a trajectory that doomed Newtonian physics and of course, the metaphysics of the external world or the reality of God manifest in the Cartesian system. This is because of the consequences of the habitual/psychological disposition of the human mind to always associate relations between events and causes as defining for causality or causal principle, a prominent feature of scientific ontology. Upon establishing the implausibility of any necessary connection between cause and effect, causality as a principle and induction important to sustain the Newtonian physics for instance, had immense consequences. Hence, the validity of any knowledge accruable from such

⁹³ Critique of S. Hawking et al by S. Overgaard, P. Gilbert and S. Burwood, *An Introduction to Metaphilosophy*, 45.

⁹⁴ R. A. Duschl, 'Science education and the philosophy of science: twenty five years of mutually exclusive development', *School Science and Mathematics*, 85, 7 (1985), 541-555.

science was threatened. No wonder then Putman will insist that “at every moment science does rely on what is not fully scientific”.⁹⁵

From the quantum perspective, things exist because they are perceived.⁹⁶ Ajei thus concludes;

the impact of the new scientific worldview on physicalism’s denial of truth of other systems of knowledge production is clear: modern science cannot legitimately maintain its position on this issue, for the best that its epistemological paradigm can reveal are some truths, but not all the truths, about nature. Hence it is prudent for the physicalist to pay regard to plausible propositions of truth about nature and society from other knowledge traditions.⁹⁷

Tarnas is more audacious in his view that the human person does come into contact with the external world with presuppositions. And these do play an active role in the various hypothesis or conjectures made in science in relation to the world. These must be consistently and perpetually open to being falsified in the sense that its status is as more than an imperfectly corroborated conjecture. This feature of being open to severest test and attempt at refutation defines the rationality of science. In other words, the realisation of possibility of being falsified shows the tentative nature of scientific claims.⁹⁸ Popper’s intervention suggests that through luck, hard work and many mistakes, the human mind is able to access knowledge as strangers by the correction of such. With the penchant to deploy theories, myths, stories and persistent readiness to test. The fact of lucky guess guarantees how theory works and saves the phenomena. If the human mind lacks access

⁹⁵ H. Putman, ‘Naturalism, realism, and normativity’, *Journal of American Philosophical Association*, 1, 2 (2015), 312-328.

⁹⁶ C. S. Finch, *The star of deep beginnings, the genesis of African science and technology*. (Atlanta Khenti Inc., 1998), 263; D. Akyeampong, *The two cultures revisited: interactions of science and culture*. (Accra: Ghana Academy of arts and Sciences, 1993), 16-17.

⁹⁷ Ajei, *Africa’s development: the imperative of indigenous knowledge and values*, 133.

⁹⁸ Tarnas, *The passion of the Western mind*, 364-365.

to *a priori* principles, how come it is able to come off with successful theory? Popper says it is luck.⁹⁹

As a result of the successes of the natural sciences resulting from the mutual support of empiricism and rationalism, the method that warrant such has become the toast of many disciplines. This has had remarkable effect in modern philosophical thought as it is projected as the only form of acceptable knowledge. It is taken for granted that because it combines the methods of reason and the senses, it is able to arrive at neutral and objectively acceptable facts. Hence, it is not uncommon to find the scientific¹⁰⁰ culture in the many disciplines; that is, the deployment of the trappings of the methods of the natural sciences in many disciplines with outlandish claims to be sciences too.¹⁰¹ This smacks of scientism. In brief, it can be seen clearly that the rationale of Popper's unflinching criticism of the scientific status claim by astrology, Marxism, Freud's Psychoanalysis and Adler's Psychology are bold exemplars of this trend engineered by the preponderance of confirming evidence to be the hallmark of scientificity.

The Western approach to science defends an epistemology of science that lays claim to objectivity, certainty, and truth of universal validity proportions. It prides itself as the ideal of science, rationality, and capable of serving the needs of every other epistemology in all societies. In fact, it has become the ideal and standard by which societies are considered civilised, developed and modern. Thus, societies yet to key into its characterisations are termed as pre-logical, irrational, uncivilised, superstitious and underdeveloped. This hegemonic outlook dates back into several centuries with the

⁹⁹ Tarnas, *The passion of the Western mind*, 436.

¹⁰⁰ R. Scruton, 'Scientism in the arts and humanities', *The New Atlantis: A Journal of Technology and Society*, (2013), 33-46.

¹⁰¹ S. Fuller, *New frontiers in science and technology studies*, (Cambridge: Polity Press, 2007), 75. Where he observed that Popper challenged the aping of the natural sciences by the social sciences as positivistic epistemology is itself not adequate in its analysis. After all, they are not careful generalisations from observations. Observations are not neutral as they are theory-laden. By this, Popper according to Fuller is stressing the historical role of metaphysics in the formulation of scientific theories.

inception of European ascendancy, a temporal reality that Abu-Lughod describes as the formation and dominance of official discourses that attempt to render so much knowledge and ways of knowing that was happening around the globe as mainly non tenable, and deprived of real categories of philosophy and epistemology.¹⁰²

Some general thoughts can be gleaned with an appreciation of Jean's ideas that since, modern Western science has portrayed itself as the only universally valid framework for the explanation and prediction of natural and social phenomena. It has endeavoured to retain and promote this self-made image by proclaiming its knowledge as constituted of a level of objectivity and rationality that makes it universally valid. The point of departure of this view is the claim of science to have secured control over the principle of uniformity of nature. This principle states that what has happened will, all things being equal, under similar circumstances, happen again.¹⁰³

The implication is that the search for these principles is part of the concern of Western modern science as the discovery of these principles will facilitate the explanation and prediction of the events in nature; after all, events are expectedly to follow the orderly pattern drawn from the operations of the principles so discovered. In other words, chance or other fortuitous grounds have little or no space within the operations of nature as far as Western approach to science is concerned. For instance, the Darwinian evolutionary theory speaks volume for the kind of metaphysical implications that arise from the modern scientific culture. The contentious debate between evolutionary biology and intelligent design or creationist' account against the backdrop of teaching and promotion

¹⁰² Abu-Lughod (1989) cited in A. A. Abdi, 'Eurocentric discourses and African philosophies and epistemologies of education: counter-hegemonic analyses and responses', H. K. Wright & A. A. Abdi (Eds.), *The Dialectics of African Education and Western Discourses: Counter Hegemonic Perspectives* (New York: Peter Lang Publishing, 2012), 12. Abdi strongly argues in favour of an inclusive epistemological outlook in contrast to the popular exclusivist philosophy of education as the basis for the discourse on development in Africa with a view to benefit all.

¹⁰³ J. Jean. *Physics and Philosophy* (New York: Dover Publications, 1942), 3-4.

of science culture clearly shows the kind of metaphysical implications the newly found bride of a viable and valid knowledge system of modern science imposes. In other words, there are metaphysical issues about the human person and in fact, nature broadly, that are central in the consideration of the model of knowledge system.¹⁰⁴ Such a grandiose image of Western science is likely to preclude and dismiss as ‘superstitious’ events and occurrences for which the grounds for them are not explainable or understandable to the principles of Western empiricist outlook. If the state of quantum physics allows for the possibility of chance and indeterminate grounds, the overbearing empiricist outlook in foreclosing the possibilities that other epistemic perspective may suggest re-evaluation as this work is committed to achieving; as a first step to making dialogue feasible.

A few of these challenges show how the house of science is yet to be put in perfect order. After all, the outstanding hiccups calls for a sense of caution in its pontifical activities. This is important because some of its presuppositions have become rather orthodox in modern philosophical parlance and are at the root of the categorisation of knowledge claims as either qualifying as rational, valid or irrational, invalid. The assumption here is that some of these terms in their usage have attained predilections by which every other tradition is to be evaluated. Thus, the target here is to problematise and estimate the import of these concepts on the calibration of African knowledge perspective as qualifying to be or not to be. In the context of addressing the problem of science in the Nigerian context, whether the knowledge tradition should and can be taken seriously if science culture will advance significantly. Here, I agree with Louis et al that innovation needs in Africa are huge, meeting these needs effectively and sustainably will require

¹⁰⁴ A. Rosenberg, ‘Disenchanted naturalism’, *Kritikos: an International and Interdisciplinary Journal of Postmodern Cultural Sound, Text & Image*, 12 (2015), 1-27. The paper makes distinction between optimistic naturalism and radical naturalism. In his submissions, takes the latter as reflective of the logical consequence of taking Darwinian evolutionary system seriously and hence, argues that illusion is central to any position of naturalistic commitment that reserves a place for irreducible materialism. Very radical and contentious views but indicated here to show the kind of metaphysical consequences of the model of epistemology inherent in modern scientific system.

building upon and leveraging on domestic capacity within Africa.¹⁰⁵ My interest therefore is to be able to show the character of Western modern science approach that now stands as the epistemic gate keeper for all other knowledge traditions; in other words, characterise the epistemological, metaphysical and methodological influences it embodies for the prospects and promises of other knowledge traditions. The overall essence is to provide the epistemic context and background that Popper's critique of foundationalist epistemology on the one hand and its implications on the other hand for the traditional knowledge tradition does make sense for the challenge of the problem of science in Nigeria.

The position of this thesis is in line with Popper's view as elaborated upon by Koertge that the objectivity of scientific knowledge does not depend on the purity of motives of individual scientists, which is primarily responsible for the special character of scientific knowledge. It may be that sociologists of scientific knowledge are conflating two quite separate claims: it is non-controversial to claim that sociological factors such as peer review play a causal role in the production of scientific knowledge. To claim however, that factors such as interest in eugenics directly influence one's appraisal of statistical measures implies that the social institutions of science are not working properly.¹⁰⁶

The pervasive influence of rationalism and empiricism as important traditions of knowledge in the enlightenment context is not in doubt. For as Lakies rightly observes, "led by the presupposition of empiricism, the scientific enterprise is now the dominant means of knowing our world".¹⁰⁷ The scientific method is assumed to be able to furnish

¹⁰⁵ G. E. Louis, N. Nazemi, S. Remer, 'Innovation for development: Africa in C. C. Mavhunga (Ed.), *What do science, technology, and innovation mean from Africa?* (Cambridge, Massachusetts: MIT Press, 2017), 152.

¹⁰⁶ N. Koertge, 'New Age philosophies of science: constructivism, feminism and postmodernism', *The British Journal for the Philosophy of Science* 15 (2000), 671-672.

¹⁰⁷ C. Lakies, 'Deconstructing the secular magisterium: voices past and present for conversations of the future', *The Heythrop Journal*, 51, 6 (2010), 921. In the paper, Lakies sought to deepen the call to continually engage the enlightenment's presupposition in a conversation needed to vitiate its stand towards acknowledging the possibilities of other ways of knowing beyond its absolutist commitment especially

and give access to unbiased, certain and universally objective valid knowledge. Popper's critique of this epistemology is underlined by his claim of provisional or limited nature of the knowledge we are able to access based on the discontinuity between what we can theorise about and what we can observe. The former includes abstract matters beyond observation, for instance, force of gravity and the latter, those we can easily observe. According to Lakies, Popper's critique has been marginalised and ignored.¹⁰⁸ Hence, it has assumed itself as the gatekeeper of knowledge. On this, Gaukroger writes,

one of the most distinctive features of the emergence of a scientific culture in modern Europe is the gradual assimilation of all cognitive values to scientific ones. This is not merely a distinctive feature of Western scientific practice, it is a distinctive feature of Western modernity: a particular image of the role and aims of scientific understanding is tied up in a fundamental fashion with the self-image of modernity. A striking illustration of this is the way that the West's sense of what its superiority consisted in shifted seamlessly, in the early decades of the 19th century from its religion to science.¹⁰⁹

The image of Western science serving as the 'cognitive gate keeper'¹¹⁰ while laying claims to universalistic rationality and objectivity possessing internal epistemologies is problematic. For instance, Ajei echoes the other critical voices in the call for the rejection of this self-image of modern science because its claim to be totally immune from the

within the postmodernist programme epitomised by pragmatism that is able to democratise the ways of knowing without privileging any other over the others. The context is the discourse was an expansionist project on reason championed by Benedict XVI so as to encourage greater dialogue of cultures, disciplines and faiths. This notion is also central in J. Dupre's *Human Nature and the limits of science* (Oxford: Oxford University Press, 2003). Dupre analyses broadly 'the idea of imperialistic scientism; i.e, exaggerated confidence in the superiority of science to knowledge traditions in non-Western societies', 112. A direct challenge to this kind of thinking is reflected in the work of L. McIntyre, *Respecting truth: wilful ignorance in the internet age*. (New York & London: Routledge, 2015). The work challenges the culture of science denial prevalent in the age of science. For him, and rightly so, science with its standards has brought immense benefits that ignoring that truth is an unfortunate throwback. Such challenges and projects as contesting the place of science are seen and interpreted to mean attack on truth. The work specifically defends the view of modernism that upholds the standards of evidence and reason and insists any attempt to erode these values will mean contempt as every point of view will claim to be as good and viable as everyone else.

¹⁰⁸ Lakies, *Deconstructing the secular magisterium*, 921-922.

¹⁰⁹ Gaukroger came to such a conclusion by reviewing the following works; namely, M. Adas, *Machines as the measure of man* (Ithaca, New York: Cornell University Press, 1989); L. Pyenson, *Cultural Imperialism and Exact Sciences* (New York: P. Lang, 1985); L. Pyenson, *Empire of Reason* (Leiden: Brill, 1989) and L. Pyenson, *Civilizing Missions* (Baltimore: John Hopkins University Press, 1993).

¹¹⁰ Shiv Visvanathan, 'On the annals of the laboratory state', A. Nandy (ed.) *Science, hegemony and violence: a requiem for modernity*. (Oxford: Oxford University Press, 1988), 277. Visvanathan calls the 'Maxwell's Demon' that prevents the return to a more genuine, sacred and inclusive ecological vision of the world.

social context as its peculiar epistemological weight and ontological burden do play key roles in the project of science. Scientific theories are subject to these issues and their societal contexts cannot be ignored but appears to the Western scientist as an objective truth about the world.¹¹¹ For instance, the Cartesian-Newtonian mathematical system served the purpose. This attitude, that is, epistemic confidence, predicated on certainty of the natural sciences, according to Ajei, includes the application of the trappings of the natural sciences in social phenomena in the area of social sciences; that is, “the deductive nomological explanations, discovered laws seen as universally valid descriptions of the fundamental structure and patterns of the physical and social world. These explanations are contingent on the canons of mathematics and logic”.¹¹² The throwback of this epistemic disposition is partly the bane of development in many parts of Africa because many theories of development are products of the applications of the ontologies and epistemologies of natural sciences borrowed by the social sciences and imposed in the African context paying no attention to her unique peculiarities.¹¹³ Again, whether or not there are internal or external values by which science must be evaluated against is particularly contentious. Harding, for instance, argues that the internalist epistemology does not immune the operations of science from the influences of other cultural values. In fact, the social context determines the presence of scientific ideas, practices and nature. Thus, the claim that the scientific knowledge and its effects are consequences of internal epistemological features of modern scientific processes, such as inherent rationality, unique logic of justification, universal language and objectivity achieving method cannot stand.¹¹⁴ Another insightful view on objectivity in science is the contribution of Longino’s ‘contextual empiricism’, which seemingly bridge the gap between social context and the

¹¹¹ Ajei, *Africa’s development: the imperatives of indigenous knowledge and values*, 112-113.

¹¹² Ajei, *Africa’s development: the imperative of indigenous knowledge and values*, 114.

¹¹³ Ajei, *Africa’s development: the imperative of indigenous knowledge and values*, 115-116.

¹¹⁴ S. Harding, “Is modern science an ethnoscience? rethinking epistemological assumptions”, E. C. Eze, (ed.), *Post-Colonial African Philosophy: A Reader* (Oxford, Blackwell Publishers, 1997), 46.

natural world in the activity of science. Longino's expansive research highlights the notion of evidence through history to demonstrate that contrary to the general assumption on the close affinity the community of scientists will naturally establish between the scientific method as value free and the reliable knowledge it guarantees, there is no such genuine basis. Longino emphasises two senses of the idea of objectivity; objectivity in relation to process and objectivity in regards of results.¹¹⁵

To situate these issues on the one hand with the necessary consequences these intellectual predilections have had in non-Western societies, one can argue that indigenous knowledge tradition came to have two perceptions. One negative and the other, positive. The former was as a result of the overarching outlook with which Western science theories were applied in some societies with fundamental changes in those societies with ingrained practices these new modern practices were directed at eliminating or replacing.¹¹⁶ The underlying theme at the heart of the much of the scholarship centres on the reconstruction of what knowledge and a concerted effort to unpack the complex relationship between knowledge and power – rational human society and the empire. Instrumental rationality or functionalist thinking/capitalist value, that is, the shift in emphasis to technical knowledge as the defining feature of knowledge, such that whatever epistemic practice or knowledge claim that lacks this attribute was considered inferior,

¹¹⁵ H. Longino, *Science as social knowledge: values and objectivity in scientific inquiry*. (Princeton: Princeton University Press, 1990).

¹¹⁶ Much of the tradition of South Asian scholarship reflects the postmodernist thinking as it seems to be the overarching intellectual predilection of much of their contribution. A few examples of some of the scholars whose insights are relevant in many ways, the list though not exhaustive include; Edward Said, *Orientalism* (New York: Vintage Books, 1979); Nanda Meera, *Prophets facing backward: postmodern critiques of science and Hindu Nationalism in India* (New Brunswick, New Jersey: Rutgers University Press, 2003); Nanda Ashis (Ed.), *Science, hegemony and Violence: a requiem for modernity* (Delhi: Oxford University Press, 1988); Shiva Vandana, *Biopiracy: the plunder of nature and knowledge* (Boston, MA: South End Press, 1997); Chakrabarty Dipesh, *Provincializing Europe: postcolonial thought and historical difference* (Princeton, New Jersey: Princeton University Press, 2000). It must be quickly noted that not all of these scholars listed above hold postmodernist views. Nanda Meera, for example is one whose interventions serve as a critique of much of the scholarship on this theme. See, N. Meera, Postmodernism, Hindu Nationalism, and "Verdic science", in N. Koertge (Ed.), *Scientific Values and civic virtues* (New York: Oxford University Press, 2005), 221-235.

irrational and non-science.¹¹⁷ It is also quick to note that this perception is not only important as it touches on the identity of the people because the various policies of relationship with the outside world were based on these perceptions as well, but sets the stage for a re-examination of the anthropological hermeneutics of the people that the chapter on African philosophy will further elucidate upon. The latter emerged from the realisation of the view of knowledge as situated¹¹⁸ and located¹¹⁹ in origin. Thus, Western modern science is considered to be indigenous to Western/European culture but has attained ‘universal’¹²⁰ hegemonic status. Therefore, the claim of superiority was purely social and political rather than epistemological and ontological. Against these views however those who hold that Western modern science are is superior, objective, universal and value-neutral.¹²¹ Care must however be taken so this project will not be construed as supporting relativism of any kind.¹²²

In response to this, it is important to point out the reactions that this thinking has generated especially from the perspective of those who experienced and continue to deal with the

¹¹⁷ M. Elshakry, *When science became Western: hagiographical reflections*, 108.

¹¹⁸ D. Turnbull, ‘Reframing science and other local knowledge traditions’, *Futures*, 29, 6 (1997), 551-562.

¹¹⁹ M. V. D. Velden, ‘Knowledge management software and the structures of indigenous knowledges’, F. Sudweeks, H. Hrachovec & C. Ess (Eds.), *Cultural attitudes towards technology and communication*, (School of Information Technology, Murdoch University, 2010), 4. Especially, Chapter 1, 1-18, traces the use of the word indigenous knowledge that emerged in the early 1990s within developmental focused institutions and used for lobbying purposes for the legitimisation of local practices of people and cultures. It acknowledges the challenges technology brings to the codification of the indigenous knowledge and proposes an interaction model that keeps the interface between the technology and those who have these knowledge vibrant and living and open ended.

¹²⁰ S. Huntington is of the view that Western culture, (of which modern science is a constitutive part) is rather unique and not universal. See, L. E. Harrison & S. P. Huntington, (Eds.), *Culture matters: how values shape human progress*. (New York: Basic Books, 2000).

¹²¹ P. Gross & N. Levitt, *Higher superstition: the academic left and its quarrels with science*. (Baltimore: John Hopkins University press 1994); N. Koertge, *A House built on sand: exposing postmodernist myths about science*. (New York: Oxford University Press, 1998); M. Nanda, *Postmodern Critiques of Science and Hindu Nationalism in India*. (Rutgers: Rutgers university press, 2003).

¹²² Koertge criticises such projects that cite familiar philosophical discussions of theoryladdeness of observation, the undertermination of theory by data, anti-realist conception of scientific theories and a non-foundationalist accounts of observational or experimental data, and then construe them to be arguments that no interesting epistemic or methodological distinctions can be drawn between scientific knowledge and other systems of belief. N. Koertge, ‘New Age philosophies of science: constructivism, feminism and postmodernism’, *The British Journal for the Philosophy of Science* 15 (2000), 668-669; Also, Kitcher, *The advancement of science*, 7. And Meera Nandy’s piece, The epistemic charity of the social constructivist critics of science and why the Third World Countries should refuse the offer, in N. Koertge (Ed.), *A House built on sand: exposing postmodernist myths about science* (New York: Oxford University Press, 1998), 287-309.

practical implications of this epistemology as well as ideology of science. Extreme and exclusive representations fuelling counter extreme reactions as epitomised by anti-science culture is quite unhelpful to all parties.¹²³ Acknowledging this challenge, Kitcher argues that “a convincing account of practical progress will depend ultimately on articulating an ideal of human flourishing against which we can appraise various strategies for doing science. The extreme positions are clear. At one pole, it is suggested that science, as practiced, is a terrible thing, and that human beings should want none of it; at the other, that science as we have fashioned it, is already perfect. Neither extreme is likely to be right”.¹²⁴

By way of summary, one can locate the limit of the progress and success to the extent that the meta-narratives and standards of Western modern science (purportedly pretending to be universalistic) disenfranchise and discountenance the contextual perspective into which efforts and interventions are made to advance and develop it. It is my considered view however, that due care must be therefore taken to make sure that the reactions and responses do not become opposite extremes and so fall short of the very demarcatory and discriminatory agenda they set out to contest and undercut. Therefore, some sort of a middle-ground position is here advocated and this seems to be the point of dialogue model that this thesis seeks to defend with Popper’s intervention. What arises then is the commitment to shifting grounds on both sides of the knowledge traditions in view of expanding the frontiers of science. The point should not be missed because as Cobern illuminatingly remarks, “the problem of non-Western science education is not to make it more scientific, but to make it less culturally Western”.¹²⁵

¹²³ W. W. Cobern, Public understanding of science as seen by the scientific community: do we need to reconceptualise the challenge and to re-examine our won assumptions? Seminar presentation on the theme: Science, Technology and Civilisation, held at Leangkollen, Norway, November 18-19, (1996), 14.

¹²⁴ P. Kitcher, *The advancement of science: science without legend, objectivity without illusions* (New York & Oxford: Oxford University Press, 1993), 391.

¹²⁵ W. W. Cobern, ‘Constructivism and non-Western science education research’, *International Journal of Science Education* 4, 3 (1996), 296.

When we understand Western modern science as an endeavour produced in Europe during a particular historical period, whose cultural characteristics have endured to dominate, as a consequence of Western imperialism, global understandings of science and the regulation of its boundaries¹²⁶, then, it raises a number of issues, cultural, political, social, and epistemological. Thus, looking at the global order today, Bauman underlines the values of instrumental reason and efficient cause by which globalisation trumps society and cultures. These ideas have their roots in the individualism that arose in Descartes and found in Locke's notion of private property rights to such an extent that the intellectual ambience within which modern science arose, that is, the reformation, industrial revolution and the market economy are all defined by the reduced and narrow conception of causality.¹²⁷ The obvious implication is the project of a unified science with the metaphysical feature of reductionism and its implied downgrading of other modes of knowledge.¹²⁸ Shiva identified a number of grounds to contest the universal, objective and neutral knowledge claims of modern science and emphasises that capitalist ideology is intricately linked with reductionist science that define its nature and distinguishes it from all other non-reductive knowledge systems.¹²⁹

At the base of this programme is the sort of motivation for the project of integration of modes of knowledge into one with universal acclaim and objective pretensions. On this, Tarnas warns that;

¹²⁶ L. Carter and C. Smith, 'Re-visioning science education from a science studies and futures perspective', *Journal of Future Studies*, 7, 4 (2003), 51. The work thoroughly audits the nuances of science studies that embody the scathing criticisms of science with the touch of relativism and postmodernism and showed the growing call to explore new dimensions to the science curriculum that is sensitive to the past and the future; one that is able to reinvigorate lively interests in science in the twenty first century. Western science is a powerful and reliable knowledge tradition ... it has provided for much of human flourishing which being mutually coproductive of the interests of capitalism and imperialism.

¹²⁷ R. Harmut and J. Trejo-Mathys, *Social accelerated: a new theory of modernity*. (New York: Columbia University Press, 2015), cited in W. Bauman, "Religion, Science, and Globalisation: Beyond Comparative Approaches", *Zygon*, 50, 2 (2015), 395.

¹²⁸ J. Ziman, *Real science*. (Cambridge: Cambridge University Press, 2000), 154.

¹²⁹ Shiva, *Reductionist science as epistemological violence*, 234-235.

... the deep interconnectedness of phenomena encouraged a new holistic thinking about the world, with many social, moral, and religious implications. Increasing numbers of scientists began to question modern science's pervasive, if often unconscious, assumption that the intellectual effort to reduce all reality to the smallest measurable components of the physical world would eventually reveal that which most fundamental in the universe. The reductionist programme, dominant since Descartes, now appeared to many to be myopically selective, and likely to miss that which was most significant in the nature of things.¹³⁰

An example of this can be found in the increasing calls for all peoples around the world to take action in how the world's resources can best be sustainably appropriated. To achieve this requires that attention be given to the kind of observations expressed by Tarnas in the foregoing.

Focusing specifically on the medical science programme, Kidd is obviously not ready to go too far on the empirical and metaphysical potentials of alternative medicine (that is, whether it works or is real) versus orthodox medicine. Kidd demonstrates that on epistemological/logical grounds (pejorative and ignorance objections), the project of integrative medicine as the ideal of medical science progress should be rejected given its opportunistic engagement rather than cognitive engagement between allopathic medicine and alternative medicine. Appealing to the radical alternatives in Feyerabend as a brand of radical criticism is deployed to augment Zuzana Parusnikova's project of applying Popper's critical rationalism as a basis to undercut the dogmatic outlook that militates against the project of integrative medicine championed by Straus.¹³¹ What is clear in the work of Kidd, is the politics of power and professional authority that is fundamental to

¹³⁰ Tarnas, *The passion of the Western mind*, 357.

¹³¹ I. J. Kidd, 'A pluralist challenge to 'integrative medicine': Feyerabend and Popper on the cognitive value of alternative medicine', *Studies in History and Philosophy of Biological and Biomedical Sciences*, 44 (2013), 392-400.

the project of integration of different knowledge traditions. I will however argue that Popper's views well-articulated, are sufficient to achieve the task on hand contrary to Kidd's presentation of Popper by Zuzuna. After all, criticism alone was not the high point of Popper's epistemological intervention. Thus, instead of integration, my thesis argues for dialogue. Kidd's insight on two objections with which he undercuts the self-image of allopathic medicine in relation to alternative medicine were ignorance and derogatory dispositions as defining the opportunistic, rather than cognitive relation, may be epistemologically worthwhile. For Kidd, these dispositions and objections are critical in the preparation for any meaningful engagement with different traditions of knowledge; in this case, between allopathic and alternative medicine as espoused in the integrative medical knowledge project as a model of scientific progress.¹³² A fall out of the intervention is the power dimension to the debate on retaining the integrity and identity of the knowledge systems, whether Western modern science on the one hand or other knowledge traditions on the other. For instance, Nandy, writing on the Indian situation argues,

to be able to participate in the politics of knowledge in India, the very first step is to participate in the intellectual and political struggles of other forms of alternative knowledge that have survived against the hegemony of modern science. Even though these form of knowledge may not have ready-made answers to crisis in India but have been part of the body of knowledge challenging science.¹³³

Traditional knowledge forms have been wholly categorised as pseudo-science, magic or superstitions by defenders of the integrity and identity of Western science exclusively while inadvertently aiding and abetting bio-piracy as many relevant knowledge items in the traditional societies are appropriated into the general corpus of the Western science which is very often the end goal of any integrative project. In fact, as Nandy opines, the syncretic nature of modern science's ability to integrate into itself knowledge and values

¹³² Kidd, *A pluralist challenge to integrative medicine*, 396.

¹³³ A. Nandy, 'Introduction: science as a reason of state', A. Nandy (ed.), *Science, hegemony and violence: a requiem for modernity* (Oxford: Oxford University Press, 1988), 12.

of other knowledge systems as a pointer to its proof of universality.¹³⁴ Thus, there are not only epistemological concerns but also political considerations in the evaluation of the relationship between knowledge traditions in contemporary society. This thesis is set to engage some of the issues.

For worries about the benefits that traditional knowledge systems can bring to the table when modern science seems to be the only acclaimed viable means of attending to all of human needs, Visvanathan argues that, “the ecological benefits of traditional farming system for instance is more beneficial than the rationalist repressive science”.¹³⁵ Therefore, the thoughts of Sheldrake find contextual relevance in the sense that excessive reliance on modern science’s materialism seems to be engulfed in some crises. Therefore, the science that is taught in non-Western societies must recognise this. The materialist ideology was shaped by European past; albeit, there are immense practical ends to which its claims have been employed but not enough to prove its veracity as freeing science from the ideology of materialism opens science up for dialogue, new opportunities and new possibilities.¹³⁶

While one can broadly categorise and summarise the intellectual predilections of debates that have transpired thus far to be majorly between the modernist commitments championed by the promoters of modern science as an epitome of the enlightenment ideas of progress and development and the counter reactive movement who perceive the disillusionment of the modern era predicated on postmodernist presuppositions.¹³⁷ As interesting as these debates in various forms seem to be, my contribution to the debate in the literature comes from a reading of Popper as relevant to the African context on a transmodern imaginary wherein we can overcome the limitations of both movements of

¹³⁴ Nandy, *Introduction*, 11.

¹³⁵ Visvanathan, *On the annals of the laboratory state*, 286.

¹³⁶ R. Sheldrake, ‘Setting science free from materialism’, *Explore*, 9, 4 (2013), 218. Available Online: <http://dx.doi.org/10.1016/j.explore.2013.04.004>. [Accessed on 29/06/2015].

¹³⁷ See, Nanda, *Postmodernism, Hindu Nationalism, and “Vedic science”*, 221-235.

modernity and postmodernity based on pluralist-dialogic approach to science. The next section will provide a clearer picture to the foregoing discussion.

1. 5 Science and Science Education in Nigeria: Problem, Debate and Proposal

The history and nature of the formal education in Nigeria is tied to its roots, the Western model of education. Hence, much of science and science education did not form a major part of the formal education and policies of the colonial system. In fact, while some hold the view that the peculiar administrative needs of the colonial structure did not require comprehensive training and education in the sciences for the colonial subjects and so emphasis was rather on the training or education in basic administrative subjects and arts/humanities programmes to facilitate the smooth running of the system in place at the time. And so, the various schools and institutions of learning in place did not pay so much attention to science subjects. However, a careful assessment of the situation suggest something much more sinister, as Adas states that it was held that Africans lacked the capacity of science related disciplines.¹³⁸ In fact, Adas argues further that,

the application of technological and scientific gauges of human potential has also vitally affected Western policies regarding education and technological diffusion which go far to explain the varying levels of underdevelopment in the third world today. The misuse of these standards has not only impeded and selectively channelled the spread of Western knowledge, skills and machines; it has undermined techniques of production and ways of thinking about the natural world indigenous to African and Asian societies.¹³⁹

Interestingly, not much seems to have changed in the kind of epistemic attitude that informs some policy advice of some multilateral institutions and agencies involved in quite a lot of African issues and developmental matters. For example, the contested view supported by the World Bank underpinned by neo-liberal thinking and structural adjustments programmes to the effect that public spending on education in Africa should

¹³⁸ Adas, *Contested hegemony*, (2004), 39.

¹³⁹ Adas, *Machines as the measure of men*, 15.

dedicate greater percentage in favour of the primary and secondary education since the return on investment on these two segments are higher than those of the higher education.¹⁴⁰ This and many more continue to be the basis upon which the need for radical reforms of the educational sector in Nigeria is not only an imperative, it is pertinent because of the growing gap between what is on offer and the needs there are. This is even more urgent at a time of growing calls for the decolonisation of the curriculum.

To have a clearer and practical appreciation of this concern, one has to understand what is at stake when Western modern science with its form of what constitutes knowledge gets into a cultural context where tacit modes of knowledge and other forms are prevalent, then this creates an epistemic crisis. What sort of crisis one may ask? How much of what we have is Western and how much of what we have truly reflect the condition and identity of the society and culture within which this desired change is expected to take place and who decides what the priorities are and should be? In what way can there be an increased sense of sensitivity to the epistemological and cultural context within which Western modern science seeks to grow?

Since it is taken for granted that modern science is not indigenous to Africa as has been clearly established in the preceding section of this chapter. And so, in the context of education and science education therefore, this form of knowledge comes with its many assumptions and presuppositions some of which do not easily conduce with the prevailing model of knowledge that is indigenous to the context of science teaching and learning. The picture here therefore brings to the fore one of the fundamental concerns that experts in the field of education generally and science education particularly in non-Western societies have concerned themselves over the years.

¹⁴⁰ D. Bloom, D. Canning, K. Chang, *Higher Education and economic development in Africa* (Washington DC: World Bank, 2005); M. Mamdani, *Scholars in the market place: the dilemmas of neo-liberal reform at Makerere University, 1989-2005* (Kampala: Fountain Publishers, 2007).

Various experts in different fields have made contributions to the broad area of cultural studies of science and the various interventions around this theme have continued to grow exponentially. To this extent, one agrees with Pomeroy's categorisation of scholarship broadly on this debate to include the following themes;

support systems for under-represented groups, localised context of the science curriculum (language and the role of teachers in the use of local and contextually relevant examples for instance), appropriate teaching strategies for diverse learners, inclusion of contributions of those generally omitted, study real stories of Western scientific discovery, science for language minority students, study of science in indigenous knowledge, bridge the worldviews of students and that of Western science, and explore beliefs, methods, criteria for validity, and rationality upon which other cultures' knowledge of the natural world is built.¹⁴¹

These show a clearly broad and vibrant area of scholarship. As a very broad area of academic interest, I will only attempt to a broad categorisation of these interests and highlight the scholars whose reflections help the focus of the present concern of the thesis. Some of these scholars include; M. Ogawa¹⁴², G. S. Aikenhead¹⁴³, O. Jegede¹⁴⁴, W. W. Cobern¹⁴⁵, O. Ogunniyi¹⁴⁶ at others.

Though we have witnessed a lot of broad changes with the passage of time, there are still significant aspects that have yet to experience the kind of crucial transformation upon which much of the society can experience the desired development. Science education particularly much of a later development has however witnessed some changes in form,

¹⁴¹ D. Pomeroy, 'Science education and cultural diversity: mapping the field', *Studies in Science Education*, 24 (1994), 49-73; E. Krugly-Smolka, 'Twenty-five years of multicultural science: looking backward, looking forward', *Encounters*, 14 (2013), 21-31; J. Osborne, S. Simon & S. Collins, 'Attitudes towards science: a review of the literature and its implications', *International Journal of Science Education*, 25, 9 (2003), 1049-1079.

¹⁴² M. Ogawa, 'Toward a new rationale of science education in a non-Western society', *European Journal of Science Education*, 8 (1986), 113-119.

¹⁴³ G. S. Aikenhead, 'Science education: border crossing into the subculture of science', *Studies in Science Education*, 27 (1996), 1-52.

¹⁴⁴ O. Jegede, 'Collateral learning and eco-cultural paradigm in science and mathematics education in Africa', *Studies in Science Education*, 25 (1995), 97-137; O. Jegede, 'Towards a philosophical basis for science education of the 1990s: an African viewpoint in D. Herget (Ed.), *The history and philosophy of science in Science teaching* (Tallahassee: Florida State University, 1989), 185-198.

¹⁴⁵ W. W. Cobern, 'World view theory and science education research', *Monograph Series*, 3, National Association for Research in Science Teaching, Cincinnati, Ohio, 1991.

¹⁴⁶ O. Ogunniyi, 'adapting Western science to traditional African culture', *International Journal of Science Education*, 10, 1 (1988), 1-9.

content and context but there is still a yawning gap in terms of the viability, relevance and competitiveness of much of what the system in operation is able to deliver. For example, recently the continent of Africa has been in the news because of the growing activities of China on the continent and the increasing concerns expressed at different quarters about the possibility of a new phase of colonialism. Though rightly or wrongly, these projections seem justifiable and deserve to be taken very seriously by Africans would not be much of a worry if in deed the state of science and technology capacities within Africa are adequate and sufficient for the kind of development that we need on the continent. While there is an acknowledgement of the limitations of the quality of science education, the potentials of the learners and capabilities are not in any way in doubt as quite a number of people who go elsewhere become excellent professionals in different fields.¹⁴⁷ Again, there are also many others who in spite of the immediate challenges of the learning environment demonstrate excellence in many fields. For example, the various technological excellences of the adaptability of information technology to address a number of local challenges point to the fact that given the right science and technology policy environment, appropriate approach to science and the right educational context coupled with a generally motivated atmosphere, so much more will be achieved. Thus, Ogunniyi argues, “if the African can absorb technological products without mental conflicts, it is certainly not impossible to design ways and means that will help him/her

¹⁴⁷ A. Salau, ‘STEM is critical to propelling Nigeria and Africa to greatness’, Premium Times Newspaper. Available online: <https://opinion.premiumtimesng.com/2017/02/16/stem-is-critical-for-propelling-nigeria-and-africa-to-greatness-by-adetola-salau/> [Accessed on 20/10/2017]. Salau opens the piece by this very insightful sentence, “one of the biggest tragedies in Nigeria is the fact that the skills of critical thinking and problem solving isn’t largely unavailable, to compound matters even highly educated people often act and think quite irrationally and hold unto superstitious beliefs. Very few forward thinking ideas of 21st century globalisation has taken root in the belief system of many. Unfortunately, much of the economic and social development in society are mainly driven by international aid agencies and NGOs”. The remark captures the sense in which some of the fundamental issues associated with the problem taken up in this thesis.

absorb scientific interests, attitudes, thoughts, and habits without destroying his/her identity or religious sentiments”.¹⁴⁸

It is a given that when one considers modern science in a non-Western context, it means a whole lot of baggage, taken to be heritage of the West finding its way outside its original place of birth. According to Selin,

if we wish to study science in non-Western countries, we need to take several intellectual steps. First, we must accept that every culture has a science, a way of defining, controlling, and predicting events in the natural world. Then we must accept that every science is legitimate in terms of the culture from which it grew. We must extend this view to our science, recognising that it too is a reflection of its culture, and that culture plays a role in every step of doing science; in what we choose to study, how we collect data, and how we interpret them, we say that Western science is superior because we consider it rational, objective, and value free, and we look disparagingly at others science and call it magic. The transformation of the world as a distinct rationality valued above magic is uniquely European. It is not common to most non-Western societies, where magic and science and religion can easily coexist, even today.¹⁴⁹

An example of the foregoing is presented Verran’s book, “Science and an African logic”.¹⁵⁰ The book documents her experiences as a teacher involved in the teaching of science and mathematics to science teachers in Nigeria. While it focuses on the notion of number and numeration system of the Yoruba thought system vis-a vis the number system embodied in modern science and mathematics, it touches on very significant issues at the heart of understanding and relating with the “other” from the perspective of the popular model of mathematical knowledge and science. According to Hallen, “the way the Yoruba verbalise their interactions with things virtually obliterates the conventional Western distinction between subject and object and substitutes for it a world of dynamic objects (human and non-humans) actively display their natures on the basis of

¹⁴⁸ M. B. Ogunniyi, ‘Adapting Western science to traditional African culture’, *International Journal of Science Education* 10, 1 (1988), 8.

¹⁴⁹ H. Selin, (Ed.), “Introduction”, *Encyclopaedia of the History of Science, Technology and Medicine in Non-Western Cultures*. 2nd Edition. (Dordrecht: Kluwer Academic Publishers, 1997), XV.

¹⁵⁰ H. Verran, *Science and an African logic* (Chicago: University of Chicago Press, 2001). She taught from 1979 to 1986 at Obafemi Awolowo University, Ile-Ife, Nigeria before she returned to the Department of History and Philosophy of Science at the University of Melbourne, Australia.

performative actions”.¹⁵¹ Sometimes, these various issues are so interwoven and lumped up together in how some Africans appreciate and understand reality, such that unbundling these various issues proves very problematic not only for Africans who hold such views but also for non-Africans who do not hold such views.

There is no question that there is a problem of science and science education in Nigeria. This is reflected in not only in the school environment but also at the larger society level and the reinforcement that comes from the context. from a deeply faulty policy direction and prioritisation of science as against other domains which also reflects in the poor attention that education receives generally, to the lack of the culture of science in relation to dealing with challenges and problems even among those whose professional learning and training makes it more troubling. This plays huge role among the teachers and those who should embody the values of science and on whose shoulders lies the responsibility to transmit the culture to the learners. The challenge is one cannot give what one does not have. For example, a former minister of Power in Nigeria, Professor Neibo, an expert in the field of metallurgical engineering trained in the United States of America and in fact a former Vice Chancellor of a university, while he was before the federal legislative assembly for the confirmation of his ministerial appointment made a claim that did not provoke outrage and rebuke of any form. Professor Neibo posited that witches and witchcraft were responsible for the problem of power in Nigeria. The ministerial nomination was confirmed. In a similar manner, a one-time presidential spokes’ person wrote a piece that really resonated with so many other claims that fly around in the society as one which perhaps is excessively superstitious.¹⁵² These few examples do reflect the

¹⁵¹ B. Hallen, Review of Helen Verran’s *Science and an African logic* (Chicago: University of Chicago Press, 2001) in *African Studies Review* 45, 3 (2002), 160-162 (162)

¹⁵² R. Abati, ‘Rituals, blood and death: the spiritual side of Aso Villa’, Available online: <http://dailypost.ng/2016/10/14/evil-spirits-control-aso-rock-reuben-abati-explodes/> [Accessed on 12/11/2016]. Aso villa or Aso Rock is the seat of power in Nigeria, where the presidency is located and operates.

rather prevalent consciousness and worldview in the society to such an extent that Experts in the field of science education regard as problematic as one that involves cognitive dissonance or border crossing which undermines the various efforts to inculcate the needed culture of science among learners.

More than that, as Popper argues, “the problem which troubled me at the time was neither, ‘when is a theory true?’ nor, ‘when is a theory acceptable?’ My problem was different. I wished to distinguish between science and pseudo-science; knowing very well that science often errs, and that pseudo-science may happen to stumble on the truth”.¹⁵³ Epistemic boundary contestation continues to highlight the shifting and fluid nature of issues of reason/rationality, objectivity, truth and neutrality in scholarship. These contestations inherently are problematic given the whiff of scientism more often unquestionably defining what is considered to be intellectually relevant and hence, merit space in the academia. Thus, there is a prevalence of a culture of justification instead of the character of criticism as defended by Popper. With Popper’s strategy therefore, the age-old Socratic challenge to always recognise and acknowledge one’s epistemic self-status becomes a useful reminder for any form of hubristic tendency that is very often associated with a model of knowledge with very long history of success. As Adas rightly argues,

less arrogance and greater sensitivity to African and Asian thought systems, techniques of production, and patterns of social organisation would have enhanced the possibility of working out alternative approaches to development in non-Western areas, approaches that might have proved better suited to third world societies than the scientific-industrial world in either its Western or its Soviet guise. At the very least, the first generation of Western –educated leaders in the newly independent states of Africa and Asia would have been more aware of the possibilities offered by their own cultures and less committed to full scale industrialisation, which most of them viewed as essential for social and economic reconstructions.¹⁵⁴

¹⁵³ K. Popper, *Conjectures and refutations: The growth of scientific knowledge* (New York: Basic Books, 1962), 33-36.

¹⁵⁴ M. Adas, *Machines as the measure of men: science, technology, and ideologies of Western dominance* (Ithaca: Cornell University Press, 1989), 16.

As Gaskel writes,

how are we treat alternative conceptions of nature such as the Chinese system of Ch'i? Is it a religious belief or a superstition? Is it an alternative science or an ethno science? If we use the terms alternative science or ethnosience are we implying that modern science is just another ethnosience rooted in the particular contexts of the modern world? If so, are there grounds for claiming that one form of ethnosience has a greater legitimacy than another... these questions open a Pandora box.¹⁵⁵

Intellectual debates around these sorts of fundamental problem for what constitutes an appropriate science within non-Western contexts have been framed between proponents of universalism and defenders of relativism.¹⁵⁶

Interestingly, Gaskel agrees with Aikenhead (1996) that the way out is through the encouragement of conceptual proliferation sensitive to specific social and natural contexts. This idea seems synonymous with the idea of pluralism as inspired by Popper's philosophy and advanced in this thesis because according to Gaskel,

this pluralistic perspective has several advantages. It provides a learning environment of respect for the culture of the students. Their culture's knowledge is coherent and rational and is appropriate in particular contexts. The cultural identity and self-esteem of the students is enhanced. Teaching from a pluralistic science perspective also allows questions about science to be raised more easily. Being able to contrast how two systems explain a phenomenon illustrates the assumptions, strengths, and limitations of each system.¹⁵⁷

Thus, the dialogic model inspired by Popper's philosophy comes with many advantages, amongst many others, it creates the epistemic space within which each there can be a genuine encounter between the various knowledge traditions.

¹⁵⁵ J. Gaskel, 'Engaging science education within diverse cultures', *Curriculum Inquiry* 33, 3 (2003), 241.

¹⁵⁶ Gaskel, *Engaging science within diverse cultures*, 242.

¹⁵⁷ Gaskel, *Engaging science within diverse cultures*, 243-244.

1. 6 Possible Contribution

To reiterate the possible contributions of this intervention inspired by Popper's philosophy, it is my hope that the epistemic consequences which arise as a result of a shift from how we approach traditional epistemology, whereby we focus or begin by exploring the sources of knowledge to one of how we hope to detect and eliminate errors in knowledge in our estimation should have some implications for the general epistemology of science which cannot be ignored in terms of inherent potentials thereof. Some of which include:

1). The assessment of the idea of science ably represented by the popular Western approach to science as dominating, domineering and dismissive of other possible approaches to science which can(not) make viable epistemic claims. This is a fallout of the Popper's severe attempt to dismantle the epistemology of science built on Bacon's inductivist agenda and of course, the developmental philosophy it engenders. While focussing on the model of development that the epistemology of Western science underpins, Kenedy¹⁵⁸ from an economic perspective, presents an insightful connection between basic science, applied science and development. This reading brings out clearly one major problem that this thesis seeks to underscore. Following the visionary and prophetic axiom of Bacon that 'knowledge is power', there is no denying the fact that economic and political developments are influenced by the scientific knowledge of this utilitarian nature. From an African epistemic perspective, Kaboha identifies some unwholesome ends, which the utilitarian/materialist underpinning of Western science dictate for some aspects of society and human life.¹⁵⁹ There is, therefore, the need to

¹⁵⁸ J. V. Kenedy, 'The sources and uses of U.S. science funding', *The New Atlantis: A Journal of Technology and Society* (2012).

¹⁵⁹ P. Kaboha, 'African metaphysical heritage and contemporary life: African contributions to contemporary life', A. T. Dalforo et. al. (Eds.), *The Foundations of Social Life: Ugandan Philosophical Studies*, (Washington, D.C.: Council for Research in Values and Philosophy, 1992).

constantly complement the Western approach to science in its bid to solve human problems in this regard as a way of mitigating the excessive utilitarian agenda in societies and cultures.

2). Popper's epistemology also has consequences for political issues of society in general. Thus, it makes it appropriate to examine the social/political factors in relation to the challenge of science development, the materialistic rationality¹⁶⁰ upon which the development engendered by modern science and technology reflect in important ways on the various sectors of society. The emphasis of development that seems to exclude some aspects of reality as wholly exhaustive of what reality is all about is not only presumptuous but dangerous for human relationships but also affects the universe/nature generally as the new challenges of climate indicate. This epistemology of development must be interrogated and examined in the light of the precarious times in which we all live. In this light, the immediate intuitive thinking is that Popper's commitment to pacifism and reasonable application of the benefits of science can open the space and thus able to call for some modest outlook that the Western approach to science should portray if indeed the theories of science are rather provisional and not final. Against this background, the contributions of other epistemic traditions and the kind of interpretation of nature inherent in these traditions, can serve as constant reminder to the Western approach to science in ensuring values of responsibility towards some harmonious existence of humanity in the universe can be guaranteed.

3). Of equal importance too is the opportunity Popper's epistemic requirements of openness and perpetual readiness to be exposed to the severest of tests bring towards the re-examination of the grounds for misunderstanding and rejection of the knowledge traditions of the people not readily amenable to the empirical method of modern science.

¹⁶⁰ This phrase is used to characterise the tendency to define the basic nature of reality to be matter and has several expressions in metaphysics, epistemology and other aspects of philosophy.

In other words, certainty and the claims to possess it have the potential to promote closedminded outlook – the Cartesian epistemological foundation of justification, ‘I think therefore I am’ – can be reductive as well as oppressive at the same time. And so the call to openness and exercise of restraint in making claims to certainty makes the need for openness pertinent. Some aspects of the African indigenous knowledge tradition have been accused and described as ‘magic’, ‘superstitious’, or with other derogatory names because of lack of openness. A change of epistemic attitude towards these indigenous epistemic heritages can be the starting point towards a better engagement with the people towards resolving the tension or conflict of traditions of knowledge at the root of the problem of science advancement. By this, the emphasis will be more of accommodation of relevant and meaningful epistemic claims alongside the Western tradition of science. Thus, a call for the review of the science curriculum and pedagogy in the context of Africa become more reasonable and practical beyond theoretical formalities. This can facilitate possible dialogue with the hitherto misunderstood and misrepresented indigenous epistemic claims consigned to the backwaters, while leaving the identity and heritage of the people badly hurt. The psychological complex that comes with them can then be very well repealed. When it is no longer christened fetish and magical, it can gradually begin to be more open and amenable to be reconstructed in linguistic terms that are open and assessable, with a reinvigorated psychological or identity reenergised, the people can then begin to approach and own the science culture as its applications to their life, history and experience become more meaningful. Here, the relevance of Popper’s insistence on the idea of the open society and the critical culture it promotes become very insightful to the Nigerian (African) science situation. This is all important given that one-sided approach

cannot go all alone in the effort towards explaining and understanding totality of reality. Through this means therefore, 'epistemic fundamentalism' is eschewed.¹⁶¹

4). The end to which this reflection aims is of ecumenical and planetary cooperation of knowledge traditions; enhancing the ability of all of humanity to make their various contributions as co-partners and be able to live better and more humanely in a much more understood universe/reality. If science is aimed at working for the good of all, then it behoves on those who lay claim to this project to enter into some dialogue and conversation and make the scientific endeavour participatory. With the realisation of limitedness and possibility of error, the Western approach to science should be much more welcoming and partner-ready with other viable and complementary contributions from other traditions of knowledge to the global science for the good of humanity. In the light of this vision, the pedagogical disposition of Western science within the African educational science classroom experience must be reviewed to reflect this kind of negotiation of epistemic options.

1.7 Conclusion

The chapter has so far outlined the question of the problem of science advancement in Nigeria and why it should be taken philosophically serious. A number of interventions to resolve the problem of science advancement in Nigeria have been lopsided in outlining only the socio-political/material reasons for the advancement of science. To make for a comprehensive understanding of the problem, the thesis establishes that the epistemological aspect is indispensable in the dialogic model that is best poised compared to the modernist and relativist responses the challenge of science development has received in many parts of Africa. Hence, the thesis explores the epistemological as well

¹⁶¹ Mawere, xii. The term is employed to describe the tendency to think that because of the long standing influence of western imperialism, there is the belief that western science is the only answer to development and all other problems of humanity.

as political application of Karl Popper's philosophy which straddles both aspects to the problem and so, makes a philosophical contribution to an aspect of development; i.e. science advancement in an African context.

In this, I underline the fact that there is an intellectual connection between what is considered and adjudged to be science, reason or rationality and so, what is to be taken seriously on the one hand and what does not count as such, is discountenanced. By this, not only that the knowledge system suffered neglect, disapproval and dismissed, a core part of the African identity suffered to the same degree. Thus, the thesis takes up the immaterial dimension to thoroughly assess and broaden the discourse beyond what it has been. It has simply established that the problem of science advancement is not as simple as it is usually presented. As important as the material reasons are, the immaterial dimension is essentially fundamental and crucial in estimating why science advancement remains a tall order in an African (Nigerian) context. Thus, in the thesis, I take up a philosophical framework able to attend to these two important aspects in the examination of the problem of science advancement in Nigeria. The coextensive relationship between the political philosophy and philosophy of science of Popper therefore, provide a contextually relevant tool of analysis in addressing the problem at hand. It elaborates on the philosophical question that the problem of science advancement in the Nigerian (African) context raises. To my mind, the basic challenge is that the dismissive and dominating disposition of the ontology and epistemology of the Western approach to science over and above the basic ontological framework of a typical African has not been particularly helpful to its own science and its culture, thus, generating a conflict or clash of ontologies and contexts that has militated against the proper appropriation of the commitment needed to transform science in the African context.

To dissipate this tension therefore, the thesis claims Karl Popper's philosophy of science (especially its relationship with political philosophy) provides a veritable framework that

can engender a dialogue and conversation between these different approaches to science. The epistemic virtue of tentativeness, provisional and hypothetical state of every knowledge claim reemphasises the need for the Western approach to be open towards an indigenous tradition of knowledge to make its modest contribution to global science. This does not just stop here as it touches significantly at the heart of a people's heritage and identity hitherto denigrated. This has implications for the science education culture in Nigeria and the model of development thereof. The importance of this exploration and engagement is far reaching because at a time when the global attention towards sustainable development and climatic change are front burner issues in today's world.

2. 0 Karl Popper’s Philosophy (as response to traditional epistemology and methodology of science)

“... the act of entering into relationships with other ways of knowing can be fruitful in assessing motives, strengths and inherent limitations of scientific descriptions”.¹⁶² Laura Colucci-Gray.

2. 1 Introduction

Quickly, the fundamental nature of traditional epistemology is foundational, authoritarian and a justificatory epistemology against which Popper’s philosophy reacts to by undercutting its hubristic convictions and foundation and thus, providing an alternative that is non-justificatory and non-authoritarian epistemology. Thus, very straight to the point, the advancement of Popper here at this point in this thesis, is to achieve two main objectives; vis, to explore the potentials of Popper’s philosophy with a view to deflate the domineering and dominating epistemological outlook epitomised by Western modern science and secondly, explore its promise to be able to reposition African knowledge tradition,- and to predispose it to engage in dialogue with Western modern science. These two objectives have a common goal, that is, to provide a framework of dialogue between these two knowledge traditions as an important model upon which the problem of advancing science in the context of Nigeria can best be negotiated and facilitated.

While reflecting on how to begin this chapter targeted at aspects of Popper’s philosophy relevant to the task of examining the possibilities of dialogue between ‘other’ traditions of knowledge and the popular Western tradition of science as a viable way to address the science question in Nigeria, I found the thoughts expressed by Hetherington as insightful and quite concise to the central task of this chapter. If, over time, what is scientific explanation and what counts as observable undergo changes and continue to do so, what

¹⁶² L.collucci-Gray, *et al.*, ‘Science education for sustainability, epistemological reflections and educational practices: from natural sciences to trans-disciplinarity’, *Cultural Studies of Science Education*, 8 (2013), 133.

this signals is a picture of interesting presuppositions that underlie Popper's philosophy. With a background and orientation in 'fallibilism'¹⁶³ (which of course is strongly highlighted in Popper, though first used by Charles Sanders Peirce), Hetherington¹⁶⁴ notes:

... our current grasp of epistemological possibilities is itself more limited than we realise... How good are we at judging epistemological proposals without reflecting entrenched yet narrow or misleading central concepts, standards, methods, questions, and so on? How good are we at improving upon those, even at imagining new central concepts, standards, methods, questions, and the like? ... this process [of moving into improved epistemological future] can stagnate, as we assume that some proposals are irrelevant or mistaken, simply because of how 'implausible' they can currently strike us as being. Bare assessment of implausibility tend to give voice merely to our professional training... but what is entrenched need not be true. Nor need it be able to fair-mindedly to assess fundamental challenges or alternatives to itself.

The idea expressed in the above long quotation suggests the possibility of a pluralistic outlook without falling into relativism. It speaks to the epistemic attitude of openness which is core in the kind of epistemology defended by Popper.

2. 2 Popper's Philosophical Strategy, Approach and Background

To question and to pose questions as such remains core to philosophy. In keeping with the spirit and letter of posing questions, Popper relishes this philosophical style that begins with reformulating questions as they relate to core issues to make them worth reflecting upon or to make these issues resolvable. It is no news that Popper, more often, argued that the fundamental questions in political philosophy and in epistemology, 'Who should rule?', and what are the credible sources of knowledge?' were not properly founded. These questions rather, should be reformulated into; 'How can we so organise

¹⁶³ The term fallibility was first used by Charles Sanders Peirce and was central to Popper's philosophical flavour in both his epistemology and political thoughts. The idea suggests simply that humans are not error proof. However, it does not just stop at the fact that humans are prone to the possibility of mistakes, but that they are capable of learning from such mistakes gives a positive dimension to how Popper appropriated this term. The entire voluminous work of Popper, *Logic of Scientific Discovery* was set to accomplish such account amongst other things.

¹⁶⁴ Hetherington quoted in P. Rooney, 'The marginalisation of feminist epistemology and what that reveals about epistemology', in H. E. Grasswick (ed.), *Feminist epistemology and philosophy of science: power in knowledge* (Dordrecht: Springer, 2011), 20.

our political institutions that bad or incompetent rulers can be prevented from doing too much damage?', and How can we avoid error?' respectively.¹⁶⁵ In this way, Popper takes interesting revolutionary positions on a number of philosophical issues that, when wholly evaluated in the light of his entire philosophy, one stands a better chance of appreciating the far reaching implications of such contributions to the received body of philosophy before, during and after Popper. By this, two things are taken up, and therefore, achieved at the same time in this thesis; firstly, it adds to the body of knowledge in a direction that is refreshingly inspiring as far as the philosophy of Karl Popper is concerned. Secondly, the thesis presents an African reading of Popper away from the limited and often faulty understanding of Popper spread in the literatures in history and philosophy of science texts, mostly used at undergraduate levels and even popular views held in the public domain.¹⁶⁶

In the light of this, the hermeneutics of Popper's thought I will do shortly will provide the framework towards advancing the dialogical agenda of this thesis. Briefly, from the political dimension, it is important to emphasise that it is not only the emergence of despots or autocrats that worry Popper; but, in fact, any system of thought or belief system in which the tendency towards dogmatic or fundamentalist ends inheres, - Popper is averse to all such, for everything is worth subjecting to the purifying touch of critical examination or crucible of questioning. Part of chapter four will endeavour to show more of this tendency in the context of Nigeria, how the conscious avoidance of the appreciation of philosophy for instance does contribute to the overwhelming role that an excessive religious outlook can define and determine the priorities of leaders at various levels of governance at the expense of science and technology development.

¹⁶⁵ Popper, *Conjectures and refutations*, 25. And it is basically through what Popper regards as criticism.

¹⁶⁶ For instance, it is rather ironic that Karl Popper seems more popular among practicing scientists than philosophers and many of these scientists consider themselves to be involved in the very practice of falsifying hypothesis; that is, rigorous testing of hypotheses and theories to estimate the extent to which they stand the rigour of testability.

Karl Popper remains a scholar of many colours whose philosophy and academic works have been subjects of immense debate and contestation. Thus, the intellectual interventions of Popper have remained largely controversial in how they are understood and interpreted. Though, in his active engagement over long period of time, Popper reacted and responded to many commentators of his works, disagreeing with many for several reasons. I will however not be considering all these issues here because of the constraint of space.

I consider Popper's interventions in epistemology strategically linked with his political thoughts to be substantially relevant to the problem under consideration. The current debate on the problem of science in Nigeria has only successfully emphasised the socio-political dimension to the problem and has neglected the fact that at its heart, there lies an epistemological dimension. By using Popper's philosophy with its integration of political and epistemological projects, I aim to move the debate forward.¹⁶⁷ More precisely, in this thesis, efforts will be made to bring together these two important aspects (epistemological and political) into one single whole narrative so as to provide a more

¹⁶⁷ Literatures on the challenges of development (of which science is an important component) in and across Africa tend to simply locate the political leadership question as core factor to be considered when any aspect of development is to be analysed or discussed. What is becoming increasingly evident is the change in the narrative from colonial to good governance debates. Thus the focus seems to be one that the typical African is responsible. While agreeing partly with that view, this thesis is interested in something unique as it attempts to flip the narrative in reverse manner to engage the epistemic outlook of Western modern science as fundamentally problematic. The thesis notes the viability of the earlier discourses but insists that an engagement with the science tradition in the context of Nigeria is urgently needed for science to progress, if not, nothing significant will be achieved even if the political leadership is got right. One very insightful and classic work that brazened the trail along this trajectory but ended up putting up parallel systems of knowledge traditions instead of dialogic model proposed herein. K. A. Ojong, *A philosophy of science for Africa* (Calabar: African Pentecost Communication & University of Calabar Press, 2008), XIII. Ojong however argues that the socio-political factors are contributory to the problem but it is lack of understanding of the very method of doing science that is the bane of scientific advancement in Africa. Thus, through the cultural story of science using the anarchist approach of Feyerabend defends a unique African method of science as competently viable and equally valid and can indeed grow side by side the Western method of science. In my view, the reading of Popper by Ojong seems faulty as it is highly selective and peripheral given the emphasis of falsificationism to be the capstone of Popper's philosophy, whereas it is not the case. The link and relationship there is in Popper's epistemology and political thought is totally ignored and not explored as a viable engagement to dealing with the question of science in Nigeria. In addition, the relativism inherent in the position defended makes any attempt to engage in dialogue and intercultural exchanges using the anarchist approach of Feyerabend not only impossible but futile. Again, the growth and development of science in Africa, nay, Nigeria will not and cannot be sustained by such an exclusive approach to science that is uniquely Africa as there are a lot of aspects where this cannot apply.

comprehensive account of the problem of science advancement in Nigeria. Achieving this feat therefore, the thesis would have taken the discussion to a level beyond others, and so adds significantly to intellectual interventions and scholarship on the problem of science advancement and development in Nigeria. Popper's philosophy speaks to both aspects (political and epistemological dimensions) in much interconnected and radical manner often ignored by commentators on Popper.

Again, in its contribution, the thesis will engage the relevance and connection of Popper's thought to other aspects of contemporary epistemology against the backdrop of an alarming neglect of Popper's philosophy and largely reductionist reading of the entire philosophy of Popper as falsificationism in recent times, observable in many texts.¹⁶⁸ The thesis, therefore, demonstrates some connection and relevance of Popper's philosophy to the debates raging in other areas of epistemology; especially, decolonial and postcolonial epistemology'¹⁶⁹, 'feminist epistemology'¹⁷⁰ and other key approaches than has been appreciated in the overall knowledge question the thesis considers important to the science development in an African context. Thus, the thesis contends the tendency to keep spreading such limited representation of Popper's philosophy, through an expansive contextualisation of Popper on the knowledge debate as well as any limited reading of Popper's philosophical contributions in these instances.¹⁷¹

¹⁶⁸ There is more to the philosophy of Karl Popper than has been popularised. This assessment was the context within which P. Godfrey-Smith's essay 'Popper's philosophy of science: looking ahead', opens the discussion by asking: 'Is Popper's philosophy alive or dead?' in J. Shearmur and G. Stokes (Eds.), *The Cambridge companion to Popper* (Cambridge: Cambridge University Press, 2016), 104-124.

¹⁶⁹ Postcolonial epistemology is a recent trend in epistemology that seeks to examine amongst other areas the politics and knowledge questions in the context of postcolonial experience and histories of many erstwhile colonies. Championing this discourse include but not exhaustive is Anazulda Gloria, Walter Mignolo, Enrique Dussel, Gayatri C. Spivak, Homi K. Bhabha, Edward Said, and many others.

¹⁷⁰ Helen Longino, Donna Haraway, Evelyn Fox Keller, Martin Linda Alcoff, Maria Lugones, Sandra Harding and many others with burgeoning works in feminists' theory and thoughts centred around knowledge and issues of objectivity, rationality and power relations in the context of gender and women experience and the overall science project.

¹⁷¹ R. Champion has also clearly accused and rightly so, the simplistic reduction of Popper's entire philosophy to falsificationism as replete in the work of Chalmers's basic introductory text in philosophy of Science titled, *What is this thing called science?*

While not indulging in any blame game, this trend is not caused by the opponents or critics of Popper alike, for as, Rowbottom rightly observes that Popperians have largely ignored developments in other areas of epistemology in their excessive concern to engage with those who criticise the views of Popper are not free of this challenge.¹⁷² He insists that naive falsificationism is taken as the capstone of Popper's philosophy, as it is still popular in many introductory undergraduate texts in the philosophy of science. In his contribution towards the revitalisation of Popper's thought, he argues that Pancritical rationalism rather than critical rationalism as presented by Popper, provides a much more comprehensive approach by which the mutual benefits there is between Popper's philosophy and philosophy generally can be improved. The project of Rowbottom focuses on how Popper's philosophy received and interpreted within the Anglo-American analytic tradition can be improved or enhanced. This view partly acknowledges that there are some obvious challenges with Popper's philosophy and of course this thesis does not perceive it as error proof either. In the estimation of this thesis, whatever reservations there are on Popper, such views are not sufficient to undermine the appropriation of Popper's philosophical intervention to address the science question in Nigeria as this thesis will not dwell on them more than necessary.¹⁷³

I will now consider some other important themes in Popper's philosophy with which the problem of science in Nigeria can be examined following the overall aim of the chapter.

¹⁷² D. Rowbottom, *Popper's critical rationalism: a philosophical investigation* (New York: Routledge, 2011). The work generally gives a new approach demonstrating the relevance of Popper's thoughts in contemporary philosophy of science. For instance, the Duhem-Quine challenge to falsifiability principle was treated in a way that group system dissolves such a problem, unlike in the traditional Popper's approach that sidesteps the challenge, he contends. This contention is not immediately relevant to the task before this thesis and so, this contention will not be pursued any further.

¹⁷³ S. L. C. Fernandes, in his work, *Foundations of objective knowledge: the relations of Popper's theory of knowledge to that of Kant* (Dordrecht: D. Reidal Publishing Company, 1985), XIII-XIV. Fernandes demonstrates clearly how Popper's account of objective knowledge that combines deductive and evolutionary systems to lack a transcendental element which is central in Kant to be able to justify reliance on experience as reason to accept or reject test-statements. Also, the formal definition of verisimilitude and the rational justification for pragmatic belief in best corroborated theories are not accounted in Popper's account. For Fernandes, these problems arise because Popper was not Kantian enough contrary to mere acknowledgment of debt to Kant. See also, K. R. Popper, *Conjectures and Refutations*, 27.

As can be clearly observed, the thesis has briefly hinted and highlighted the limited reading, or interpretation of Popper's philosophy by reducing it to falsificationism to be rather erroneous, as there is a lot more in Popper than the falsificationism narrative tells.

2. 3 Popper versus Representationalism as a Traditional Problem of Epistemology

One of the central themes in Popper's philosophy is his revisit of the problem of representationalism in epistemology. Is the question of how we relate and represent the external world – the subject-object nexus? The epistemological problem raises questions ranging from the nature of scientific theories to the justification of the epistemic claims of scientific theories. The extent to which scientific theories reflect the world as it really is, or how to justify the claims of scientific realism is central to this problem. Underlying the challenge arising from the claim that confirming evidences confer truth on scientific theories or claims is the “common sense theory of knowledge” or “the bucket theory of the mind”, from where Popper's epistemological drift is situated; that is, the edifice of induction or the traditional epistemology of justified true belief model. The human person, according to Popper has expectations in certain regularities (laws of nature, theories, the belief that the future will always look like the past, etc.), but the challenge has always remained how these (reasons) can be justified. What is the basis or ground for causality? How is it justified?¹⁷⁴

Traditionally, induction, with the quest for justification by verification through observation and experiment was the basis by which scientific theories, laws, operate and hence, find rationality; or, as it has been well put, “the appeal to the authority of

¹⁷⁴ Popper in many parts of his epistemology compares the human person to the amoeba in its ability to relate with the external world and how to capture or describe the workings of the external world. The trial-and-error dynamics of learning from experience and mistakes makes the human person quite unique in how it relates with the external world and it is this that captures the fundamental problem of induction that Popper makes bold to say, he has solved. See more, K. R. Popper, *Objective knowledge: an evolutionary approach*, revised edition (Oxford; Clarendon Press, 1986), 1-3.

experience”.¹⁷⁵ Popper had a number of issues with this idea, for example, Popper insists on theory-laddenness of experiences which will serve as a critical point for engaging traditional epistemology of the enlightenment, exposing the pretensions of such epistemology in many ways. In other words, there is no presuppositionless/neutral experience.

Before turning to theory-laddenness, and its importance for the general thrust of my argument, I will focus on induction and how the problem was discussed by Popper. Of course, Popper was not the first to observe the problem with induction as he rightly calls the trouble with justifying theories in relation to experience of the external world, ‘Hume’s problem’.¹⁷⁶ Popper’s treatment of the problem of induction is strongly linked with his discussion of the demarcation problem. Incidentally, these two problems are referred to as Hume’s and Kant’s respectively. The response of Popper to Hume helps in a fundamental way to retain some quality of rationality for the project of science that would have been undermined if Hume’s psychological solution is to go the long haul. Particularly, the positions of Kuhn and Feyerabend will naturally result in an epistemic situation where a cacophony of epistemic voices will dominate. The result will be lack or absence of the possibility to engage in any meaningful dialogue and conversation between these positions making claims to be in possession of truth in an exclusive fashion, of course with conservative implications.

Popper’s logical solution was based on the fundamental asymmetry between verification and falsification by showing how we cannot confirm or verify the truth of a scientific statement, but can ascertain the falsity of scientific hypothesis/theory/epistemic claim by the presence of a single refuting evidence. Thus, Popper rejects the move to justify

¹⁷⁵ J. Dancy & E. Sosa (eds.), *A Companion to epistemology* (Oxford: Blackwell Publishers, 1992), 349. Popper’s epistemology was a challenge to the appeal to the authority of experience.

¹⁷⁶ Popper, *Objective knowledge: an evolutionary account*, 4-5.

arguments by inductive logic, which is at the heart of what scientific reasoning tries to do. Popper, instead supports the view that our ideas be exposed to the severest of tests of criticism;¹⁷⁷ as a theory is never proven but falsified. More importantly, the point here is that, it is an attitude to theories that allow for the potentiality of a theory to the possibility of being refuted.¹⁷⁸ Here, Popper's non justificatory intervention can be clearly delineated from the inductive justificatory epistemology.

In addition, Popper's characterisation of the nature of truth rather makes distance from truth, a useful and salient point by which we can understand the concept of truth serving as a regulative and objective standard by which the content and quality of epistemic claims can be compared, contrasted and evaluated. While truth remains the aim, the pursuit of this aim guarantees improvement and progress, the possession of it remains illusory, as truth remains an ideal, a fact that should discourage any kind of epistemic hubris and the absolutizing or totalitarian consequences associated with such claims. In other words, such nuance helps us to begin to appreciate the rational basis of epistemic plurality and the logical implications for collaborative and complementary ends to which the dialogue of traditions advocated in this thesis promises. Hence, Popper's notion of truth-likeness or 'verisimilitude', a term, the final chapter of the thesis will further explore the regulative role of truth as a rational basis for the viability and praxis of the dialogue model advanced in this thesis. As the claims of rational application is to be further subjected to some form of crucial test, the soul and value of critical rationalism which is basically what obtains in the peer review culture in contemporary science. Here, we immediately begin to see the connectedness of the two epistemological problems;

¹⁷⁷ G. Stokes & J. Shearmur, Popper and his philosophy: an overview in G. Stokes & J. Shearmur (Eds.), *The Cambridge Companion to Popper* (Cambridge: Cambridge University Press, 2016), 1.

¹⁷⁸ R. Dewitt, *Worldviews: an introduction to the history and philosophy of science*, (Chichester: Wiley-Blackwell Publishers, 2010), 66.

problems of induction and demarcation and how they flow into one another. We will examine them one after the other.

Hume basically observed the logical flaws on relying on the authority of particular instances or observations to asserting the validity or truthfulness of universal statements to be problematic, as no amount of particular instances/finitude exhaust the possibilities of what is rather larger than finitude. Or again, given that the future is not part of the past and it is more or less, yet to be experienced, to assert that the future will always look like the past (the presumption of the uniformity premise) is to make a logical leap that is wanting as far as induction and its justificatory potential is concerned. According to Bird, this Humean problem was first formulated in terms of causation. So, if an argument is going to give us knowledge of the conclusion, it must justify our belief in the conclusion.¹⁷⁹ For example, that the laws of physics have worked in the past does not logically entail that they will do same in the future. In Hume's thinking, this is part of the human situation. The way out of this logical logjam, according to Hume, is to consider psychological formatting of the human person. This creates a lot of problems for the credibility of empiricism as the ultimate arbiter or foundation of scientificity/scientific method. The solution of Hume to the problem of induction through the psychological route of our habitual nature predispose the human person to always relate with the external world as such eventually landed Hume into an irrationalist epistemological point (reason as slave of passion). The logical end of Hume's damning view was not only going to be dangerous for metaphysics, but for science as well, as it relies on the inductive principle to show its empirical and rational basis. Bird confirms this thus, "if Hume is right about induction then there is no scientific knowledge. Scientists are never justified in believing a theory. Science is not a rational enterprise we suppose it to be".¹⁸⁰ Russell

¹⁷⁹ A. Bird, *Philosophy of science* (Montreal & Kingston: McGill-Queen's University Press, 1998), 15.

¹⁸⁰ Bird, *Philosophy of science*, 172.

observes that in the face of competing rival theories, it will be almost impossible to show any difference between them if the problem with the principle of induction was not resolved.¹⁸¹

Thus, Popper sets out to salvage science and its identity while also restoring metaphysics that was the target of destruction in the philosophy of Hume. The psychological/subjective terms were formulated into objective terms and criticisable terms, thus, logically reformulated so as to show a much more appealing model by which the representations of the external world can be made without endangering the rationality of science. Popper writes “this way of looking at knowledge made it possible for me to reformulate Hume’s problem of induction. In this objective formulation the problem of induction is no longer a problem of our beliefs – or of the rationality of our beliefs – but a problem of the logical relationship between singular statement (descriptions of observable singular facts) and universal theories”.¹⁸² In this way, Hume’s ‘beliefs’, ‘impression’, ‘justification of belief’ became Popper’s ‘statements/explanatory theory’, ‘test/objective statement’, ‘justification of the claim that a theory is true’ respectively.¹⁸³ With this strategy, theories are seen as schema and upon the structure of theories, universal statements are distinguished from basic/singular or protocol sentences.¹⁸⁴ On the relationship possible in this formal structure is founded the application of the rule of reasoning Popper adopts to show the error of confirmation that observation or evidence is meant to achieve in science. The space of observable particulars is infinite and so inexhaustible, yet the scientific theory is finite and projection into the future on the basis of past experience cannot be warranted as induction readily implies. One must be quick

¹⁸¹ Cited in Popper, *Objective knowledge: an evolutionary account*, 5.

¹⁸² Popper, *Unended Quest*, 96.

¹⁸³ Popper, *Objective Knowledge: an evolutionary account*, 6.

¹⁸⁴ K. R. Popper, *Logic of Scientific Discovery*. (London & New York: Routledge, 2002), 37-38.

to add here Shearmur's remark that "it is not the structure of a theory as such which determines whether it is testable/falsifiable but rather the method we apply to it".¹⁸⁵

Using *Modus Tollens*, Popper showed the sense in which falsifiability is to be contrived. In place of induction, therefore, Popper prefers deduction to avoid the infinite regress one necessarily falls into in an attempt to use induction to justify the rational basis of science or objective knowledge. What Popper successfully does is to sidestep induction and rely on deduction. Popper is however, quick to recommend as a methodological rule, "never to give up search for universal laws or a coherent theoretical system nor ever give up any attempt to explain causally anything that we can describe".¹⁸⁶

Inductive reasoning under threat as the relationship between hypothesis and evidence in view of confirmation then had to be explored not inductively anymore, for it was found wanting. For no amount of evidence can ever confirm and justify scientific theories based on inductive principle but only a single evidence can refute/falsify scientific theory - that is, superiority of the negative case. The asymmetry was very much emphasised in Popper and should not be trivialised. This approach of Popper, Bird considers as the negative approach for the reconstruction of the rationality of science threatened by the Hume's challenge.¹⁸⁷ In other words, the non-justificatory approach to rationality which of course is not authoritarian in any form.

The question to ask at this point is then, what sets science apart from other systems of claims, theories or ideas? Do we conclude that the problem of induction gives rise to the problem of demarcation? I earlier asserted that Popper considers these two related

¹⁸⁵ J. Shearmur, 'On Barry Hindess' philosophy and methodology in the social sciences', *Alternatives: Global, Local, Political*, 36, 1 (2011), 35-36. Nevertheless, it must be emphasised as Popper declares, the more informative and daring that a theory claims, the more falsifiable/testable such a theory is.

¹⁸⁶ Popper, *Logic of scientific discovery*, 39.

¹⁸⁷ Bird, *Philosophy of science*, 177. Popper, *Logic of Scientific Discovery*, 18-19. Popper relies on the asymmetry between verifiability and falsifiability to the extent of claiming that not to fall into the pitfall of the positivists, one must be ready to admit to the empirical sciences even statements which cannot be verified by the criterion of demarcation to be chosen. Thus, Popper's nuance is basically that all verifiable statements are falsifiable but not the converse, once falsifiability criterion is adopted.

problems to be Hume's and Kant's, so will it not amount to shooting oneself on the foot to defend a view that in Popper, one of the problems gives rise to the other? How do we resolve the challenge that emerges from the foregoing analysis? We can rely on the argument of Hansen to avoid contradiction when he argues that, "Popper's solution to the problem of induction leads to the solution of the problem of demarcation".¹⁸⁸ This is because whereas induction served as both justificatory method of science as well as the demarcating criterion between what is science and non-science. Its alternative however, which Popper proposes as the falsifiability principle, can be deployed to same end but in a way that it does not exclude, or rule out, as it is not authoritarian. I must quickly add however, that, this falsifiability principle is a philosophical theory of scientific method, a point often missed by critics who raise objection to the effect that the principle itself is unfalsifiable.¹⁸⁹

Since the attribute of confirmation or its inductive preponderance characterises what is to be deemed scientific, the verifiability criterion must be satisfied. Hence, confirmability was to serve as the demarcation criterion according to the proponents of Vienna Circle. So, whatever fell out of the scope of this adopted principle was deemed non-scientific and meaningless. In this regard, the measure of meaningfulness is the extent to which any knowledge claim conforms to this standard. The Logical Positivists impressed by the successes of what they understood to be the methodology employed in the natural sciences, that is, inductive positivism, set out to eliminate from philosophy, the source of errors, metaphysics. Consistent with Hume's fork of 'matters of facts' and 'relations of ideas', the distinction between synthetic and analytic was reintroduced to save philosophy

¹⁸⁸ T. E. Hansen, 'Which came first, the problem of induction or the problem of demarcation?' I. Jarvie, et al (eds.), Karl Popper, *A centenary assessment, vol. 1 – Life and Times, and values in a world of facts* (Milton Keynes: Ashgate Reprints, 2006), 74-75.

¹⁸⁹ J. Ladyman, *Understanding philosophy of science* (New York: Routledge, 2002), 85.

according to them, ‘from the Kantian danger of mixing metaphysics with epistemology by his postulation of synthetic a priori truths’.¹⁹⁰

This project that enthralled the proponents of Logical Positivism was very problematic for Popper and he never shied away from engaging their views. Hence, Popper is sometimes thought to belong to this school of thought by some scholars, to include; T. W. Adorno, J. Habermas.¹⁹¹ For Popper, the movement pursued a programme that undermined even sciences based on the inductive logic upon which the demarcation between science and pseudo-science was to be predicated according to them. As Popper argues,

... the positivists in their anxiety too annihilate metaphysics, annihilate natural science along with it. For scientific laws cannot be logically reduced to elementary statements of experience. Here, even Wittgenstein’s criterion of meaningfulness is implicated. For if consistently applied, the criterion rejects as meaningless those natural laws the search for which, as Einstein says, is the supreme task of the physicists.¹⁹²

With these considerations, Popper found the preponderance of many disciplines and theories whose penchant for interpreting every evidence as confirmation of their scientific status suspect and troubling.¹⁹³ Hence, his aversion for Marxist, Freudian and Adlerian theories given the dogmatic and ideological tendencies inherent in such justificatory programme of their theories. For instance, Popper writes,

the encounter with Marxism was one of the main events in my intellectual development. It taught me a number of lessons, which I have never forgotten. It taught me the wisdom of Socratic saying, ‘I know that I do not know’. It made me a fallibilist, and impressed on me the value of intellectual modesty. And it made me most conscious of the difference between dogmatic and critical thinking.¹⁹⁴

¹⁹⁰ J. Kyle, ‘Analytic versus Continental philosophy’, *Philosophy Now: A Magazine of Ideas*, 74 (2009), 8-11.

¹⁹¹ T. W. Adorno, et al, (Eds.), *The positivist debate in German sociology* (London: Heinemann, 1976).

¹⁹² Popper, *Logic of scientific discovery*, 13.

¹⁹³ K. R. Popper, *Conjectures and refutations: the growth of scientific knowledge* (London: Routledge, 1963), 33-34.

¹⁹⁴ K. R. Popper, *Unended quest: an intellectual autobiography* (London: Fontana, 1976), 33.

The historical development of these modes of thinking reveal that as pre-scientific thinking characterised as rather dogmatic precedes the scientific thinking identified by critical thinking. The intellectual attitude of Einstein in the presentation of the theory of relativity was however different because Einstein risked refutation of his theory, if the results of Eddington's observation of the total eclipse in 1919 had been consistent with predictions based on the theory. Einstein's epistemic attitude stands in contrast with one exhibited by the aforementioned theorists and their explanatory strategy wherein every situation further confirms and verifies the claim of their theories. Here, the openness and readiness to be exposed to the possibility of refutation highlights an instance of one crucial epistemic principle in Popper's epistemology. It is the question of the fundamental nature of knowledge and what that means for the pursuit of science. Such an understanding can facilitate how we conceptualise knowledge and best challenge it to bring us closer to the truth – verisimilitude. It goes hand in hand with the features of an open society when conceived within the socio-political context configuration in Popper as against the feature attributable to a closed theory/system or society. The experience was particularly instructive for Popper as this approach highlighted the critical attitude best described, as one, which never desperately seeks out confirming evidences, but one, open to the possibility of error by seeking refutability through conscious exposition to rigorous/severest of tests. For Popper, the criterion of scientific status of a theory is its testability, refutability or falsifiability, and hence, the defining criterion not of meaning but of demarcation.¹⁹⁵ The attempt to immunise theories from refutation; that is, adopting the stratagem ought to be avoided, for the approach to be adopted is that of critical rationalism that defines the rationality of theories.¹⁹⁶ For Popper, Einstein's approach was

¹⁹⁵ Popper, *Unended quest*, 39-41; Popper, *Conjectures and refutations*, 36, 37, 39. Popper makes the point that there is degree of falsifiability, 36.

¹⁹⁶ Popper, *Objective knowledge*, 27, 30. Also, J. Sheamur writes that Popper at the time of writing his major epistemological work, *The Logic of Scientific Discovery* was well aware of the challenge of Pierre Duhem and other conventionalists who were of the view that it was possible to preserve any particular

truly scientific. On the basis of this, Popper went further to reflect on what the possible demarcation criterion between science and pseudo-science could be, which he termed the 'demarcation problem'.¹⁹⁷

With the foregoing sketch on the problem of induction, - (especially, - how it is used to characterise science and the demarcatory role it plays), one can see that it is relevant to the problem of knowledge in the context of science problem in Nigeria. The point becoming apparent is the close relationship there is between the two problems of induction and demarcation that Popper particularly focused upon in his epistemology. For example, it is the appeal to the authority of experience and the observation of confirming evidences which characterise how induction, does provide justification and hence, determine the rationality of science which serves at the same time as the grounds by which other claims of knowledge not amenable to its standard is dismissed as magic or superstition. It then follows that with the view of Hume, such dismissal of other forms of knowledge, that is, traditional knowledge forms relative to science based on the appropriation of the appeal provided by inductive reasoning runs into some errors because fundamentally, the rational superiority of science is effectively undermined by Hume's position and thus, the comparison that arises thereof. If my argument is correct, then, the basis upon which certain knowledge traditions are disparaged, is, - itself faulty, and so, - demands a reassessment of some sorts. Thus, Popper's intervention is commendable to the extent that it attempts to restore rationality into the equation in a way and manner that

claim which was prima facie refutable, in the face of a refutation through adhoc manipulations/adjustments. See, J. Shearmur, *On Barry Hindess' philosophy*, 34.

¹⁹⁷ Popper, *Logic of scientific discovery*, 11. The two main and related problems in Popper's epistemology are induction and demarcation. The best way to study the growth of knowledge is to examine scientific knowledge. In a way then the research focusing on the problem of science in Nigeria is fundamentally Popperian as one is questioning the basis of scientific knowledge in an African context.

does not in any way prove detrimental to traditional knowledge forms because intrinsic to his philosophy are principles that allow for a dialogue.¹⁹⁸

Keita challenges what is to many, the patronising view of Horton on African traditional thought/knowledge system, motivated by the same universal rationality (same theoretical principles) as Western modern science- a view point generally regarded as the continuity thesis – the claim that there are theoretical similarities between the two of them. This position is particularly faulty and disingenuous because only certain aspects can be evaluated along the continuity thesis of Horton. In fact, if the project had been sensitive to the history of thought, such comparative project of Horton will be irrelevant. Keita argues that Horton was therefore in error in the general presentation of the African system without any attempt on his part to distinguish the religious aspect from the general metaphysical aspects of the body of beliefs of Africans as sharing in the same explanatory, control and predictive orientation akin to how Western science operates.¹⁹⁹The interesting dimension of the presentation was the unique effort of Horton whose approach was very different from the common trend that disparaged the thought pattern of Africans on the basis that these claims do not agree with Western science paradigms and are absolutely incommensurable, replete in many other anthropological texts.²⁰⁰Horton, contrary to the

¹⁹⁸ See more, K. Popper, 'Knowledge without authority', in D. Miller (Ed.), *Popper selections* (Princeton: Princeton University Press, 1985), 46-57. It is instructive to note that some scholars like Newton-Smith argue that Popper's project to put rationality back into Western science was not successful based on the very strategy adopted by Popper; See more W. H. Newton-Smith, *The rationality of science*, 44-45. I however disagree with Newton-Smith's claim because Popper's epistemology of science taken together raises doubt about the unsuccessful attempt of Popper on the rationality project in science. I acknowledge that Popper's thoughts have received decisive criticisms, however, there are important lessons in his thoughts that we can learn from and that is exactly what this thesis explores really.

¹⁹⁹ L. Keita, 'Horton revisited: African traditional thought and Western science', *African Development*, XXXII, 4 (2007), 139-169. Robin Horton first published his primer on African thought system in 1967 and with the various responses the paper generated Horton reviewed it after three decades in 1997 under the title, 'African Traditional Thought and Western Science'. The reviewed piece however did not particularly change the core position defended in the first piece published. It is important to recall that it was in the 60s that the popular rationality debate raged and flourished in Anthropology that Horton published his primer. The debate did not entirely die out as vestiges of the debate manifest in one form or the other in many other disciplines. For instance, M. Weston, 'Forms of life: Wittgenstein and the later Heidegger', *Philosophical investigations* 33, 3 (2010), 245-265.

²⁰⁰ The trend seems to have however changed in contemporary anthropology in how knowledge systems different from the Western system are interpreted and characterised as there seems to be a lot of analysis that suggest the equality of values and systems of knowledge across cultures.

view of anthropologists like Bruhl, Durkheim, and Evans-Pritchard, holds the position that Western modern science and traditional thought or beliefs are not far from each other, basically because it is a common human enterprise, to make sense by formulating explanations that are based on analogies with other experiences.²⁰¹ In the comparison of these models of thought systems, Western modern science and African traditional thought, there is however noticeable differences in terms of penchance of over generalisation common in the latter; wherein, the idea of causality generalises by attributing every significant event to some single specific cause. In the view of Barnes, “it is a sign of intelligence to look for causes rather than to assume that things can occur with no cause whatsoever. But primitive culture does not push people very far toward evaluating probabilities or the plausibility of various ideas about what the specific causes of this or that effect might be”.²⁰²

In an assessment of Popper and his philosophy, Maxwell considers this contribution of Popper to be a radical intervention in philosophy yet to be attended with the degree of attention it deserves, a project to which Maxwell commits to achieving. According to Maxwell, Popper’s works aim to resolve some of the intellectual predilections, championed by the enlightenment thinking.²⁰³ The successful predictive competences of the natural sciences played key roles in the emergence of the social sciences in the overall thinking that the world will become a much more civilised and humane world with the adoption of the working methodology of the natural sciences.²⁰⁴ To Maxwell, there was

²⁰¹ M. H. Barnes, *Stages of thought: co-evolution of religious thought and science* (Oxford: Oxford University Press, 2000), 68.

²⁰² Barnes, *Stages of thought*, 73.

²⁰³ N. Maxwell, ‘The enlightenment programme and Karl Popper’, I. Jarvie et al (Eds.), *Karl Popper: a centenary assessment, vol. 1- Life and Times, and values in a world of facts* (Milton Keynes: Ashgate reprint, 2006), 177-190.

²⁰⁴ Maxwell defends the thesis that the enlightenment programme was basically how to learn from the successes of the sciences towards implementing its approaches in the advancement of the social reality of the world towards enlightenment and how Popper’s intervention can better square up to that project/task. In his view, the limited application of rational inquiry to only social sciences instead of developing a more comprehensive social thought/ social methodology was not deep and sufficient enough for the advancement of the world driven by the logic of wisdom and not knowledge alone towards the desired end; humane, civilised and more fulfilling world. Thus, knowledge of the social world grew towards social progress

fundamental flaw as the social sciences did not appropriate the right method that guaranteed “progress of the natural science since they did defend the erroneous inductivist account of methodology. With this enlightenment programme flawed but never the less influential, Popper’s interventions were strategic but was not totally successful”, argues Maxwell.²⁰⁵ For instance, historicism is pointed out as an instance that relies on the presupposition of the validity of the method of verifiability/ induction. That is, the quest for the discovery and application of such laws in interpreting and demonstrating the rationale of history and society show Popper’s effort in trying to correct the flawed errors of the enlightenment programme influential in the larger socio-cultural context of his time.²⁰⁶

This effort of Popper does show clearly how discontinuous and continuous his thoughts are with the enlightenment agenda. For instance, the notion of reason, rationality and truth central to science as the standard model of certain and valid knowledge, a standard which claims to be objective and universal as well are deeply enhanced within Popper’s schemes – do not appear to have similar meaning with the enlightenment programme. Such that the conception of modernity that flows from the enlightenment intellectual culture presents a problem for the liberal values that Popper cherishes so much. How do we reconcile the very paradoxical activity of the movement within the West and outside the West during the voyage of discovery. While it represented certain values in the West, the very opposites were in place in those areas outside of the West. To show the connection this discussion has for the African condition for instance, once God with his attributes is

instead of an enlightened/humane world. The insight of Maxwell in this regard, especially the distinction he tried to make between ‘traditional’ and ‘new’ enlightenment programme was novel as Popper never formulated his thoughts within this classical enlightenment framework in Maxwell. See more, N. Maxwell, *The enlightenment programme and Karl Popper*, 177-190.

²⁰⁵ Maxwell, *The enlightenment programme and Karl Popper*, 177.

²⁰⁶ K. Popper, The poverty of historicism, where Popper defends the claim that there are no historical laws of social development. Also, I. C. Jarvie, Popper on the difference between the natural and the social sciences?, in P. Levinson (Ed.), *Pursuit of Truth* (New Jersey: Humanities Press Inc., 1981), 83-107; Also, Maxwell, *The enlightenment programme and Karl Popper*, 178.

replaced by man, in fact, Western man, we can begin to imagine the relevance and linkage of this epistemological intervention championed by Descartes and others. This new moment in the history of Western thought according to Grosfoguel ushered in universal truth beyond time and space, privilege access to the laws of the universe, and the capacity to produce scientific knowledge and theory is now placed in the mind of the Western man. Thus, the Cartesian ego-cogito is the foundation of modern Western science. This epistemic strategy has been crucial for Western global designs. By hiding the location of the subject of enunciation, European colonial expansion and domination was able to construct a hierarchy of superior and inferior knowledge and thus, of superior and inferior people around the world.²⁰⁷

For with Popper comes a refreshing understanding of the enlightenment programme where “a rational society is one fully in accord with liberal traditions rather than entirely at odds with such traditions. If one upholds pre-Popperian conceptions of science and reason, and construes reason, in particular, as a set of rules that determine what one must accept or do, the very idea of the rational society is abhorrent. It can amount to little more than a tyranny of reason, a society in which spontaneity and freedom are crushed by the requirement that the rules of reason be obeyed. When viewed from the perspective of falsificationism and critical rationalism, however, all this changes dramatically”.²⁰⁸ Thus, Maxwell has argued how problematic it will be reconciling the dictates of scientific standards, in determining what defines a rational society, especially how such societies must conform to it by all means. This type of mood bespeaks of a regime of “tyranny of science or reason, where the spontaneity and freedom are crushed by the demand that the rules of reason be obeyed”.²⁰⁹ Maxwell goes on to assert that rationality as envisioned

²⁰⁷ R. Grosfoguel, ‘The epistemic decolonial turn: beyond political economy paradigms’, *Cultural Studies* 21, 2-3 (2007), 211-223.

²⁰⁸ Maxwell, *The enlightenment programme and Karl Popper*, 178-179.

²⁰⁹ Maxwell, *The enlightenment programme and Karl Popper*, 178-179.

by Popper requires a plurality of ideas, values and ways of life.²¹⁰ Thus, for Popper, the rational society is the open society, the society in which diverse ways of life can flourish. So, the open society is compatible with the scientific society. In a radical and critique of Popper, Maxwell goes on to observe that falsificationism as the method of science and the demarcating rule has some contradictions. While not leaving it at that level, Maxwell develops the ‘aim oriented empiricism’ as a much more comprehensive intellectual commitment for both the natural sciences and the social sciences, - a new intellectual revolution, to refocusing the emphasis from knowledge to wisdom, from the problem of knowledge to the problem of living. By this, any apparent contradiction that arises with Popper’s theory of falsification and the demarcation project is overcome and of course, provide positive replies to certain reservations expressed about Popper’s falsificationism or his other interventions. The goal of rationality is towards aims and methods, improvements of aims, thus improving and developing further the views of Popper’s critical rationalism, falsification.²¹¹

At a time therefore, when the methodology of the natural sciences is again beginning to define the credibility and legitimacy of every discipline in terms of relevance, Popper’s critique can illuminate the issues in broader ways. Specifically, the views of Popper on fallibility provides critical insights as to the extent to which the tyranny of evidence-based theories/researches are considered to be the *avant garde* of all other epistemic claims of theories/disciplines. Dupre has demonstrated such intellectual attitude and challenged it in preference for tolerant pluralism. According to him, “as scientific methodologies move further away from their central areas of application, their abstractions become ever grosser, and their relevance to the phenomenon become ever more distant”.²¹²

²¹⁰ Maxwell, *The enlightenment programme and Karl Popper*, 179.

²¹¹ Maxwell, *The enlightenment programme and Karl Popper*.

²¹² J. Dupre, ‘Against scientific imperialism’, *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, 2 (1994) 380. This interesting topic of scientific imperialism has recently been taken

In addition, the views of Popper highlighted above in relation to the overall project of demarcation of science and pseudo-science has found very robust application in the intellectual attention Africa and Africans have received from many experts in various disciplinary fields. For instance, the debates between the proponents of continuity thesis (evident in Horton's view that defends a common theoretical basis/principle for both Western modern science and African thought system) and opponents of such in anthropological narratives best exemplifies the influence and appropriation of the intellectual characterisation underlies what is rational, scientific, reasonable on the one hand and what is not scientific, non-rational and unreasonable on the other hand. At the background of some of these intellectual interventions include the fine appropriation of Popper's distinctions of open and closed societies with "other significant details that accompanied the colonial programme".²¹³ It goes without saying that some of the pretensions that informed the colonial programme in Africa had well thought out intellectual and philosophical foundations that propelled the convictions and activities of the colonial experiment in Africa. The contributions of Hegel, Locke, Kant amongst others to the build-up of the rationalisation of the colonial mission, to civilise, to modernise the people, their cultures and civilisations cannot be underestimated in this

on by S. Clarke and A. Walsh in their paper 'Scientific imperialism and the proper relations between the sciences', *International Studies in the Philosophy of Science*, 23, 2 (2009), 195-207. The paper noted the various senses in which the term is used (scientism, pre-clinical testing of pharmaceuticals in under developed world, etc) with reference to how Dupre employed it in his works. They tried to fill out the concerns not accounted for in Dupre's account, like the normative dimension of scientific imperialism. However, M. Uskali, 'Scientific imperialism: difficulties in definitions, and assessment, (forthcoming) *International Studies in the philosophy of Science* claims to have a much more comprehensive and nuanced account as a dynamic feature of relationship among disciplines and with distinctions of such incursions that are recommendable and those not recommendable with definitely difficulties in putting into practice. Available Online: <http://www.helsinki.fi/tint/maki/materials/MakiSciImperialismISPS3sept2012.pdf> [Accessed on 01/11/2015].

²¹³ R. Grosfoguel has vehemently defended the decolonial project along the lines of showing some fine details of the colonial project along the many historical phases it developed. Accordingly, coloniality and modernity were mixed and in fact two sides of the same coin such in that any decolonial intervention that fails to appreciate the connection falls for the myth of a postcolonial reality and the reductionist reading of the colonial system as purely a capitalist system. Ramos therefore agrees with Dussell on Transmodernity as the viable model of horizontal system where in diversity is emphasised. The importance of this view is seen in this research that considers Popper's philosophy as instrumental and able to mid-wife such a decolonial possibility. (See, R. Grosfoguel, 'A decolonial perspective'. Lecture Series and Workshops, 17-19 May, 2011. Institute of European Ethnology, Berlin).

regard.²¹⁴ To contend this challenge has been central to a number of experts in various fields of endeavour. For instance, Yoshida contrasts Winch with Jarvie and Agassi, to examine two approaches to the problem of rationality. Winch's view entails relativism because language and context are primary and all that there is to our understanding reality while the views of Jarvie and Agassi relying on Popper's paper, 'Towards a rational theory of tradition', insist on degrees of rationality.²¹⁵ Hence, the applicability and preference for the thoughts of Popper to interrogate African issues is illustrated in many ways better and deeper than can be seen in many others like Feyerabend or Kuhn, for instance. And very often, the contrast between 'closed societies' and 'open societies' characterise some discourse of epistemic values and belief systems of Africans versus the West are a commonplace.²¹⁶

The thought system of Africans was often categorised or compared with standards of rationality/truth/objectivity from the perspective of Western science system with its claim of universality and objectivity in total disregard of Popper's emphasis of the 'conjectural/hypothetical/tentative nature of scientific claims'.²¹⁷ The civilisation programme in Africa never embodied such epistemic outlook highlighted by Popper. For instance, on the nature of knowledge claims, scientific theories, according to Popper, are provisional/conjectural and are not presented as claims of truth in the nature of

²¹⁴ At this point, Hegel writing in his *Phenomenology of the spirit* insisted that the Absolute has not yet attained self-consciousness in Africa. Writing in another context, Popper discusses 'the myth of the univocal voice', that we are to always distrust any overarching sense of intellectual, social or moral unanimity', See more, K. Popper, *Conjectures & Refutations*, 5th edition, (1989), 172.

²¹⁵ K. Yoshida, 'Rationality and other cultures', in I. Jarvie (ed.), *Karl Popper: A centenary assessment*, vol. III- Science (Milton Keynes: Ashgate Reprint, 2015), 251-260.

²¹⁶ For instance, P. Winch, 'Understanding primitive a society', *American Philosophical Quarterly*, 1, 4 (1964), 307-324. R. Horton represents the continuity thesis in his classical piece, 'African traditional thought and Western science' *Africa: Journal of the International African Institute*, 37, 2 (1967), 155-187; R. Horton, 'Levy Bruhl, Durkheim and the Scientific Revolution', in R. Horton and R. Finnegan (eds.), *Modes of thought* (London: Faber and Faber, 1973); E. E. E. Pritchard's *Witchcraft, oracles, magic among the Azande* (Oxford: Oxford University Press, 1939); L. Bruhl, Durkheim and others represent anthropological narratives that insists on discontinuity thesis as regards the contents of thoughts of the Western science tradition versus the African tradition of thoughts. And several anthropological reports about African society and people are fraught with these typologies and symbolisms.

²¹⁷ Popper, *Objective Knowledge*, 9.

certain/absolute finality.²¹⁸ Otherwise, such knowledge claims become totalitarian and absolutist with inherent dogmatic or ideological tendencies. They are in no way different from epistemic claims in the pre-scientific stage where dogmatism reigns supreme.²¹⁹ Thus, knowledge claims are perpetually open to the possibilities of improvements since human beings are not immune from error or mistakes. Little wonder then, Popper is strongly of the view that scientific progress occurs through mistakes, correction of such mistakes and learning from such mistakes. This, Popper technically refers to ‘trial and error’, or ‘conjectures and refutations’, as one of his collected essays is titled.

When a scientific theory is proposed as tentative solution to a problem or problem situation, it must be consistently and ferociously tested and exposed to severest of test. In the face of passing such tests, it is not to be seen as possessing truth but that of all available theories, it is the most tested and have survived of all the competing theories, the most corroborated and remains as such while efforts to refute it remains ongoing. The schema of science according to Popper follows: “problems-theories-criticisms”.²²⁰ Science does not possess truth and what it gives is basically theories and laws that are of less error than the others.²²¹ The import of this is that, when epistemic claims are not in possession of truth as such, (of course, his notion of verisimilitude is emphasised here) it behoves on such claims to remain open and modest in how its proponents propagate them. In this

²¹⁸ Popper, *Conjectures and Refutations*, 116. The hypothetical nature of theories does not suggest that they do not reflect the world for even their rejection based on the clash with aspect of the world is itself enough to show that indeed theories’ hypothetical nature does not mean they are incapable of reflecting what is or what is not true of the world.

²¹⁹ For Popper, Open and Closed societies are central terms Popper used to examine Plato, Hegel and Marx in his anti-authoritarian epistemology in relation to knowledge claims that characterised societies where liberalism or freedom were undermined given the burden of totalitarian and authoritarian conception of truth and power in the thoughts of Plato, Hegel and Marx. The ideological and dogmatic dispositions of such systems arrogantly will not allow space for the possibility of mistakes or error on the part of the systems built by Plato, Hegel or Marx.

²²⁰ K. R. Popper, *The myth of the framework: in defence of science and rationality*, 101.

²²¹ Popper, *Objective Knowledge*, 30. In Popper, truth serves more as a regulative principle even though he shared the correspondence theory of Alfred Tarski who revived the notion of truth as correspondence in Aristotle.

regard, Hetherington's remarks in the introductory part of this chapter are made practical and real.

In place of verificationism, Popper regarded falsificationism as a proposal based on the asymmetry between the two concepts to ascertain by logical relations, the status of scientific theories.²²² Popper, was therefore set on a collision course with the analytic tradition built on early Wittgenstein, motivated by the hope that linguistic exegesis was adequate to dissipate the so-called problems in philosophy. In sharp disagreement with such a position, Popper was convinced that genuine philosophical problems are beyond language solution proposed and to which, science and philosophy are legitimately directed to resolve. One of such hard problems was the riddle of the world; the problem of knowledge exemplified in the study of the growth and development of scientific knowledge.²²³ For Popper, it is in fact because of the viability of such problems, that both science and philosophy find rationale as they are directed to tackling the problems even in the face of apparent failures at resolving some of the problems. To consider Popper's project broadly therefore, will save one from not falling into any form of hasty conclusion

²²² The idea of a fundamental asymmetry between verification and falsification has been underplayed in some works to show that what indeed Popper claims to affirm is indirect induction. For instance, A. Sokal and J. Bricmont's *Fashionable nonsense: postmodern intellectuals' abuse of science* (London: Profile Books, 1998) claim that any theory that succeeds an attempt at falsification has somewhat being confirmed. After all, scientific theories are accepted on the basis of their propensity for success, Popper however disagrees and insists that no matter the number of times, it remains it can never be confirmed rather it can be said to be corroborated, that is, of all other available or competing theories or rival theories it is approximates truth but never confirmed. Such theories enjoy pragmatic preference no doubt as there is never absolute reliance but rational (rational is used here advisedly as Popper makes a nuance with two senses by which such choices are made. That is, the choice is not *rational* in the sense that it is based upon good reasons for expecting that it will in practice be a successful choice; there can be no *good reasons* in this sense, and it precisely Hume's take on induction) to choose the most corroborated of theories for action. Both authors went ahead to wrongly accuse Popper of failing to draw any hedge between astrology and astronomy, a reading which have been rightly contested by David Miller and others to show that while astronomy has within the property of falsifiability, astrology lacks such properties. (See more, Popper, *Conjectures and refutations*, 22-23). Also, L. Williams, 'Karl Popper: the enemy of certainty, part 5: the craving to be right. Available online: <http://www.theguardian.com/commentisfree/be:ief/2012/oct/08-karl-popper-enemy-certainty-craving>. [Accessed 25/09/2015] writes about Sokal and Bricmont as 'defining confirmation as when a theory passes the test of falsifiability; that is, attempts at corroboration, it is confirmation', Popper strongly disagrees with such simplistic readings of his distinctions.

²²³ Popper, *Logic of scientific discovery*, XXII-XXVI.

about his contribution as often thought by some commentators who limit all of Popper's work to falsificationism.

After all, there are important epistemological questions Popper sought to deal with in his philosophy of science. To then conclude that falsification exhausts his intervention is to deal with only one of the two major problems of interest to Popper.²²⁴ The problems of induction and demarcation, however related are distinct. The reading of Popper's philosophy as a response to enlightenment epistemology can be strategic for the emergence of the epistemic conditions required for the dialogue of traditions of knowledge as advocated in this thesis. These conditions have been inadvertently made dysfunctional largely because of the epistemic hubris of Western science in relation to African knowledge tradition and so had prevented such dialogue over the ages in the African science context. The inductivist pretension taken (as both standard of acceptance and demarcation) applied in the excoriation of African knowledge systems by the explorers of Africa that rejected/denied/neglected these bodies of knowledge. Popper's intervention on these two problems of knowledge are instructive given the fundamental flaws the unexamined appropriation of these by Western modern science in relation to the knowledge situation in Africa and so the thoughts of Popper can be used for the reassessment of this relationship and what it has caused.²²⁵ The objective is to undercut the self-image of Western modern science in its appreciation of the epistemic worth of other knowledge traditions. In this case, the African knowledge tradition is hoped, does

²²⁴ For instance, T. T. C. Hang claimed that both Carnap and Popper were guilty of scientism in laying down an experimental standards (of verifiability or falsifiability) for all philosophical rationality. The claim of Hang that Popper is guilty of scientism just like the Logical Positivists is erroneous from a simple understanding and appreciation of Popper's stand as far as the project of the Logical Positivists was concerned. More so, the emphasis of Popper is the openness or readiness to be exposed to the severest of tests that defines philosophic rationality rather than the falsifiability principle alone as claimed by Hang. Cf. T. T. C. Hang, 'Why Chinese civilisation has not discovered modern sciences', in V. Shen & T. V. Doam (Eds.), *Philosophy of science and education: Chinese and European views* (Washington DC: The Council for Research in Values and Philosophy, 1995), 128.

²²⁵ For example, S. Hendrix & B. Feltham, (Eds.), *Rational magic* (Fishers Imprints, 2011). There are several barriers to understanding societies because of the trend in scholarship to always ignore analytic approach to studying aspects of a people's beliefs system in opposition to enlightenment concept of rationality and scientific orientation.

have some potential relevance for humanity, volume regardless.²²⁶ More importantly, this thesis is interested in shifting the ‘geography of reason’²²⁷ with the overall interest to find an appealing rational basis for the conversation/dialogue important to resolving the tension of worldviews at the base of the problem of science advancement in Nigeria. Adas argues that less arrogance and more sensitivity to African and Asian thought systems, production techniques, and patterns of social organisation would have greatly impacted positively to the development better suited to third world societies as opposed to Western approaches and systems. To him, this would have made Africans more aware of their indigenous cultures and hence, build better upon them more seamlessly.²²⁸ In fact, the neglect of the foregoing standards for African development have thus only succeeded in popularising all things Western and as such, overridden and undermined African ingenuity and heterogeneity. According to Adas,

the demise of these diversities and ingenuity means been dominated by Western modern science and technology. The need to advance development in these contexts more qualitatively, have however, made it imperative to preserve difference and heterogeneity; which means, Western thought must be open to accommodating other thoughts and epistemic values especially as related to Africa.²²⁹

²²⁶ The challenge here is an important one not only to African knowledge system but also for science as well. For example, according, Goonatilake the uncertainty question at the core of the conceptualising the fundamental particle physics indicate epistemological crisis of our perception of the physical world provides opportunity for experts in the third world to break out of the imitative science they very often follow. An opportunity to be creative themselves and make contributions to resolving this problem at the heart of science using some of their peculiar traditional resources. See Goonatilake, *Scientific expansion (And contraction): Review*, 434.

²²⁷ Shifting the geography of reason is a phrase that serves as the motto of the Caribbean Philosophical Association, (CPA). It is used to denote the project of scholars committed to the decolonial scholarship especially in the south and employed as critique of knowledge production as dominated by the North. The movement for instance projects an ecology that perceives humans an integral part of nature considered as an end in itself as against the Cartesian understanding of nature with which modern science and technology operates motivated ultimately by an understanding that perceives nature as means to an end. It is unlikely therefore to come to some conclusions that the environmental crisis and challenges of sustainable development in recent times is a pointer to this view point. See more, M. P. Banchetti-Robino & C. R. Headley (Eds.), *Shifting the geography of reason: gender, science and religion* (Newcastle: Cambridge Scholars Press, 2006).

²²⁸ M. Adas, *Machines as the measure of men: science, technology, and ideologies of Western dominance* (Ithaca & London: Cornell University Press, 1989), 15.

²²⁹ Adas, *Machines as the measure of men*, 16.

The view as expressed in the elaborate and detailed quotation in the foregoing show clearly the epistemic attitude (important in Popper no doubt) and ideological dominance that were as a result of direct comparison of technological instruments/tools between the West and these societies as ‘superiority of technology’ was evidence of superior versus inferior abilities. Accordingly, such assumptions were to play fundamental roles in education too as the next chapter on the state of science will develop clearer.

2.4 Popper’s Thoughts in Broader Context

Within his epistemological schema, Popper laid a very important foundation for his social and political thoughts where he challenged the ideological presuppositions and totalitarian assumptions in Marxism (historicism), Plato, and Hegel which had consequences for libertarian ideals so dear to him.²³⁰ The question to ask at this juncture therefore, is, how Western modern science embodies these epistemic virtues in Popper in relation to the African situation; especially the science situation in Nigeria? Well, the response is in the negative. The implication of the response to this question is significant for the project of science/knowledge in the Nigerian context. The evidence of this is found in practice of science education at a very broad and general level to which I give some attention later in chapter five. The role of teachers of various science subjects in promoting public appreciation of science culture and how that plays a role to improve science literacy in societies is a task that goes beyond the formal classroom to one that includes, educating the public as well. This is to help ensure that the benefits of mutual connection between the two realms can be harnessed towards the targeted objective of advancing the culture of science in the society. This is achieved by engaging both the public and the scientists in reflecting on what science really is, how it is presented, its history, nature and mode of operations in society with respect to its

²³⁰ K. Popper, *The poverty of historicism* (London: Routledge & Kegan Paul, 1961).

possibilities/deliverables and limits too.²³¹ Such a project is important against the backdrop of the concerns that have been raised by some other scholars as regards some ‘myths’ about science in the public space.

For instance, Moreland, generally writing in the context of the relation between science and religion is of the view that despite the intellectual attention science has received, there is a pervasive notion of it as the only model of truth and rationality in popular and scientific culture.²³² While Popper notes that ‘scientific explanations do not exhaust all that there is to reality’,²³³ the extent to which the potentials of scientific enquiry are explored and projected in ways to suggest an all capable means to addressing all of the challenges of day to day experiences of humans remains largely suspect. Such limitations applied within the context of Nigeria where there is apparent failure of political leadership which inadvertently fails to propel the full transition of consciousness that gives primacy to the potentials of what scientific explanations are capable of achieving make rather unclear delineating the boundaries of what is in the realm of science or otherwise. Thus, the perceived mythical consciousness is in constant strife with the scientific consciousness as competing theories for the challenges people face in Nigeria with respect to simple mundane matters. The problem is compounded in Nigeria by what Okeja refers to as ‘hybridism especially within the religious context’ that cuts across the Nigerian society.²³⁴ In any case, these matters are important in the project of the culture

²³¹ J. Agassi, *Science and its history: a reassessment of the historiography of science* (Boston studies in the philosophy of science, Springer, 2008); J. Gregory & S. Miller, (Eds.), *Science in public: communication, culture and credibility* (Cambridge: Basic Books, 1998).

²³² J. P. Moreland, *Christianity and the nature of science: a philosophical investigation*. (Grand Rapids: Baker Books, 1989).

²³³ Popper, *Conjectures and refutations*, 29. Here Popper talks about human ignorance even in the face of the all that we grasp of the vast universe.

²³⁴ U. Okeja, ‘Witchcraft and magic in African context’, in S. Hendrix and B. Feltham (Eds.), *Rational magic* (Fishers Imprints, 2011). The idea of hybridism is widespread across the society as it provides escapist route for the people in their indisposition to confront reality or what they do not like and so, defer to God’s hands/intervention. Hence, instead of a market economy, it is a praying economy that predominates in many African countries. The ideological/dogmatic tendencies of such epistemic attitude are too obvious to outline here. The consequences of this regime of consciousness promotes all sorts of challenges ranging from human rights abuses on the purported claims and accusations of witches and wizard. As evident in the work of U. Onuzulike, ‘Children accused of practicing witchcraft in Akwa-Ibom

of science that Western modern science in Nigeria still grapples with, from the classroom to the larger society's body of knowledge or worldviews because as people come to class, these matters as part of the larger body of beliefs come with them into the science classroom situation.

Popper, in a very interesting manner has tried to revolutionise traditional epistemology capable of opening up the epistemic space for the contestation of all sorts of epistemic claims. On the basis of such reformulation, this thesis insists the epistemic heritage of the people can be better interacted with that can facilitate some exchange germane for the advancement of science in Nigeria. Thus, rather than the hitherto exclusionary outlook and denial disposition, an engaging model envisaged in Popper when he introduces the community into the science process is helpful. In Popper's words, "science and more especially scientific progress are the results not of isolated efforts but of the free competition of thought".²³⁵ Within this kind of thinking therefore, certain African epistemic claims can be interrogated, by way of adopting an epistemic approach that allows for engagement so as to ascertain their error status. As Appiah observes, the status of one's epistemic stance is not some finality as with the preserve of confirming evidence; this can be enhanced.²³⁶ At the same time open to the possibility of contrary ones targeted at the correction and elimination of beliefs held falsely. The overall aim is the recognition of the non-finality of our epistemic confidence; there should be room for improvement. We approach reality trusting our rational/cognitive faculties with trust not with suspicion; in other words, innocent until proved guilty and not contrary. Not with suspicion, the

state, Nigeria: analysis of online media", *International Journal of Child, Youth and Family Studies*, 4 (2013), 447, 467. The author concludes that the beliefs should be engaged and not flatly denied while in dialogue with those who hold such beliefs.

²³⁵ Popper, *The Poverty of Historicism*, 154-155.

²³⁶ K. A. Appiah, 'African Studies and the concept of knowledge', *Poznan Studies in the Philosophy of the Sciences and Humanities* 88, 1 (2005), 23-56.

deliverances of our rational capacities are not infallible. We should trust them until we have reasonable grounds for doubt.²³⁷

The foregoing adumbration is in line with the relevance of the distinction that Bird makes between a reliabilistic and optimistic approaches to knowledge. An interesting distinction that will warrant an elaborate quotation while we pay attention to the terms used by Bird, which, in my view, are profoundly Popperian. Bird argues that if we take the path of the former relative to the latter then,

We should be more open to the possibility that other cultures may have developed or stumbled across methods that happen to be reliable. Furthermore, it is perfectly compatible with a method being reliable that those using it misunderstand it. For instance, a **witch doctor** may have a procedure for making prognosis on patients with certain illness. He attributes the success of the method to occult powers, spirits of ancestors, and the like. Yet the procedure may be reliable for physiological reasons unknown to him. Such ignorance does not prevent him from using it to make successful predictions about recovery or death, predictions which can amount to knowledge. In this way, reliabilist epistemology is more liberal than internalist epistemology or the optimistic view of the scientific method. This should make us want to modify the cumulative progressive, traditional picture of scientific knowledge. First of all, science cannot have an exclusive claim to (sophisticated) knowledge. Secondly, the accumulation of knowledge is imperfect. Some pieces of knowledge get forgotten if they are not accommodated. It is probably the case that many efficacious herbal remedies have been ignored or lost altogether because they lacked the prestige of scientific medicine.²³⁸

The relevance of Bird's elaboration on the reliabilist approach to knowledge hinges on the epistemic consequence that can be derived from it, one which is consistent with the "Socratic Method to dignify the alternative views"²³⁹ while educating those who hold such views or belief system. This no doubt is in sync with the pluralistic epistemology I

²³⁷ K. A. Appiah, 'Akan and Euro-American concepts of the person', in L. M. Brown (ed.), *African philosophy: new and traditional perspectives* (2004), 21.

²³⁸ A. Bird, *Philosophy of science* (Montreal & Kingston: McGill-Queen University Press, 1998), 267-268. The term witch doctor as employed by Bird is however problematic as many scholars within African philosophical tradition will easily disagree with him because of the inherent Eurocentric bias of the terms. Recall that the belief and practice was suppressed by the Christian tradition in the evolution of European culture and the subsequent role of this tradition in the expansionist programme of a number of Europeans in Africa. An example of a work by one the philosophers who will disagree with Bird is, A. Mosley, 'Witchcraft, science, and the paranormal in contemporary African philosophy' in, L. M. Brown, (ed.), *African Philosophy: New and Traditional Perspectives* (Oxford: Oxford University Press, 2004), 136-160. I will engage more of this discussion in the next chapter.

²³⁹ W. W. Cobern & C. C. Loving, 'Defining "Science" in a Multicultural World; Implications for science education', *Science Education* 85, 1 (2001), 64.

have argued, is derivable from Popper's thoughts. A view that reasserts Hart's claim that "the assertion of the absence of science in every other culture - rested on little more than ignorance of the sciences of other cultures, mistaken for the ignorance of other cultures of science".²⁴⁰

2. 5 Popper's Reformulatory Strategy in Epistemology and Politics: As a Basis for His Ontological Leap

Another important theme in the philosophy of Popper is the ontological access route to his epistemology and politics because the foundational questions that underpin these discourses are revised in ways that transforms fundamentally. According to Popper, the fundamental problem to which both science and philosophy have legitimate task to tackle is "the cosmological question of how we are able to understand the world- including ourselves, and our knowledge- as part of the world".²⁴¹ In a sense, one can begin to notice how Popper ties two important aspects of philosophy; that is, metaphysics and epistemology together in an attempt to present his view on science. It seems to be a common feature as Popper did attempt to apply the metaphysical formula to other enduring problems in philosophy, like the mind-body problem for instance.²⁴²

Popper argues that traditional epistemological question about the "sources of knowledge" confuses the question of 'origin' and the question of 'validity'. The question is authoritarian in spirit and therefore misplaced. It should rather be reformulated into, "how to detect and eliminate error". For Popper it is through critical rationalism, technically, an epistemic attitude, a view and a tradition that has a very long history down to the

²⁴⁰ R. Hart, 'Beyond science and civilisation: a post-Needham critique', *East Asian Science, Technology, and Medicine*, 16 (1999), 89.

²⁴¹ Popper, *Logic of scientific discovery*, 2002, XVIII.

²⁴² K. Popper & J. Eccles, *The self and its brain: an argument for interactionism* (New York: Springer International, 1977).

Greeks.²⁴³ Relatedly, it is not then difficult to understand the connection that there is in Popper between a culture of science and the socio-political practice of democracy underpinned by the question of how the state is to be constituted so that bad rulers can be got rid of without violence or bloodshed, rather than one defined by the foundational question of who should rule as Plato's republic names the philosopher kings – only those who have privilege access to the truth (post truth).²⁴⁴ In this connection, it envisages a system where active critical engagement and self-criticism are taken seriously by all. Thus, it is the rational society, one which is open to be consistently engaged and interrogated, for only such exchanges guarantees sustainable improvement. As Chang argues,

... we come back again to the inevitable political dimension of knowledge, and the ineliminable link between knowledge and politics, between science and policy. And again scientists and others who extol the virtue of science might take a humble lesson from the messy world of politics, in which people have learned some valuable lessons over the centuries through unspeakable suffering of millions caused by failed political systems. Without pretending that the current forms of pluralist liberal democracy are anywhere near perfect, we should also acknowledge that they are protecting us from far worse excesses. There is a simple and crude pluralist lesson: at least have a two-party system, not a one-party system; yes, pluralism is less efficient than totalitarianism in many ways, but we have to remember that efficiency creates a nightmare if it serves a nefarious aim. Science has learned some basic lesson about its governance, including the principle of peer review.²⁴⁵

In furtherance of his intervention, Popper maintains the distinction between the context of discovery and the context of justification while relying on Reichenbach to home in the point about the error of confusing the question of origin with that of validity.²⁴⁶ In this regard, Popper will find no particular source of knowledge as the sole and reliable one, but whatever epistemic claim that is made arising from anywhere is to be consistently

²⁴³ Popper, *Conjectures and refutations*, 26-27. Origin and pedigree have little or nothing to do with truth. For every source is welcome but must be exposed to severe test; i.e. criticism.

²⁴⁴ Popper, *Conjectures and refutations*, 25.

²⁴⁵ H. Chang, *Is water H₂O? Evidence, Realism and Pluralism* (Dordrecht: Springer, 2014), 264.

²⁴⁶ Popper, *Unended quest: Intellectual autobiography*, 65. Here, Popper criticises Kant who mistakes a genetically or psychologically apriori to also be valid apriori. The distinction captures how ideas prop up and how such thoughts or ideas can be justified. Its relevance to science as far as the problem of objectivity and some other values are concerned is so crucial to both science and philosophy.

subjected to the crucible of critical rationalism. For instance, the place of intuition is not a problem to Popper as far as its epistemic claims are to be subjected to thorough and severe tests. Parvin lends support in the claim that philosophy of Popper was fundamentally a critique of the enlightenment epistemology because the reconfiguration of the epistemological bases of the rationalist tradition challenged dominant understandings of rationalist and analytic philosophy'.²⁴⁷ However, it is important to remark that the distinction between context of discovery and the context of justification may not entirely be clear in a way that values are totally eliminated even in the evaluative aspect of the real work of testing in science and scientific practice. As Bird argues, "devising and carrying out of novel experiments requires considerable inventive imagination".²⁴⁸ Popper may also be alluding to same point when he states that, "then what I originally regarded as the psychology of discovery has a basis in logic: there was no other way into the unknown, for logical reasons".²⁴⁹

The distinction between contexts of discovery and justification has implications for knowledge tradition within which science in the context of Nigeria is to develop significantly, as it has been important in the traditional story about the objectivity of Western science. Since Popper makes a fine distinction between the psychology of knowledge and the logic of knowledge, the convolution of the two often causes trouble for scholars. The empirical psychologist may focus upon the former while the epistemologist's concern is the latter. It is against this background that even the role of intuition in the process of knowledge is not out rightly denied in Popper.²⁵⁰ The thesis has noted earlier that the central role of the method of induction in science is that it serves as

²⁴⁷ P. Parvin, 'The rationalist tradition and the problem of induction: Karl Popper's rejection of epistemological optimism', *History of European Ideas*, 37, 3 (2011), 257.

²⁴⁸ Bird, *Philosophy of science*, 260. Bird goes ahead to detail an intriguing account between Felix Ehrenhaft and Robert Millikan. Millikan used the oil drop experiment to show that the electron carried the basic unit of charge whereas Ehrenhaft held that the charge could come in continuous quantities.

²⁴⁹ Popper, *Unended quest: intellectual autobiography*, 65.

²⁵⁰ Popper, *Logic of scientific discovery*, 8-9.

demarcation between science and metaphysics for the Logical Positivists.²⁵¹ Therefore, the demarcation problem is key to the question of understanding the knowledge tradition in Africa and as Popper argues, the empiricist leaning or the positivist tradition emphasise the problem in a very unique manner as they conceive it in a naturalistic way. As Garrard and Wegierski acknowledge thus,

it can be argued that technology and scientific positivism constitute the dominant ideology of Western civilisation today. Technology has indeed become, as Heidegger noted, the metaphysics of our age, a totalistic form of secular religion ultimately incompatible with the existence of rival, nontechnological assumptions, beliefs, or thought systems.²⁵²

Basically, it comes down to what Popper calls, “positivist dogmatism”²⁵³ which I broadly problematised in the opening chapter of this thesis. In other words, the problem of science in Africa is strongly connected to the project that was central to Popper’s engagement with the problem of induction. With the position of the inductivist logic and the necessary contradiction it leads by not succeeding to eliminate metaphysics it sets out as target to eliminate as meaningless, the new method of demarcation is to serve as a proposal for an agreement/convention in terms of the motivational basis – seeking for truth.²⁵⁴ Here Popper envisages that reasonable discussion between parties committed to truth and disposed to listen to each other is possible in seeking to dare in uncharted areas.

To reiterate the point made earlier, Kant’s philosophy as a response to Hume’s sweeping criticism of causality as the basis of induction was important to Popper in his acknowledgment of his debt to Kant’s thought. The attack of Hume on induction ultimately targeted at the elimination of metaphysics, the source of ambiguity and confusion in philosophy was severe. Ironically, such damning criticism was set to even undermine the project of science and scientific methodology itself. Kant’s response was

²⁵¹ Popper, *Logic of scientific discovery*, 11.

²⁵² G. Garrard and M. Wegierski, 1991 as cited in Cobern and Loving, *Defining “science” in a multicultural world*, 63.

²⁵³ Popper, *Logic of scientific discovery*, 15.

²⁵⁴ Popper, *Logic of scientific discovery*, 15.

particularly relevant but not entirely successful in saving the day; that is, providing necessary and sufficient rational/epistemic basis for the workings of science. The categories of the mind are constitutively and inherently part of the nature of humans in relation to the world. These categories come to the fore at every opportunity the mind is to experience or grasp the world. Even though they are psychologically a priori, they are not valid a priori as Kant would have us to believe. On this, Kant was overreaching according to Popper. In Kant therefore, the problem of linking the subject with the object of the external world remained intractable.

To be more precise, subjective realism reared its head in Kant's rational system as every access to the external world retained the idiosyncrasies of the subject he calls 'categories' in knowing the world; time – space – causality, for instance. The question of how to characterise the world in itself remained epistemologically impossible in Kant haven made the distinction between the world as it appears to us (phenomena) and the world as it is itself (noumena). The accessible world as it appears to us was always possible through the structure of the mind that seeks to know it. The obvious consequence then, is the epistemological problem of objectivity. Popper examined knowledge as objective rather than subjectively. This way of looking at knowledge made it possible for him to reformulate Hume's problem of induction. In this objective reformulation, the problem of induction is no longer a problem of our beliefs – or of the rationality of our beliefs – but a problem of the logical relationship between singular statement (descriptive of observables singular facts) and universal theories.²⁵⁵

The contribution of Popper to the object-subject problem cannot be disparaged in discussing the state of science in Nigeria because of the problematic claims of objectivity that arises in how Western modern science operate in an African colonial context. The

²⁵⁵ Popper, *Unended quest: an intellectual autobiography*, 96.

question will then be whether there are values and interests which underlie the claims of Western modern science in relation to the knowledge tradition in Nigeria. If, as Bartley says of ‘Popper’s philosophy renders traditional epistemology and much of the rest of traditional philosophy obsolete’ is anything to go by,²⁵⁶ one can then begin to appreciate the effort of Luaer and others who rely on some perspectives in the history and philosophy of science as a basis to rethinking tacit assumptions about African intellectual heritages. These, according to Luaer help to overcome the illusion that there exists an indomitable, diametric opposition between African’s allegedly regressive cultural attitudes and indigenous superstitions about nature versus the enabling paradigms that have nurtured scientific initiative exclusively within the cultural purviews of Eurasia and the America.²⁵⁷

According to Popper, the enlightenment/traditional epistemology’s consideration of knowledge in such subjective propositional terms has caused traditional epistemology and epistemic logic to become atrophied.²⁵⁸ Popper was able to come to such conclusion as result of his *pluralistic* ontology (often ignored by many commentators) as the basis for the ‘kind of epistemology he engages’.²⁵⁹ The theory of the three worlds is a clear demonstration of Popper’s commitment to realism (belief in the real world).²⁶⁰ This sort of realist commitment does not suggest a materialistic type but the metaphysical brand. This effort conceptualised as an evolutionary process was his attempt to reclaim from

²⁵⁶ W. W. Bartley, ‘A Popperian harvest’, P. Levinson (ed.), *Pursuit of Truth: Essays in Honour of Karl Popper’s 80th Birthday* (New Jersey: Humanities Press, 1982), 279.

²⁵⁷ H. Luaer, Philosophy of science and Africa in A. Afolabi & T. Falola (Eds.), *The Palgrave Handbook of African Philosophy* (New York: Palgrave Macmillan, 2017), 539-556.

²⁵⁸ Popper, *Objective knowledge*, 108.

²⁵⁹ Popper, *Objective knowledge*, 108-109. For scientific theory belongs to world three and not world two, where the subjective propositional terms (*I know*) emphasised by traditional epistemology as done by, for instance, Hume, Locke, Berkeley, and Russell. To study scientific knowledge which is in the third world in the way the subject in world two is to be understood is mistaken accordingly.

²⁶⁰ R. Corvi, ‘Reflections on the interactionist dualism of Karl Popper’, *Revista di Filosofia Neo Scolastica*, 89, 2/3 (1997), 343. This pluralistic ontology makes for rational appreciation of the fine distinction Popper makes between the ‘context of discovery’ and the ‘context of justification’. The creations of the human mind constitutively make up the world three but do exercise plastic control over the other worlds in ways far unanticipated.

destruction delinking of ontology and epistemology evident in Kant's philosophical system. That is, the 'theory of the three worlds' forms a critical aspect of the metaphysical structure of his entire epistemology made of 'world one, world two and world three'. For him, traditional epistemology deals with issues and concerns of the subject restricted to the second world.²⁶¹ By this, Popper's anti-foundationalist account of knowledge became a challenge for the authoritarian spirit of traditional question in epistemology. This question, as posed in history was important to both continental and analytic philosophers of the enlightenment era as seen in the role it played towards the advancement of schools of rationalism and empiricism.²⁶²

In Popper's estimation, through the trial and error dialectics, i.e. critical rationalism, humans are able to learn from their mistakes, eliminate error and get nearer to truth. For every problem situation necessitates a proposed solution which can be further sharpened through self-criticism and intersubjective criticism; which is, by being exposed to the severest of tests. It never really gets to attain the status of certainty but remains conjectural. Every organism including humans have certain inborn expectations in the experience of the external world.²⁶³ These experiences are interpreted against the background knowledge which are to be further subjected to severe criticisms to help in reducing the realm of error. Thus, Popper does not subscribe to justificatory preoccupation of the enlightenment or inductivists epistemology championed by rationalism and empiricism. Hence, the anti-foundationalist account of science in Popper as response to the traditional or enlightenment epistemology which necessarily begets authoritarian kind of answer to the question it traditionally poses seem to connect intimately with the concerns of decolonial epistemology.

²⁶¹ Popper, *Objective knowledge*, 108.

²⁶² Popper, *Conjectures & refutations*, 4.

²⁶³ Popper, *All life is problem solving*. Translated by P. Camiller (London: Routledge, 1999), 45-72. Also, Popper, *Conjectures and refutations*, vii.

2. 6 Popper's Thought and the Decolonial Intellectual Project

There has been a shift in the burden of legitimisation of knowledge from religious establishment to Western modern science and the exercise of this important role has led to exclusionary, elitist positivistic posture with an air of superiority that has come to define modern science as invincible, authoritative form of knowledge, by its standards, every other is to conform. This, accordingly, has remained its trade-mark as well as the chief drawback of modern scientific discourse to this day.²⁶⁴ For a greater appreciation of this claim and its implication for a recurring theme in this thesis - pluralism versus relativism – a theme I have not particularly addressed up until now in the thesis. In my view, the insights of Cobern and Loving suffice to clear the issue once and for all in my view. And so, permit me to quote elaborately their argument that,

Being exclusive, however, does not confer science with any privilege vis-à-vis other domains. Science is properly privileged only within its domain for that is where its strength lies. When other forms of indigenous knowledge are devalued is because it is not because of the exclusive nature of the standard account of science. It is because someone is involved in the scientific practice of extending scientific privilege from its proper domain in science and technology into other domains. The solution is to resist this scientific practice by emphasising throughout schooling the concept of epistemological pluralism, bearing in mind that pluralism is not relativism ... pluralism is the civil engagement of our differences and disagreements about what is most importantly true. Against the monism that denies the variety of truth, against relativism that denies the importance of truth, and against the nihilism that denies the existence of truth, we intend to nurture a pluralism that revives and sustains conversation about what really matters, which is truth. Bearing in mind that truth is never under the sole proprietorship of any single domain of knowledge – not even science.²⁶⁵

There are obvious important lessons in the foregoing elaborate remarks with respect to some of the highlights I argue are important principles in Popper's thought. For example, it is clear how critical conversation and engagement is crucial in the search for truth,

²⁶⁴ H. Lauer, 'Cause and effect between knowledge traditions: analysing statements that address the regression of science and technology in Ghana', *Transactions of the Historical Society of Ghana*, 8 (2004), 261-262.

²⁶⁵ First Things, 1995, 12 as cited in Cobern and Loving, *Defining "science" in a multicultural world*, 65; Also, W. W. Cobern, 'Worldview, Science and the understanding of nature', *Scientific Literacy and Cultural Studies Project 22* (2005), 13. Sourced from: http://scholarworks.wmich.edu/science_slcsp/22 Accessed: 03/02/2018.

hence, as Chang argues, "... by shutting down debate within science, we only manage to pervert science into the same objectionable dogmatism... to say that it is not even worth debating is, again, hubris..."²⁶⁶ And Mares, lends support thus, "pluralism is closely connected with one of the features of the open society which Popper defines as the science of tolerance".²⁶⁷ For example, in 2008, Professor Michael Reis, the Director of Education of the Royal Academy of Science resigned on the basis of the unphilosophical response of the academy to his remarks that teaching will have to deal with pupils who held other views apart from Darwinian evolution during the 2008 Science Festival in Liverpool.

One of the major concerns of decolonial epistemology has been some critique of popular Western epistemology as epitomised in the sciences. The overall presupposition is that this form of epistemology; that is, popular Western epistemology is not neutral as it conceals some fundamental principles entwined in the whole colonial system more often regarded as coloniality, more profound than colonialism.²⁶⁸

Thus, the project of decolonial epistemology has been directed at distilling these aspects that may appear innocuous, but in actual fact are enmeshed in the complexity of coloniality. For instance, it is argued that the 'Cartesian ego is often concealed while it

²⁶⁶ Chang, *Is Water H2O? Evidence, realism and pluralism*, 263.

²⁶⁷ P. Mares, 'Tolerance and universalism', *Procedia: Sciences and Behavioural Sciences* 149 (2014), 537.

²⁶⁸ The term coloniality simply refers to the persistent structures which remained in place even after the end of political and juridical colonialism. As applied by Quijano within the Latin American setting, it also speaks to other areas with similar historical experiences of colonialism. See A. Quijano, 'Coloniality of power, eurocentrism, and Latin America', *Nepantia: Views from South*, 1, 3 (2000), 533-580. Others like, R. Grosfoguel, W. Mignolo have added their voice in this decolonial epistemic campaign expanding these issues as they relate to different disciplines and areas of the society. R. Grosfoguel for instance, shows how there are about fifteen dimensions where this coloniality is evident and has consistently championed the decolonial programme within the social sciences as he defends a pluriversal vision of knowledge where the dominated and domineering models of epistemologies eschew these pretensions and then engage and enrich the common pot of knowledge broadly tagged as beyond modernity towards a Dusselian transmodern epistemology. The need to adopt Popper's epistemic attitude to actualise this lofty vision cannot be over emphasised if this dialogical dimension is to be ever successful. See for example: R. Grosfoguel, 'A Decolonial approach to political economy: Transmodernity, border thinking and global coloniality', *Kult* 6- Special Issue Epistemologies of Transformation: The Latin American Decolonial Option and its Ramifications (2009). For Mignolo, coloniality is entwined with modernity and in deed the darker side of modernity. See, W. D. Mignolo, *The Darker Side of Western modernity: Global futures, decolonial options* (Durham: Duke University Press, 2011), 2.

pontificates as a universal/objective/rational standard of knowledge'.²⁶⁹ The overall goal of the decolonial project goes beyond challenging the hegemonic and domineering epistemic outlook of Western epistemology of a universal kind where only one form of epistemology define everything towards a 'pluriversal' goal. This sort of vision is consistent with the pluralistic emphasis in Popper by which diversity and inter-epistemic dialogues is rendered feasible in the whole picture of a 'transmodern' future where decolonial, 'pluriversal' epistemology is not only possible but has potentials to flourish. Here, then, is the central focus of liberalism and freedom that Popper was quite obsessive about in his philosophy. In other words, the notion of liberalism in the epistemology and political philosophy of Popper is at the heart of the issues central to the decolonial project in epistemology as well. The emphasis of Popper on fallibility, epistemic humility, and openness to the possibility of error, limitedness as humans which undermines authoritarian epistemology resonates with the discourses of decolonial thinkers whose consistent criticisms continue to interrogate the problem of the 'coloniality of power and knowledge from the perspective of the subaltern'.²⁷⁰

It is against the foregoing context that one can begin to see the intersection, for instance, between feminist epistemology and philosophy of science has important lessons for this present exercise. In relation to Africa, there is no question as to the testimony that the knowledge tradition in an African setting relative to the Western setting has largely been one of 'domination, marginalisation and the resultant effects that show in terms of their

²⁶⁹ R. Grosfoguel, 'Decolonising post-colonial studies and paradigms of political economy: Transmodernity, decolonial thinking and global coloniality', *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World*, 1, 1 (2011), 4.

²⁷⁰ A. Quijano has championed the need to accomplish the final phase of decolonisation. Even though the term decolonisation seems to have emerged at the point of colonialism, its project has remained largely unfinished. The mark of this is the fact of coloniality pervades several important segments of the society and the world. The idea of coloniality simply refers to the persistent structures which remained in place even after the end of political and juridical colonialism. As applied by Quijano within the Latin American setting, it also speaks to other areas with similar historical experiences of colonialism. See A. Quijano, 'Coloniality of power, eurocentrism, and Latin America', *Nepantia: Views from South*, 1, 3 (2000), 533-580. Interestingly, today there is a growing interest in calls for decolonising the curriculum and university across the globe.

development; science and knowledge production as central features of the relationship'.²⁷¹ The way and manner the relationship developed was well orchestrated as it had intellectual foundation that perceived and read Africans as savages and inferior that were to ultimately benefit from the relationship thereof. The enlightenment's intellectual atmosphere defined values of 'universality, rationality, individualism and progress along with the arrogant self-image that accompanied the developments of Western science upon replacing the Church as standard of knowledge. Such an attitude marked the overall ambience within which the colonial mission across the continent of Africa flourished to such an extent that, 'the entrenched institutions were aimed at consolidating the intellectual domination which made the physical domination much easier and the results far reaching.'²⁷² The results were readily manifest in the nature of education prevalent in such contexts.

For these decolonial scholars, Cartesian dualism seems to continue to play important role in the development and emphasis of modern science today in its claims as the standard of rationality and universal knowledge. For instance, the replacement of the authority of religion as the defining epistemic standard by the Western egopolitics that pretends to speak and represent universal ideals of what should be adjudged as valuable epistemologically is deeply entwined in the coloniality project which needs constant interrogation. The epistemological hierarchy that privileges Western knowledge and cosmology over non-Western knowledge and cosmology is institutionalised in the global university system. The monologism and monotopic global design of the West relates to other cultures and peoples from a position of superiority and thus remain deaf toward the cosmologies and epistemologies of the non-Western world.

²⁷¹ A. S. Mlambo 'Western social sciences and Africa: the domination and marginalisation of a continent', *African Sociological Review*, 10, 1 (2006), 161-179.

²⁷² Mlambo, *Western social sciences and Africa*, 164.

Real horizontal dialogue and communication could exist among all peoples of the world, to achieve will require the transformation of systems of domination and exploitation of the present colonial power matrix of modern/colonial system. This kind of dialogue does not allow for any hierarchical sense of superiority as has been the case. It seems to me that it is with this type of vision that “the cultural hegemony of science can be checked. For when it is used to dominate the public square as if all other discourses are of lesser value, it further reinforces the hierarchic view of knowledge with science placed at the epistemological pinnacle”.²⁷³ By treating the other as underdeveloped and backward, metropolitan exploitation and domination were justified in the name of the civilising mission. The ascribed superiority of European knowledge in many areas of life was an important aspect of the coloniality of power in the modern/colonial system. Subaltern knowledges were excluded, omitted, silenced and ignored. Though, it is not a call for a fundamentalist nor an essentialist rescue mission for authenticity. The point here is to put the colonial difference at the centre of the process of knowledge production.²⁷⁴ This becomes the basis for the actualisation of the kind of conversation and dialogue I envisage which is not only possible but seems imperative.

The knowledge question and the decolonial perspectives applied to an African context therefore, finds resonance with epistemological concerns of Popper broadly construed. The role of induction as the method of science that emphasises confirmation/verification by experiments and on this basis, establish the demarcation criterion between what is science and what is not science; that is, demarcation reflect deeply some philosophical issues in a number of disciplines; to include African philosophy as the next chapter will show, has had to deal with and continue to interrogate even in contemporary times. The ‘totalitarian’ character of Western science in the context of Africa points to tendencies

²⁷³ Cobern, *Worldview, science and the understanding of nature*, 12.

²⁷⁴ Grosfoguel, *Colonial difference*, 4.

Popper finds with the philosophical systems of Plato, Hegel and Marx as capable of obstructing the search for truth. For even the simple, ignorant can be potential sources of truth.²⁷⁵

The certainty and ‘universalist pretensions’ of discourses of many social sciences and humanities about how they understand the African predicament and then proffer various interventions fall foul of Popper’s position on certainty, fallibility and how societies change/advance. The question of development in Africa has been taken on by many experts especially of the social sciences and various theories have been designed as capable of dealing with the challenge of development, not surprisingly, the results of the application of these theories and systems have continued to fail woefully albeit for several contested factors. In fact, template transfer that is not sensitive to the epistemological and cultural context within which it is applied has always been a recipe for failure. Writing closely on this point, Binsbergen evaluates the feminist epistemological project of Harding in the critique of Western science by relating it to the knowledge question in an African context. Binsbergen concludes that,

... there is something in the contents, the format, the reproducibility, the validity of certain forms of knowledge by which North Atlantic science (Western science) detaches itself definitively from the social contexts in which it was produced and administered and is no longer dependent upon those contexts. North Atlantic science is often surrounded by the pretension of such abstract, universal applicability. However, the depressing results of much of international development cooperation demonstrate that it is only under specific additional conditions relating to physical environment, social context, infrastructure, and attitude to work, discipline that North Atlantic scientific insights can be effectively applied globally.²⁷⁶

²⁷⁵ F. Eidlin, ‘Matching Popperian theory to practice’, I. Jarvie & S. Pralong (Eds.), *Popper’s open society after 50 Years: the continuing relevance of Karl Popper* (London: Routledge, 1999), 204.

²⁷⁶ W. V. Binsbergen, ‘The understanding of scientific knowledge systems: epistemology or hegemonic power? the implications of Sandra Harding’s critique of North Atlantic science for the appreciation of African knowledge systems’, Paper presented at the Colloquium ‘*La rencontre des rationalites*’ organised by the African Centre for Advanced Studies, The International Council for Philosophy and Humanities Studies, CIPSH & UNESCO, Porto Novo, Benin, September 18-21, (2002), 32.

From the foregoing particular perspective, the colonial regime in the context of Africa was largely totalitarian and thus, unleashed what Fricker calls ‘testimonial injustice’ as far as the knowledge tradition of the typical African was relegated.²⁷⁷ Even though colonialism has finished, the colonial structures remained in place; that is, institutional, political, conceptual and intellectual schemes in ways and manners that ensured the subjugation of the knowledge tradition of the people while their identity suffered enormously in what postcolonial scholars refer to as “colonial matrix of power”/”coloniality of power and knowledge”.²⁷⁸ The effect of these cumulatively have therefore, affected the structures and institutions designed to transform science and science culture in Nigeria.

Thus, the various attempts to transform science along this trajectory have not delivered the much-desired advancement in Nigeria. The task of decolonisation in Nigeria remains unfinished as in many other African nations. To engage the unfinished task therefore requires much more than engaging only an aspect of the society as this thesis focuses on the science question alone. It is a multifaceted project/programme as other effort have targeted other sectors. The place of philosophy in this direction is here championed in this thesis as has been the objective of many other philosophical interventions. How Popper’s intellectual contributions help in the actualisation of the task explored in this thesis is what is crucial. After all, Popper connects epistemological optimism and liberalism where humans can know and thus can be free. For in fact, it was believing in human’s capacity to know that ultimately led to the birth of modern science and technology, championed by Bacon and Descartes.²⁷⁹ Agassi argues that the Popperian spirit of criticism is an

²⁷⁷ M. Fricker, *Epistemic injustice: power and ethics of knowing* (Oxford: Oxford University Press, 2007). A distinction between testimonial injustice and hermeneutic injustice as two basic forms of prejudice which affects the knowledge story of situated subjects in their social contexts. Here, issues of identity and power play very sensitive roles in whether or not epistemic claims are given credibility.

²⁷⁸ Walter Mignolo, Ramon Grosfoguel and other liberation theorists and critics use these phrases to capture the task of decoloniality of erstwhile colonies.

²⁷⁹ Popper, *Conjectures and refutations*, 5, 6.

important ingredient for the reform of the scientific tradition to ensure elimination of error/prejudice/dogmatism/verificationism which will in turn bring about progress.²⁸⁰

2. 7 Virtue Epistemology²⁸¹ and the Dialogue of Epistemologies

The outlook of Western science tradition in relation to the knowledge tradition in Nigeria has basically been one that is authoritative and oppressive of the ‘other’, even though it is represented in the public domain as neutral and objective. Thus, there is an underlying tension and conflictual epistemic situation that undermines the project of advancing science in Nigeria. This, sometimes, is as a result of insensitivity to the importance of embodying epistemic values and principles such as the ones abundantly available in Popper’s thought that can facilitate the entrenchment of the culture of science in such a context. For example, as Cobern argues, “it is important to understand the fundamental, culturally based beliefs about the world that students bring to class, and how these beliefs are supported by culture since science education is successful only to the extent that science can find a niche in the cognitive and sociocultural milieu of students”.²⁸²

To be able to deal with such a situation as above and others’ intellectual cultures where modern scientific thinking is blind to such values as argued, Popper’s view comes handy and relevant as it can be explored along the lines of the intersection there is among the

²⁸⁰ J. Agassi, ‘Epistemology as an aid to science: comments on Dr. Buchdahl’s paper’, *The British Journal for the Philosophy of Science*, 10, 38 (1959), 146. Buchdahl had argued that scientific research should ignore epistemology as it of no use to it, the of Buchdahl according to Agassi lacks consistency and in deed misguided as epistemological issues are critical to the project of scientific research, thus, concluded that Buchdahl had misread Popper.

²⁸¹ There has been a growing interest in the assessment of the nature of virtues and vices in relation to knowledge generally regarded as Virtue epistemology. For instance, L. T. Zagzebski, *Virtues of the mind: an inquiry into the nature of virtue and the ethical foundations of knowledge* (Cambridge: Cambridge University Press, 1996); J. Baehr, *The Inquiring mind: on intellectual virtues and virtue epistemology* (New York: Oxford University Press, 2011). Particularly interesting about Baehr’s work is his detailed analytical discussion of open-mindedness, one of the epistemic principles I emphasise in this thesis as an important principle in Popper’s thought. See more, Chapter eight of Baehr’s book, 140-162.

²⁸² W. W. Cobern, Public understanding of science as seen by the scientific community: do we need to re-conceptualise the challenge and to re-examine our own assumptions?’ *Scientific Literacy and Cultural Studies Project* 18 (1996), 14. Source from: http://scholarsworks.wmich.edu/science_slcsp/18 Accessed on 03/02/2018.

different emerging traditions and approaches revitalising epistemology as a respectable philosophical discipline. Consider for example, R. Feynman's degrading remarks about the relevance of philosophy (of science) to science and scientists to the relevance of the scientific study of birds to birds, a core aspect of epistemology/philosophy.²⁸³ Powerful 'epistemic authority and credibility' of mainstream tradition of knowledge production exhibits traits often provocative and insensitive to Popper's proviso of exercising epistemic restraint and openness to the possibilities of error in one's view or tradition of knowledge/ position. The rather dismissive outlook overtly or covertly not only raise epistemological issues but have links of political nature too.²⁸⁴

Some of the questions that will arise will include - How is dialogue going to be possible between two apparently different traditions of knowledge? What are the conditions for viable dialogue? Robust response to these questions and others will be provided in chapter five, suffice it to note however, that, Popper has illustrated the concerns that surround the claim that dialogical exchange is almost impossible. Instructively, Okeja makes the point clearer in the outline of two fundamental normative epistemological conditions for viable dialogue to take place as: some good inherent in the envisaged dialogue and the realisation of limitedness of knowledge of reality.²⁸⁵ With these conditions foregrounding the dialogue, forms of ossified meta-narratives will give way to a much more rounded perspective than a single story that has prevailed thus far between Africa and the West. To claim that these views are more or less, Popperian is to state the obvious.

According to Popper, it is a myth to insist that we are prisoners caught up in the framework of our theories, our expectations, our past experiences, our languages and so

²⁸³ R. Feynman's remarks reflect a powerful index of a much deeper anti-philosophy challenge for philosophers even prevalent today.

²⁸⁴ P. Rooney, 'The marginalisation of feminist epistemology and what that reveals about epistemology 'proper'', H. E. Grasswick (ed.), *Feminist epistemology and philosophy of science: power in knowledge* (Dordrecht: Springer, 2011), 6.

²⁸⁵ U. Okeja, 'Narratives and the dialogue of cultures of knowledge: a perspective on the experience of the West and Africa', *Kritike*. 10, 4 (2010), 143.

locked up in these frameworks that we cannot communicate with those encased in ‘radically’ different frameworks/paradigms.²⁸⁶ This view of Popper’s is in keeping with the pluralistic implication of his thought. While analysing the thoughts of Popper, Koertge has this to say, “when people are convinced and locked up in their frameworks and conceive of such to be complete, there is incidence of epistemic violence”.²⁸⁷

In fact, the emphasis of Popper on the epistemic virtues of openness and readiness to expose knowledge claims and theories or beliefs to severe criticisms are pointers again to the philosophical dimension of his epistemological project. What is more illuminating than Popper’s view that, “I may be wrong, you may be right, but together we may get nearer the truth” as definitive of his virtue epistemology of the responsibilist’s model. The point here is that, for Popper, the project of reforming the society and advancing knowledge implies taking seriously values of openness, cooperation, social engagement and exchanges, modesty and eagerness to work together in partnership towards the search for truth about reality. Thus, the underlying ethical formulation of Popper is his notion of fallibility.²⁸⁸ Koertge draws on these values and observes that, ‘attitude of openness as precondition for dialogue’. What is significant to emphasise is Koertge’s interpretation of ‘dialogue and its possibility even among people with obvious divergent viewpoints’. What is significant about Popper’s fallibilism is how he traced it to Socrates in Plato’s *Apologia*. ‘Intellectual modesty, critical rationalism, simple and clear language as duties’.²⁸⁹ Fallibilism ‘can show us that the role of thought is to carry out revolutions by

²⁸⁶ Popper’s notion of the myth of the framework and title was targeted at contesting the foreclosure perspective defended by paradigm defenders.

²⁸⁷ N. Koertge, ‘The moral underpinnings of Popper’s philosophy’, in Z. Parusnikova & R. I. Cohen (eds.), *Rethinking Popper* (Boston Studies in the Philosophy of Science, Springer, 2009), 323-338.

²⁸⁸ Fallibilism is at the core of Popper’s epistemology and political thought’, confer L. Williams, ‘Karl Popper, the enemy of certainty, part 5: the craving to be right. Available online: <http://www.theguardian.com/commentisfree/2012/oct/08-karl-popper-enemy-certainty-craving> [Accessed 25/09/2015].

²⁸⁹ N. Koertge, ‘*The moral underpinnings of Popper’s philosophy*’. Hence, Bruce insists that novelty and criticism are important attributes of anyone committed to pluralism, See J. C. Bruce, ‘The case for pluralism’, N. de Marchi, (ed.), *The Popperian legacy in economics* (Cambridge: Cambridge University Press, 1988), 235.

means of critical debates rather than by means of violence and warfare... that is why our Western civilisation is an essentially pluralistic one...'²⁹⁰ For Parvin argues that Popper abhors the hubris that characterised system builders and theorists of many types. He insisted on intellectual humility and open mindedness as virtues in seeking knowledge and the delivery or presentation of such ought to be simple, clear and modest as well.²⁹¹ The place of virtue epistemology therefore holds enormous promise for the recovery of epistemology as a philosophical discipline with broad human importance ... where epistemology connects with ethical and political issues'²⁹² as it is well outlined in Popper. For instance, such claim is evident in Rooney, who, in defence of feminist epistemology (but sounding Popperian) writes, "if open-mindedness as openness to new or different perspectives is an intellectual or epistemic virtue (and I certainly think it is), then openness to new or different epistemological perspectives and directions is surely a meta-epistemic virtue, and it is one that feminist epistemologists are in a position to claim to their advantage".²⁹³

According to D'amico the guiding principle of Popper's philosophy centres on dialogue and critical discussion while rejecting any form of dogmatic totalitarianism or relativism in the commitment to liberal open society in science and political affairs.²⁹⁴ Interestingly,

²⁹⁰ Popper, *The open society and its enemies*, 396.

²⁹¹ Parvin, *The rationalist tradition and the problem of induction*, 262.

²⁹² Roberts and Wood, (2007), 6-9 cited in Rooney, *The moral basis of Popper's philosophy*, 19.

²⁹³ Rooney, *The moral basis of Popper's philosophy*, 19.

²⁹⁴ S. D'amico, Speech Presented at the 2005 Leopoldo Costa Prize (2005). The thoughts expressed in the address demonstrate the possibility of pluralism without falling into relativism or absolutism with inherent incommensurability and therefore the impossibility of engaging in any dialogue of any form. The theme of dialogue and how pluralism allows for the dialogue is supported by T. O. Afisi's 'The value of cross-cultural polylogue in science', *European Scientific Journal*, October edition, 8, 23 (2013) 103-115. The work though adopts naïve falsificationism as the main focus of Popper's philosophy of science in his commitment to a universalistic unity of method of sciences. Through this sort of commitment, Western science represents the standard of rationality and thus lays claim to evaluate other cultures' prospects on knowledge inquiry and contributions. Taiwo relies on Winch's utilisation of Wittgenstein's theme of 'forms of life' as normative basis to argue for some rationality of cultures different from the Western science. Taiwo is however quick to observe the inherent relativism of the views and the burden for his overall project in defence of dialogue where I note resonates with the theme of this present research. However, my reading of Popper is in the broader context of the entire philosophical concerns far beyond falsificationism alone. Popper himself in the course time shifted as the central piece of his later works. In my view then, Taiwo's claim that reads Popper in a way that the centre piece of Popper's philosophy of science is at variant with pluralism is faulty and superficial reading of Popper. Little wonder Taiwo did not notice the continuity

Alamuti has relied on this ultimate emphasis in Popper to explore the value of critical rationalism towards a dialogical world order upon which the peace, justice and security of a globalised world can be better achieved. The work brilliantly uses Bartley's reading of critical rationalism as the central theme in Popper's epistemology, that is, as a fine piece of virtue epistemology in sociological context. The work extends and analytically explores the sociological potentials of this central piece of Popper's epistemology for dialogue in view of a much more inclusive, dialogue oriented social global order where peace and justice will flourish.²⁹⁵ Such efforts reveal not only the ethical import of Popper's philosophy, but also the epistemic and socio-political benefits inspired by Popper's philosophy.

2. 8 Chapter Evaluation and Conclusion

What this chapter has done is to highlight important themes in Popper's philosophy that can help illuminate the knowledge debate in Nigeria. It demonstrates the major problems that were central in Popper's philosophy which were both epistemological and cosmological, from where the bearing of his political thought took inspiration. These concerns, the thesis presupposes are aptly relevant to the context of science problem in Nigeria that has both epistemological and political sides to it. Obvious from the intervention of Popper as exposed in the discussion of the two related epistemological problems of induction and demarcation, the African knowledge tradition and Africa is categorised and understood by the Western science/knowledge tradition was

between C.S. Peirce's commitment to pluralism (who he incidentally pitches tent with) and Popper's philosophy. However, Taiwo rightly makes important points in his representation of two distinct modes of inquiry to represent the occidental/Western tradition of knowledge as formal/empirical/conceptual while the other is not theoretically inclined as such as it is conceptual/empirical/spiritual/ mytho-poetic for African for instance, The analysis provided and models of engagements he proposed remained at the abstract level unlike this present research which situates the epistemic condition of the problem of knowledge of science in the Nigerian context examining why it is where it is, not advancing and progressing significantly.

²⁹⁵ M. M. Alamuti, *Critical rationalism and globalisation: towards the sociology of the open global society*. (New York: Routledge, 2015).

contextualised. Precisely, the anti-authoritarian posture of Popper's epistemology serves the goal of a fundamental critique of the enlightenment epistemology and to that extent intersects beautifully with the decolonial project that has been championed vigorously by the leading scholars of liberation epistemologies across erstwhile colonies. By this, the thesis presents a decolonial hermeneutics of Popper and the import of this for the project of decolonisation that has been at the centre stage of discourse in many African countries, and reiterates that the decolonial task remains a critical and urgent concern in philosophy.²⁹⁶

My aim is to situate a relevant context to engage the challenge of development in all its ramifications across Africa. But the present purpose, to engage the science problem in Nigeria, will require a model of dialogue with which the conflictual state of epistemologies have continued to hamper the owning of science by Nigerians and so unable to demand from the political class the needed commitment to support and grow science/science culture. As a result, several factors aggregate to keep science and its culture low and failing in Nigeria as the next chapter will discuss. More importantly, the exposition of critical rationalism, epistemic virtues of modesty, openness and fallibility, the Western approach to science will be better poised as epistemically humble and able to engage a knowledge tradition that is not particularly open, authoritarian but with some values to be acknowledged so as to avoid the crisis it creates when its approach is one of denial and rejection or condemnation. With these tools explored and appropriated through Popper's philosophy, the ideological end to which religion, though a part of a whole

²⁹⁶ For instance, there is a near absence of the theme of slavery in the teaching and learning of the history of modern philosophy. This gaping fact was echoed by C. Meyns in his reflection with the title: 'Why don't philosophers talk about slavery?' *The Philosophers Magazine*, Issue 79 (October 17, 2017). Available online: <https://www.philosophersmag.com/essays/173-why-don-t-philosophers-talk-about-slavery> [Accessed 21/03/2018]. The curious fact is that while the theme does not seem to be an important consideration for philosophers in modern Western philosophy, African philosophers and some others consider it to be an important topic in a number of their reflections.

system of knowledge system which has continued to promote dogmatic thinking and resigned consciousness among the people, weaken the urgency to even demand from the political leaders commitment to transforming science in the society, can be changed for good.

In Popper, a questioning society is germane for the science culture that began long ago in Athenian society. Thus, the critical attitude is important for the advancement of science culture in any society. Any system that does not promote this intellectual culture is likely to have low level of science culture. Therefore, the constant exposition to the severest of tests and openness to being challenged, contribute to the promotion of science in any society. The lessons arising from these points for the state of science in Nigeria is immense for the knowledge tradition that celebrates amongst other things; authority, sagacious wisdom tied to age and less questioning culture (the impact of excessive religiosity that defers to the authority of religious leaders for instance).

I show that instead of focusing excessively on the questions; what uniquely is this African tradition of knowledge that has more or less suffered deprivation, what has become of it as a result of a long history of epistemic neglect, the interest should be to provoke and to assess the popular tradition of knowledge upon which Western modern science flourish to examine itself and its assumptions. It thus considers the prospects of excoriating the epistemic attitude that underlies Western modern science and its assumptions. The immediate relevance of such intervention helps to save Western modern science from what Rooney calls, “regime of epistemology of ignorance”.²⁹⁷ Thus, this thesis adds to the resurgence of interest in epistemology as there is a palpable rise in meta-epistemological questions beyond the declaration of death of the discipline by an anti-

²⁹⁷ Rooney, *The marginalisation of feminist epistemology and what that reveals about epistemology ‘proper’*, 13. The author makes allusion to Mills on how the relationship between mainstream epistemology can perpetrate a long history of exclusion in relation to the ‘other’ epistemologies.

philosophy culture; for instance, the pragmatist thinker, Rorty²⁹⁸ at the tail end of the last millennium and the ambitious programme of naturalised epistemology of Quine which attempts to reduce the concerns of epistemology to what psychology is competently able to address.²⁹⁹

²⁹⁸ R. Rorty, *Philosophy and the mirror of nature* (Princeton: Princeton University Press, 1979).

²⁹⁹ W. V. O. Quine, 'Main trends in recent philosophy: two dogmas of empiricism', *The Philosophical Review*, 60, 1 (1951), 20-43.

3.0 African Philosophical Thoughts: its Context and Relations to the Science Question in Nigeria

3.1 Introduction

The focus of this chapter is to fully situate the intellectual agenda that underpins the contestations about the epistemic value or otherwise of African knowledge perspective. When reference is made to African knowledge thought or system, it takes for granted that it encompasses the many aspects of the intellectual culture of the people under consideration. With this brief clarification, the suggestive parallel of raising two issues; that is, the science debate and the philosophical contestations as the structure of the thesis suggests, is, therefore, resolved. The inspiration for this also comes from the philosophical concern of Popper that relates both his epistemology of science to his political thought. Again, the fact that modern Western science is complicit in the colonial project in Africa as its history clearly shows how interwoven it was with the intellectual philosophical perspective that facilitated its emergence in the modern era. After all, those early scientists were regarded as natural philosophers. More so, the quest to develop science in any context is an epistemologically relevant issue as it is political as well. So, this present chapter is divided into two parts; the first part attempts to summarise the philosophical context within which the science question in Nigeria is examined. Thus, the thesis will briefly expose and discuss African philosophical tradition highlighting some of the important themes to prepare the ground for engaging the science question and its challenges in the context under consideration. As Weaver observes and rightly so, that “the success of any enterprise leading to superior programme of science education in Nigeria depends upon the *zeitgeist*, the culture and its intellectual characteristics”.³⁰⁰ The second part will focus on the nature and state of science in Nigeria to instantiate the

³⁰⁰ E. K. Weaver, ‘Science education in Nigeria’, *Science Education*, 48, 4 (1964), 360.

theorisation and exploration. It will evaluate issues around science policies and interventions, science education broadly and the state of science culture with its concomitant consequences on the general intellectual outlook in Nigeria. The thesis engages the concerns presupposed for appropriating Popper's philosophy as a viable philosophical framework for reconstructing an African philosophy of science in the chapter that follows this. For now, the overall goal is to situate the problem of science advancement and how that relates with African philosophical tradition with the hope that Popper is sufficiently able to provide a rational basis for the dialogue of traditions upon which advancing science in Nigeria can be negotiated.`

3.2 African Philosophical Thought: Basis and Relevance

Philosophy by its nature is very problematic as to what it really is. In the same way, African philosophy or philosophy in Africa has had to grapple with the characteristically problematic nature of what it really is. However one conceptualises or theorises African philosophy, what is obviously at issue and intended to be highlighted is fundamentally the way and manner African people conceive and find meaning in the context of the world of their lived experience.³⁰¹ In this regard, the sense of who they are and what nature is and how it is experienced, possibilities of access and experience of nature with derivatives in terms of values and consequences of these for their daily affairs, embody the views and thoughts broadly referred to as constituting philosophy broadly in the African context.

I take for granted that there is an 'authentic African philosophical tradition' as the literatures attempt to demonstrate.³⁰² So much have been written and many are being

³⁰¹ This idea recognises the contribution and insight of B. B. Janz's *Philosophy in an African place* (Lexington: Rowman & Littlefield, 2009) to an already vast body of literature on African philosophy influenced largely by analytic philosophy. The contribution introduces the nuance of 'milieu' which enriches and enlivens the context of philosophising in Africa beyond the traditional approach popular in many texts on the subject matter (1-13).

³⁰² B. Hallen, *A short history of African philosophy* 2nd edition (Bloomington: Indiana University Press, 2009); S. O. Imbo, *An introduction to African philosophy* (New York: Rowman & Littlefield, 1998).

churned out on the nature and scope of African philosophy daily and in fact, in the last few decades. Hence, it is such a large project and task to say everything that needs to be said about it here, suffice it to note that, the beginnings and nature of African philosophy have been subject of controversies, though not unexpected. One of these challenges that the thesis finds important, is, the question of relevance so that African philosophy will not just be some exercise that is superfluous. This can be phrased as a question; is there any need for (why) African philosophy? Surely, the answer does not blow in the wind as engaging in the sort of problem of this thesis, that is, the question why science has not fared well in Nigeria (recall the Needham question as reformulated in the context of Nigeria and the interesting narrative of Ferguson as regards the place of Africa) is not only a pragmatic question, it is one that is set to demonstrate the relevance of African philosophy. In other words, attempting the discourse such as the task on hand is geared towards legitimising African philosophy amongst other concerns. Particularly, the appropriation of Popper's philosophy as able to provide a rational basis for dialogical exchange between an African tradition and Western modern science as a viable way of answering the science question in Nigeria is attestation of why African philosophy do(es) matter.

Thus, it is a philosophical exercise, an imperative task for contemporary African philosophy in seeking for a synthesis of what is good on both sides (i.e., science advancement in an African context) without necessarily undermining African identity.³⁰³ The need to provide the intellectual framework with which African people interpret, organise and render accounts of what is possible, both in the physical and non-physical realms is important to the effort and so, insights into the African intellectual perspective

³⁰³ K. Wiredu, 'Conceptual decolonisation as an imperative in contemporary African philosophy: some personal reflections, in *Rue Descartes, Philosophies Africaines: Traversees Des Experiences*, 36 (2002), 53-64. And in, O. Oladipo, 'Reason, identity, and the African quest: the problem of self-definition in African philosophy', *Africa Today*, 42, 3 (1995), 26-38.

is to precede the discussion on science situation proper in Nigeria. Such theoretical characterisations play huge role on the culture of science, science policy, and science education in Nigeria assumed to have been so neglected and misunderstood by several experts of many disciplines who have contributed to the question of science and its development in Nigeria.³⁰⁴ Therefore, the philosophical perspective will aim to add a much deeper insight into appreciating the problem of science in Nigeria from the perspective of the epistemological aspect of the problematic at hand. For as Gatsheni observes,

theorising about the African predicament is a form of knowledge production by African intellectuals and academics for use by Africans in Africa. Theory is a light that assists in avoiding ill-focused, positivistic, shallow and prescriptive narratives divorced from complex historical and economic crises and problems that bedevil Africans today.³⁰⁵

The evidence of this is not farfetched with the failure of the template transfer models in many countries in Africa. To therefore ignore the world of an African people and neglect such, is a great disservice to the project of science education particularly as has been the case in Nigeria. More so, a tradition of knowledge, beliefs and practices built around and upon these values in all aspects of the peoples' lives makes it an imperative to engage with as this thesis argues to be the appropriate option. The influences of the thought system and outlook is therefore felt in the various aspects of the society. Against this backdrop, insights into the African philosophical tradition is important in any attempt to account for the state of science culture in Nigeria. Such a task is not only targeted at interrogating the assumptions of Western science but also show some potential

³⁰⁴ G. T. Emeagwali (ed.), *African systems of science, technology and art* (Chicago: Karnak House, 1993); Same author edited another text using historical approach touching on different aspects of technological practices in Nigeria, science and technology teaching and gender in relation to technology in Nigeria. For example, G. T. Emeagwali (ed.), *The historical development of science and technology in Nigeria* (New York: Edwin Mellen Press, 1992). A. Mosley, 'Science and Technology in Contemporary African Philosophy', *African Philosophy*, 13, 1 (2000) 25-32.

³⁰⁵ S. J. N. Gatsheni, *Coloniality of power in postcolonial Africa: myths of decolonisation* (Oxford: African Book Collective, 2013).

implications this may have for its development particularly and for development generally.³⁰⁶

With the foregoing background, the task of the chapter is rendered simpler as it will quickly outline some basic aspects and themes that underlie how Africans relate intellectually with nature/reality and make sense of it, i.e. their philosophy, knowledge tradition or in fact, the entirety of their intellectual tradition and the debate surrounding the project. Thus, reference will be made to few salient aspects of African philosophy as it has progressed to indicate the overall picture of the knowledge perspective in Africa which is at the heart of this thesis.³⁰⁷

3. 2. 1 Understanding the Beginnings of African Philosophy

African philosophy, as a discipline, has had a recent history³⁰⁸ though mired in a lot of controversies not unconnected with the ambiguous nature of philosophy itself. That many aspects of the thoughts of African people were not systematised into a discipline referred

³⁰⁶ M. Mawere, *Culture, indigenous knowledge and development in Africa: reviving interconnections for sustainable development* (Bamenda: Langaa Research and Publishing, 2014), 19-22. The author argues that there is a strong connection between culture, indigenous knowledge and development, and the lack of attention to such connection has been responsible for the state of development in most African countries who rely on models of development promoted from without. It is development in the western sense that relegate indigenous knowledge through its modernisation theory founded upon positivistic scientific methodologies that views Indigenous knowledge as superstitious, illegitimate and primitive and unscientific, which has largely hampered participative development in the context of societies where value is placed on such knowledge forms and other beliefs.

³⁰⁷ The point is to made that when the thesis discusses African philosophy, it is presupposed that it addresses Nigeria as it addresses other countries in Africa given the common denominator of fundamental commitments despite obvious diversities and peoples; See, K. Gyekye, *Tradition and modernity: philosophical reflections* (Oxford: Oxford University Press, 1997), 158; C. A. Diop, *The Cultural unity of negro Africa* (Paris: Presence Africaine, 1962), 7.

³⁰⁸ This view is controversial given the school of thought developed in sharp response to the Eurocentric intellectual tradition; that is, the Afrocentric scholarship which defends the Egyptological patrimony of much of Greek scholarship; science and philosophy, and civilisation. My present focus in this thesis does not find such a move and project illuminating enough to demonstrate the present science challenge in Africa (Nigeria) and as such, the research will deliberately boycott the debate as it largely falls into the very trap/fallacy it seeks to challenge. However, it is important to state that the Afrocentric contributions remain quite interesting as they are enlightening no matter how problematic and controversial the debate seems. See for instance, M. K. Asante, *African pyramids of knowledge: komet, Afrocentricism and Africology* (New York: Universal Write Publications, 2015); I. C. Onyewuenyi, *The African origin of Greek philosophy: an exercise in Afrocentricism* (Nsukka: University of Nigeria Press, 1994); G. G. M. James, *Stolen legacy: The Egyptian origin of Western philosophy* (San Franscisco: Julian Richardson Associates, 1988); C. A. Diop, *The African origin of civilisation: myth or reality* (Chicago, Illinois: Lawrence Hill Books, 1974); M. Bernal, *Black Athena: The Afrosiatic roots of classical civilisation* (New Brunswick: Rutgers University Press, 1992).

to as philosophy does not imply that the people were not philosophical in their interactions with themselves and in relation to their environment.³⁰⁹ To conceive philosophy as a reflective and critical engagements of people in their environment by which their experiences are ordered, meanings generated and values of life derived and constantly negotiated rationally, explained and understood, is to mean then that, indeed the history of philosophy in Africa is rooted in antiquity. If however, as a formal discipline and subject within the university with certain traditions, codes, customs and recognised practitioners,³¹⁰ then it can be said to be relatively new in Africa.³¹¹

There have been questions about the body of knowledge here claimed to be constitutively African philosophy, whether there is one, and what its nature really is. These sorts of questions are of meta-philosophical kind and have remained central to anyone who claims to be engaged in African philosophy. For instance, some scholars hold that instead of “African philosophy”, “philosophy in Africa”, or philosophy for Africa³¹² will be more appropriate and less problematic. The position seems not ready for the fireworks that usually accompany any position in defence of an essentialist system of philosophising that is termed African; that is, what is the nature of the content of the prefix “African” to philosophy? However, for present purpose, African philosophy will be adopted. Without fear of contradiction, Coetzee suggests that African philosophy is practised in a number of trends and it challenges the dominance of the Western epistemological paradigm in

³⁰⁹ Wiredu, *Conceptual Decolonisation as an imperative in contemporary African philosophy*, 53.

³¹⁰ B. B. Janz, ‘African philosophy’, in C. Boundas (ed.), *Columbia companion to twentieth-century philosophies* (New York: Columbia University Press, 2007), 689-701.

³¹¹ J. O. Chimakonam, (ed.), *Atuolu omalu: some unanswered questions in contemporary African philosophy* (Lanhan: University Press of America, 2014).

³¹² J. N. Agbo, ‘The Post-modern scientific thoughts of Thomas Kuhn and Paul Feyerabend: implications for Africa’, *Filosofia Theoretica: Journal of African Philosophy, Culture and Religions*, 3, 2 (2014) 31.

Africa.³¹³ While it acknowledges the vitriolic invectives, it will follow the view expressed in a title and not indulge in undue ‘semantics’.³¹⁴

This thesis, therefore, presupposes that there is African philosophy, for “to insist otherwise is to perpetrate the myth that seeks to privilege only a segment of humanity with exclusive preserve of reason over others”, argues Mogobe.³¹⁵ In fact, ever since the classical conceptualisation of man as a rational being in Aristotle, this term has continued to play an exclusively huge role in and beyond philosophy. This myth is reflected in some of the anthropological claims of Levy-Bruhl, L. Strauss and others who insist on drawing a line between primitive or pre-logical mentality versus the logical culture represented by the superiority of Western rationality in and through modern science as dominant in the rationality debate with relics of less obvious and subtle forms today.

Sequel to the exit of colonialism on the socio-political level, many disciplines especially the humanities; i.e., Literature, Anthropology, Religious Studies, History, and others, were contextualised with African not merely as prefix/adjective but concrete and conscious attempts were made towards reconstructing these narratives from the African experience; thereby, giving them both conceptual content and theoretical flesh. In a similar vein, philosophy was not left out in articulating the African viewpoint as reflections on the experiences of the people found a renewed boost. The results have been an increasing body of literatures on various aspects of life forming a reservoir of African

³¹³ Coetzee, *A note on Eze*, 225.

³¹⁴ A. M. Makinde, *African philosophy: the demise of a controversy* (Ile-Ife: Obafemi Awolowo University Press, 2010).

³¹⁵ M. B. Ramose, ‘Discourses on Africa: struggle for reason in Africa’, in P. H. Coetzee & A.P.J Roux (eds.), *The African philosophy reader: a text with readings*, 2nd edition (London: Routledge, 2003), 8; B. Hallen’s approach to African Philosophy also lends credence to the view of Ramose in the use of the analytic tradition which stands in strong opposition to the views of Horton and Pritchard on whose projection and in faithfulness to the monolithic/positivistic culture typifies the African as lacking the rigour to engage in a rationally tasking business of philosophy. A vivid example is given by Appiah, who narrates an account of a traditional ceremony among the Asante of Ghana, which involves the pouring of libation, incantations and their underlying beliefs. The problematic nature of the question of rationality in relation to these beliefs is a basis for the philosophical significance of the rituals, which are uncontroversial and taken for granted as such, according to Appiah. See more, K. A. Appiah, *In my father’s house: Africa in the philosophy of culture* (London: Methuen, 1992), 174-176, 182.

philosophical knowledge. Despite these spirited efforts, the voyage of African philosophy has been bumpy as its existence has been subject of contestation, yet it continues to sail and wax strong within and outside Africa. Generally, the arguments about African philosophy's existence have shifted in terms of emphasis at three identifiable levels. From the question - "is there African philosophy?" to the era in which it was considered to be "just beginning", and finally, the third stage - a period in which it can be said to be making effort to flourish by showcasing its relevance. The latest stage is where the real challenge of doing African philosophy proper, or better put, philosophising in an African sense. In the words of Oladipo, the concern should focus on tackling African predicament as a philosophy of action.³¹⁶ The nature of what passes for philosophy of action and the criticisms of this have generally led to different perspectives, sometimes overlapping into what generally embody the various aspects of African philosophy. I will now distil these efforts regarded as "trends in African Philosophy".³¹⁷

3. 2. 2 Trends/Traditions in African Philosophy

I. Ethno Philosophy

This orientation was pioneered by Placide Tempel's **Bantu Philosophy** in his project towards a greater understanding of the people in view of the missionary programme among the Baluba people in Congo. The emphasis is that the communal thoughts of the people as encapsulated in their folklores, proverbs, collective worldviews or customs are constitutive of their philosophy. As an account that came on the heels of gross misrepresentation of the African people as lacking in logical rigour and as such categorised as primitive, pre-logical and incapable of having/doing philosophy, Tempel's work though salutary; inherent in it were intellectual misgivings about Africans as a

³¹⁶ O. Oladipo, *The Idea of African philosophy: a critical study of the major orientation in contemporary African philosophy* (Ibadan: Molecular Publishers, 1992), 24.

³¹⁷ O. H. Oruka, *Trends in contemporary African philosophy* (Nairobi: Shiwikin Publishers, 1990).

prevalent feature that touched on several aspects of the engagements of Africa and Africans with the West. This is not surprising given the ends to which some of the projects were targeted; primarily, a justification for the civilising mission with all the entrapments that came with it. These constructions have been challenged by many scholars but the residual effects are strongly felt even in contemporary times, no surprise that the decolonial task is an ongoing project. Mudimbe's classic text, "The Invention of Africa"³¹⁸ best summarises the project in question as it defends how Africa and Africans became products of the epistemological predilection of Western constructs. Ohiambo, reviewing Mudimbe's text states that,

It offered a titanic challenge to the progressive trend in tandem and at the same time energised those who felt somehow uncomfortable with the then domineering universalist standpoint. The synergy between political and economic imperialism of the West on the one hand and its epistemological imperialism on the other, constitutes Africa as a province of a Western territory. In fact, the Africa one encounters in European scholarship is an invention – a mirror image of Europe. It is an image whose peculiarity is that it reflects the inversion of European values. All that is evil and negative in Europe characterises Africa, as a European invention.³¹⁹

For Oguejiofor, the question of identity and its reconstruction remain significant even in contemporary African philosophy. The question of identity is at the base of the ambivalence of African cultural reality defaced by the historical experiences that inhere psychological feelings of superiority and inferiority which continue to hamper meaningful and genuine dialogue.³²⁰ Tempel's collections heralded some aggressive attempts at the reconstruction of memory in the face of a prevailing destruction of the African identity and heritage in several ways. Thus, efforts in this direction were preoccupied with the representation and description of the collective thoughts, ideas, folklores, myths, legends and proverbs of the various people of Africa to signify and

³¹⁸ V. Mudimbe, *The invention of Africa: gnosis, philosophy and the order of knowledge* (Bloomington: Indiana University Press, 1988).

³¹⁹ F. Ochieng'-Odhiambo, *Trends and issues in African philosophy*, 194-195.

³²⁰ J. O. Oguejiofor, 'African and Greek philosophy: a pristine dialogue in search of contemporary relevance' *Phronimon*, 13, 2 (2012) 55-72.

estimate, contrary to hitherto popularised views about the illogical and primitive mentality, as concrete manifestations of unique rationality and logic only misunderstood and misrepresented, as these did not immediately conduce with the standard and model adopted by the Western scholars. In some ways, the view of philosophy here is one constitutively embodied by worldviews and interpretations given to the understanding of reality within the cultural environments. Those who participated in this tradition includes; Placide Tempels,³²¹ John S. Mbiti³²² and many others.

Some general criticisms trailed this trend as it seems basically a reactionary response to the debasement of the rational capacities of the African. Thus, it has had to contend with criticisms. Hountondji, for instance, argues that there are two senses (loose and strict senses) in which the term philosophy could be used and at best what the trend succeeds in doing is to conflate the two senses, hence he christened this trend, “ethno philosophy” and is capable of entrenching the myth of primitive unanimity.³²³ By this kind of criticism, the trend is challenged as merely presenting the collective and communal thoughts of the people as philosophy with no reference to particular individuals as is popular in other traditions of philosophy, it opened the door to a barrage of interpretations and reactions. For example, the individual is lost in the communalistic/collectivistic representation of what philosophy is according to this trend and so leaves unanswered the question, of who the African equivalents of Socrates, Plato, Aristotle and others are? One other prominent feature of this trend is the oral tradition through which these worldviews held by the people are transmitted and preserved with all the dangers of depending on oral sources which can be distorted amongst other limitations. Plessis, commenting on the implication this sort of conceptualisation asserts that, “the colonial system in

³²¹ P. Tempels, *Bantu philosophy*, Trans. By C. King (Paris: Presence Africaine, 1969).

³²² J. S. Mbiti, *African religions and philosophy* (Nairobi: Heinemann, 1969).

³²³ P. Hountondji, *African philosophy: myth or reality*, 2nd Edition (Bloomington, Indiana: Indiana University Press, 1996), 36, 60.

furthering this notion, placed undue value on the thoughts of political leaders by replacing tradition with authoritarianism. The traditional scientific knowledge of the public, as well as individual contributions to science, was thereby easily marginalised".³²⁴

However, these criticisms, by no means render some of these thoughts less valid, for the pragmatic disposition of the people generally implies the valuation of these ideas before they become the property of the community. For there is no collective mind from which these thoughts originally were generated. What is most significant to note about this trend is its recovery efforts through the mining of some cultural practices, knowledge claims, and community values of the people, so as to provide the raw materials³²⁵ with which critical philosophical questions can then be raised and attended to, instead of considering them as philosophy in the strict/universal sense of the word. One is not surprised however, about the way the trend progressed as there was haste and urgency with which these scholars presented as philosophy, the descriptive qualifications of Africans as constitutively philosophy proper. This led to some fundamental errors and the result was a disservice to their original and motivational project. For instance, the categorisation of Africans as generally emotive while Westerners as rational by Senghor³²⁶ and the denial of the sense of future time beyond two years by Africans with only a sense of the past and

³²⁴ H. D. Plessis, Whose science? What knowledge? Science, rationality and literacy in Africa, in B. Schiele, M. Claessens, S. Shi (Eds.), *Science communication in the world: practices, theories and trends* (New York: Springer, 2012), 154.

³²⁵ Hountondji, *African philosophy: myth or reality*, 106-107.

³²⁶ Negritude was a programme original to Leopold Sedar Senghor that celebrated the emotive nature as characteristically African. (I feel, therefore, I am as African whereas, I think therefore I am as Western). Through this, Senghor got trapped in the binary of Western system by which much of the classification of the African were based. This is not surprising as his thought is founded on the romanticism that colour art, literature and philosophy in the French tradition. With such motivating grounds, the decolonial agenda set out to be achieved was undermined as it rather perpetrates a lowly psychological order that impede Africa's development. (See, M. Kebede, 'African development and the primacy of mental decolonisation', in L. Keita (ed.), *Philosophy and African development: theory and development* (Dakar: CODESRIA, 2011), 97-114. Also, B. Hallen, 'Yoruba moral epistemology', in K. Wiredu (ed.), *A companion to African philosophy* (Oxford: Blackwell Publishing Ltd, 2004), 296.

present within the linear scheme of time in Mbiti's thought³²⁷ are sufficient to point out this disservice.

II. Philosophic Sagacity

This trend seeks to attend to one major flaw of the ethno-philosophy school as lacking particular individuals to which specific ideas are identified and traceable to within the community. Efforts were thus directed at locating respectable sagacious individuals uninfluenced by Western modernity/education to render their critical accounts on sundry issues of philosophical import and originality. H. Odera Oruka spearheaded it with a distinction between philosophic sages and folk sages with didactic wisdom.³²⁸

The trend reports and reflects the representations of the original ideas of these wise individuals identified using the method of interview; a traditionally social science approach to interact with sages versed and grounded in the thoughts of the people.³²⁹ The application of this model contributed to Marcel Griaule's conversation with Ogotomeli³³⁰ and also employed by Hallen and Sodipo in their interview with Onisegun.³³¹ The discovery and location of renowned sages and interaction with them, documentation of the conversations into written forms seek to among other things, capture knowledge into

³²⁷ Mbiti, *African religions and philosophy*. For Mbiti, time as a concept is an important key to understanding the ontological thoughts of Africans. The descriptive discourse on time has been debunked with evidences by many later scholars. For instance, M. Oke, 'From an African ontology to an African epistemology', *Quest: An African Journal of Philosophy*, XVIII (2005), 25-36.

³²⁸ O. H. Odera, *Sage philosophy: indigenous thinkers and modern debate on African philosophy* (Nairobi: African Centre for Technological Studies (ACTS), 1991). On the distinction, while philosophic sages can also be folk sages, the latter cannot be the former because of the depth and speciality that characterise the former.

³²⁹ The approach employed is similar to the method of the social sciences within the western tradition. See, D. A. Masolo, 'Review of Barry Hallen's A short history of African philosophy', *Thought and Practice: A Journal of the Philosophical Association of Kenya (PAR)*, 3, 1 (2011) 165-171.

³³⁰ M. Griaule, *Conversation with Ogotomeli: an introduction to Dogon religious ideas* (Oxford: Oxford University Press, 1965).

³³¹ B. Hallen & J. O. Sodipo, *Knowledge, belief, & witchcraft: analytic experiments in African philosophy* (Stanford: Stanford University Press, 1997). 'Onisegun' refers to an herbalist who also embodies medicinal knowledge in traditional Yoruba society, South West of Nigeria. Such an individual is expected to have immense knowledge of traditional society as regards many aspects of knowledge as practised in the community.

a systematised, written body of discourse as against oral tradition of the ethno-philosophy school of thought.

Some difficulties arise in the use of this methodology to construct philosophical reflections. With respect to authorship, for instance, the question of where to draw the line between when and where the influence of the professional philosopher plays out against the original ideas/expertise of the identified sage remains problematic. In an essay, Oke criticised how the Onisegun interrogated by Hallen and Sodipo as the prime source was overrepresented as an embodiment of expertise of a rather complex body of Yoruba epistemic system and thus raised some linguistic interpretative problems inherent in this kind of analytic approach to philosophy in traditional African society. Oke recommends that, “as laudable as this approach is, there are visible problems but not unsurmountable and so the use of this unique methodology should only be adopted with caution and care”.³³² For example, the *ifa* corpus remains a multi-complex epistemological heritage of the Yoruba people of Nigeria which can hardly yield itself to any simplistic explanation or details.³³³

III. The Nationalist/Ideological Trend in African Philosophy

The social and political ideas of the early nationalists and independence champions across Africa who fought the colonial systems and upon whom the leadership of the newly independent states in Africa fell upon, had very lofty and ambitious ideas about the social order to be promoted following the exit of colonialists. These nationalists embodied largely socialist ideological positions which influenced the leadership style of immediate

³³² M. Oke, ‘Ordinary language analysis and African philosophy: some comments on method’, E. J. Alam & W. Sweet (Eds.), *Philosophy, culture and traditions*, 5 (2008/2009), 143-150.

³³³ O. Adegbindin, *Ifa in Yoruba thought system* (Durham: Carolina Academic Press, 2014). Ifa provides an excellent example of a comprehensive body of knowledge claims in many aspects of life which requires more than a methodological attention to comprehend and appreciate its worth. Though many experts in African studies, linguistics, religion, social anthropology and ethnology have worked on this important thought system, the philosophical worth is comprehensively explored in Adegbindin’s work.

leaders of various countries across Africa supporting and preaching freedom ideologies for other countries that were still under the yoke of colonialism as independence occurred at different times for various countries in Africa. The general theme that runs through the various formulations was the notion of communalism or sense of fellow feeling, which operated on the principle of extended family with rules and norms guiding the management of the relationships. The blend of these thoughts with the socialist orientation many embraced underline the idea of Ujamaa of Julius Nyerere in Tanzania, Humanism preached by Kenneth Kaunda, Senegal's Sedar Senghor promoted Negritude, Sekou Toure of Guinea harped Communuacratique ideals, Consciencism or African Socialism of Kwameh Nkrumah of Ghana, Welfarism and socialist ideas as adumbrated by Azikiwe and Awolowo in Nigeria, among many others. These were enthusiastic but over ambitious socio-political efforts contained in speeches, pamphlets and manifestoes aimed at the reconstruction of the futures (identities and social orders) of these newly emerged independent states. These social visions had as core, African humanism or the idea of familyhood quite strong in erstwhile simple African communities prior to colonialism though not without its challenges.

Some of the challenges that accompanied these grandiose efforts of the early nationalists were partly the inexperience and lack of depth with which many of them were to manage the affairs of governance in their various newly independent nations. There was in some sense, an overzealous and exuberant leadership mantra and outlandish visions, coupled with an over romanticised past, that was in their estimation, worthy of wholesale recapture to direct the affairs of their nations with which they were saddled with leadership responsibilities once the colonial masters began to vacate those positions. The practicality of these ideas in modern African societies demanded more critical attention than they thought and so it was not long, they were caught in the contradictions of the emerging complex societies. The emerging system to which these new leaders were heirs,

confounded many as they found themselves complicit in managing the immense wealth the exited colonialists bequeathed to them, compounded with the task of expanding infrastructure other than the ones provided purposely for colonial interests. It was overwhelming for many of these young leaders as they soon ran out of ideals of leadership. Most of these young African leaders failed to realise that the ideas deployed as rallying thoughts that ensured political emancipation are different from ideas requisite for development.³³⁴

It was therefore no surprise that most of these early nationalists became dictatorial, authoritarian, and autocratic with little positive benefits to show for the long reign in power in view of their overwhelming claim that unity was paramount in the business of nation building. Many states turned into one party states with intolerant disposition towards any opposition and gradually these leaders became despots and the series of military and counter military interventions that changed the course of many African countries became a constant feature of African political history.³³⁵ The unrealistic glorious past painted by these nationalists lacked rigour, vigilance and critical assessment, as the ideas they took from the past and married with the new ideas they embraced at a time the ideological tension was rife did not help the course of many African states.

Hence, the high enthusiasm and great hope at independence paled into opposite extremes, in many cases, turned into disillusionment. Ironically and disappointingly as it seems, some of such leaders still dot the African continent holding unto power with poor records in terms of development while many countries still reel under the burden of the consequences of the historical poor leadership that trail many countries in Africa.³³⁶ With

³³⁴ O. A. Failaye, 'A Philosopher interrogates African polis: how can we get it right?' University of Lagos Inaugural Lecture, (16th May, 2012), 13-15.

³³⁵ J. Healey & M. Robinson, *Democracy, governance and economic policy: sub-Saharan Africa in comparative perspective* (London: Overseas Development institute, 1992), 10-20.

³³⁶ Literatures are too numerous to chronicle as regards the nature of leadership in relationship to the indices of underdevelopment that keep the continent of Africa as a scar of the world in the words of a poet and literary icon in Nigeria, Wole Soyinka. One may not have to search deep for literatures and sources on the

regard to the move by the nationalists to recapture the entirety of African past, Falaiye insists that the “nationalists were guilty of revisionism”.³³⁷ It should however be noted that this criticism does not by any means imply a total swipe on African socio-political heritage as having nothing positive or good in it. The inexperience and ineptitude of leadership coupled with a number of other factors set Africa on the path of retrogression responsible for underdevelopment, poverty, disease and high illiteracy in many African countries. The successes and failures of these socio-political ideologies and experiments across many countries in sub-Saharan Africa are interesting topics in themselves the thesis may not be able to exhaustively outline here. This picture of the socio-political situation is broadly adequate for the purpose of showing one of the legs often emphasised exclusively responsible for the problem of science advancement in Africa, nay Nigeria. The contention is that there are other important factors and more critical is the question of the epistemological dimension this thesis presupposes was lacking and in fact, seems to me to be at the very root of the failure of these socio-political ideologies in the first place.³³⁸

IV. The Professional/Universalist Trend in African Philosophy

The trend generally describes the contributions of trained professional philosophers mostly of the Western philosophical tradition whose training and expertise are directed

matter; See for example, G. Ayittey, *Africa in chaos* (New York: St Martin's Griffin, 1999); C. Achebe, *The trouble with Nigeria* (Portsmouth: Heinemann, 1983).

³³⁷ Falaiye, *A philosopher interrogates African polis*, 11.

³³⁸ The basis for this claim is the complex nature of decolonisation that was understood simplistically to mean political or juridical independence as sufficing. In fact, as Falaiye argues that the conflation of the idea of emancipation and the problem of development is suggestive of a rather complex phenomenon treated as a simple one by the early nationalists. A deeper reflection on the epistemological foundation of nation building operates on a linear model (which is inadequate and short sighted) as it does not accommodate the complexity of nation building in postcolonial Africa. Such complexity requires epistemological complexity that factor in possibilities of failure, error and limits of dealing with dynamism of social phenomena with uncertainties and unknowability that accompany it. Against this background, Popper's reflections are applied to undermine the presumptive and simplistic cause-effect conclusions of linear epistemology. See, U. Okeja, 'Epistemological foundations of Nation-Building: the paradigm of postcolonial Africa', *Annales Philosophici*, 4 (2012), 29-44; Also, J. K. Kahiga, 'Philosophical fundamentals for sustainable development in Kenya: Karl Popper's perspective', *Current Journal of Social Sciences*, 3, 1 (2011), 28-33.

to philosophical problems, engaged from the African experiences while insisting on the universal nature of the discipline and its special features. Popular among the proponents of this trend are: Kwasi Wiredu, Paulin Hountondji, Peter Bodunrin, Olusegun Oladipo, Odera Oruka and several names from the English, French speaking and indeed, others areas in Africa. These philosophers defend a strictly universalist (technical) view rather than the particularist (loose/general) sense of philosophy. For a body of work to qualify as philosophy following the bias therefore, it must be highly analytical, critical, and argumentative as these constitute the distinctive trademarks of philosophy that cannot be compromised.

By the nature of the problem under consideration in this thesis, it is safe to say that among the identified trends, the thesis pitches tent with this particular trend but with a caveat – the approach advocated in this thesis is also a critique of the universalistic perspective of philosophy as inspired by Popper. Here, the contributions of these African philosophers then seek to construct and build substantive issues relevant to the African situation. There have been great successes in this regard and future possibilities are more. They champion some intellectual and fruitful exchanges among themselves. The results have been some conscious reviews and efforts to reconstruct the cultural heritages contained in the worldviews of the people and thus improving the philosophical relevance of such ideas/thoughts and introducing new insights into philosophy at a global level. Several philosophers are beginning to engage in substantive reflections on African experiences and how they make meaning of these experiences in relation to reality. Bodunrin as a proponent of this tradition, makes a distinction between traditional African philosophy (which looks to the past) and contemporary African philosophy (looks to the future) and the latter, the focus of professional philosophers.³³⁹ There is however a strong connection

³³⁹ P. O. Bodunrin, 'Introduction' in P.O. Bodunrin (ed.), *Philosophy in Africa: trends & perspectives* (Ile Ife: Ife University Press, 1985), XI-XII.

between the two as they are not mutually exclusive as some of the works in African philosophy demonstrate, especially those that set out to critique some ideas and beliefs as held and understood in various societies, with a view of repealing and retooling such thoughts for modern times. On this same score, Wiredu is of the view that the evaluative and critical aspects, rather than the informative and narrative aspects of the African thought should be the concern in contemporary African philosophy³⁴⁰ as they affect the state of Africa in a global context. In this regard therefore, the task of the thesis sits well with the project of professional trend as it deploys Popper's philosophy as go between the Western approach to science on the one hand and the African knowledge tradition in view of advancing a philosophy of dialogue to deal with the problem of science in Nigeria. The ultimate agenda is to explore the potentials of Popper's thought towards a dialogue of knowledge traditions, upon which, the quest for science advancement can be better predicated.

Generally, the identified trends in the foregoing are not exhaustive of the trajectories that African philosophical tradition has progressed. There have been several responses to the challenges that greeted the descriptive and normative accounts of Africans in their historical experiences which the present undertaking does not pretend to have examined. In any case, I have attempted some general characterisation that gives adequate insight sufficient for the philosophical appreciation of the problem under consideration.

By way of summing up, the emphasis in each of the enumerated trend is poetically phrased as "preserving, observing, reclaiming and revising of African cultural heritage or worldviews".³⁴¹ In the light of these problems; many African philosophers endeavour to quarry specific contents and subject them to thorough analysis and critical examination

³⁴⁰ K. Wiredu, 'Introduction', in K. Wiredu (ed.), *A companion to African philosophy*, (Oxford: Blackwell, 2004), 3.

³⁴¹ O. A. Balogun, 'Rethinking the tasks of African philosophy in the twenty first century', *Proceedings of the XXII World Congress of Philosophy*, 28 (2008), 52.

with a view of reconstructing them. From the use of comparative and intercultural comparisons to identifying specific philosophical problems, analysis of the problem to systematic presentations of the ideas. One area of specific progress recorded on the part of those interested in African philosophy is the emergence of the literary tradition. As is well known, rigorous and sustained development and exchange of philosophical thoughts within Africa was greatly hampered by lack of a tradition easily supportive of advanced theory development and systematisation. The documentary and writing tradition that contemporary African philosophers now use to appropriate the rich traditions and heritages of the African people, will significantly impact on the knowledge systems which were before now left at the mercy of the limitations of various means for their preservation and transfer in these societies. Such has been made less cumbersome a task Gyekye remarks on thus, “the ideas and beliefs of the African society have not fully been elaborated and investigated or clarified and so many are in real need of profound and extensive analysis and interpretation”.³⁴² The way to achieve this goal cannot but draw on the lessons of the epistemic values of openness, clarity and use of language in ways never before. For instance, Gyekye in another text argues that one of the draw backs of science in Africa includes the lack of deployment of the impulse to pursue sustained inquiries into the inherited ideas with a highly esoteric/personalised means of securing and preserving these knowledge forms.³⁴³ And so, Popper among many others, is no less a reliable and commendable companion if this type of project is to succeed in Africa.

The point here is best understood in broader context when one reflects with Popper on how the use of language can undermine scientists participating in self-liberation through knowledge as a cultural task of science. Popper’s response on Kuhn’s work, *The*

³⁴² G. Kwameh, ‘African ethics’, *The Stanford Encyclopaedia of Philosophy* (Fall 2011 Edition), E. N. Zalta (ed.), Available online: <http://plato.stanford.edu/archives/fall2011/entries/African/ethics/html> [Accessed on 23/04/2014].

³⁴³ K. Gyekye, ‘Culture, religion, and the pursuit of science’, 154-155.

Structure of Scientific Revolution that, the characterisation of any prevailing paradigm in normal science and its transition necessitated by a period of abnormal science seems to give undue specialisation to scientists. This is because some may remain in a world of esoteric technicality and so, the reflection is very illuminating for tackling some fundamental characteristics of the knowledge tradition in an African traditional setting. For example, the ways through which some of these knowledge claims are preserved and transmitted as the trio of traditionalism, authoritarianism and anachronism have been identified as problematic.³⁴⁴ Popper shows the connection this epistemological idea on clear and simple language usage has for the larger socio-political context argues,

scientists have the responsibility to express themselves in simple language. Beyond that is the grave responsibility of scientists to be open and not an exclusive possession by a closed set of specialists. For this is tied to the survival and flourishing of an open society and democracy, as an open society is one in which dissenting voices are not merely tolerated but respected while democracy is a form of government that is devoted to the protection of an open society.³⁴⁵

Again, with language as a human phenomenon, the creation of myths as an indication of human reason³⁴⁶ is facilitated, but it does not stop there or limited to that alone as the argumentative dimension of language is expected to be brought to bear in the interrogation of the creative imaginations of human reason. By this, the horizon of relevance is ascertained by the consistent practice of mutual rational criticism with the lesson that,

... these standards of objective criticism may teach him to try again, and to think again; to challenge his own conclusions, and to use his imagination in trying to find whether and where his own conclusions are at fault. They may teach him to apply the method of trial and error in every field, and especially in science; and thus, they may teach him how to learn from his mistakes, and how to search for them. These standards may teach him to discover how little he knows, and how much there is that he does not know. They may help him to become aware of the

³⁴⁴ D. Kaphagawani, 'What is African philosophy?' in P. Coetzee & A. Roux (eds.), *The African philosophy reader* (London: Routledge, 1998), 86. Also, K. Wiredu, *Philosophy and an African culture* (Cambridge: Cambridge University Press, 1980), 1, 5.

³⁴⁵ K. Popper, *The Myth of the framework: in defence of science and rationality*, M. A. Notturmo (ed.) (London: Routledge, 1994), 107-108. Also, J. Sheamur, *The Political Thought of Karl Popper* (London: Routledge, 1996), 5.

³⁴⁶ K. Popper, *Conjectures and refutations: the growth of scientific knowledge*, revised and corrected edition (London: Routledge, 1989), 383-384.

fact that he owes his growth to other people's criticisms, and that reasonableness is readiness to listen to criticism. And in this way, they may even help him to transcend his animal past, and with it that subjectivism and voluntarism in which romantic irrationalist philosophies may try to hold him captive.³⁴⁷

Gyekye was so clear on this point when he states that "knowledge of medical plants, for instance, is clearly a form of scientific knowledge, must be rescued from the quagmire of mysticism and secrecy and brought to the full glare of publicity and openness, and its language made exoteric and accessible to many others".³⁴⁸ Applying the thoughts of Popper to the African context, Kahiga is of the view that pseudo-scientific attitude prevalent in Africa is to be overhauled if the needed renaissance is to manifest in Africa.³⁴⁹ For several of the beliefs, practices are inherently dogmatic and counter-productive and as such stifle imagination, creativity, competition, contestation and debate, hence the resulting uncritical mental attitude is the albatross of African quest for development.³⁵⁰ These criticisms amongst other crucial points basically reiterate Wiredu and Kaphagawani on the facts and influence of the three evils of authoritarianism, anachronism and supernaturalism on some aspects of the African knowledge heritage and society and why we urgently do need to do something about them.

In practical terms, Wiredu challenges contemporary thinkers to take more seriously, the task of decolonisation which is an imperative, especially the subtle and unconscious manner in which it operates pretentiously to be innocuous.³⁵¹ From mental to language, the task of decolonisation is more urgent than ever, more so, that we are in a decolonial situation makes it an imperative. How do we go about it? Is it just to endeavour the task of decolonisation for the sake of it or there is a more rewarding dimension to the task, if

³⁴⁷ Popper, *Conjectures and refutations*, 384.

³⁴⁸ Gyekye, *Culture, religion, and the pursuit of science*, 157.

³⁴⁹ Kahiga's reading of Popper in the African context presents as wholesale the entire African intellectual and cultural heritage as pseudo-scientific. This sort of understanding of Popper and in fact, the body of knowledge and emphasis within an African context does a disservice to Africa because metaphorically speaking, it tends to encourage an attitude that throws away the baby along with the dirty water.

³⁵⁰ J. K. Kahiga, 'The relevance of Karl Popper's philosophy in African renaissance',

³⁵¹ Wiredu, *Conceptual decolonisation*, 56.

successful? To answer these questions, Oladipo provides some considerations with which this task can be undertaken with no risk to the African identity. A synthesis is possible, for cultural traditionalism is limited and must be subjected to critical and reconstructive self-evaluation in an ongoing manner as it must not be blinkered to important developments in other cultures. This is the sense of dialogue in Popper which acknowledges that there are important lessons that can be learned from others in tackling problems but requires both parties to be open and genuinely disposed for such exchange and enrichment. As Oladipo states, "... the way to ensure effective African participation in the quest for development is that of critical appreciation of our culture and openness to positive developments in other cultures".³⁵² Nothing is more sensible in the idea of dialogical and conversational exchanges that are possible in the light of the foregoing reflection. The role of reason or rational thinking in this dialogical possibility cannot be over emphasised. It however, must be one that takes into account Wiredu's conceptualisation of decolonisation as "a process of intellectual liberation bearing in mind the potential of enlightenment far beyond the confines of one culture".³⁵³ The results will then mean two things; advancement and projection of aspects of the community or humanistic values important for human flourishing and new habits and attitudes have to be encouraged and adopted; to include: exactness, rigour in thinking, the pursuit of systematic coherence and the experimental approach so characteristic of science important for meaningful social change.³⁵⁴ The sense of decoloniality here is emphatically one that is pluriversal and pluralistic.

3.2.3 African Philosophy, Culture and Science Development

The relevance of African philosophy to the African experience and the global philosophical enterprise has been a thorny one. Many have continued to express doubts

³⁵² Oladipo, *Reason, identity, and the African quest*, 32-33.

³⁵³ Wiredu, *Conceptual decolonisation*, 64.

³⁵⁴ Oladipo, *Reason, identity, and the African quest*, 33.

about the prospects of philosophy in general. In fact, the future and immediate challenge for African philosophy resides in the contribution it is able to bring to reflect on the African situation. African cultural heritage presents some imminent challenges for the problem of development generally; science development inclusive that demand some attention. In this regard Moreau writes:

any discussion that attempts to meet the needs of the modern African can neither neglect the complexities that modernisation has introduced today nor ignore the reality of the fact that the traditional African mind set forms the base for much of modern African thought and society. The traditional provides the foundation for modern times.³⁵⁵

One of the ways that this attention is directed is in the linguistic analysis that has come to be adopted by many African philosophers as they seek to bring to bear their expertise within Western philosophical tradition on several aspects of African cultural heritage. It is important to note that part of the initial hiccups faced by the discipline of African philosophy was because much of the discourses were seen through non-African lens. This gap is now being filled with the efforts by professional African philosophers who bring to bear their expertise in both African and Western traditions towards enriching the universal enterprise of philosophy and beyond. The idea is well captured by Brown in these words;

little wisdom can be realised if one's perspectives are confined as were those of the challenged persons attempting to get knowledge of the elephant by touching only one part while being unwilling to learn from others. To appreciate the philosophical perspectives of other cultures, one must come to understand those perspectives from the point of view of those who hold them. Granted, unless one is intimately familiar with a culture, it is often difficult to appreciate or even to understand the how and why of the ontological and epistemological commitment that ground the perspectives upon which a culture is built.³⁵⁶

Brown noting the prospects that African philosophy has states clearly that people of African descent not unlike any other population with a language have long engaged in

³⁵⁵ S. A. J. Moreau, 'A critique of John Mbiti's understanding of the African concept of time', *East African Journal of Evangelical Theology*, 5, 2 () 44.

³⁵⁶ L. M. Brown, 'Introduction', in L. M. Brown (ed.), *African philosophy: new and traditional perspectives* (Oxford: Oxford University Press, 2004), 6.

philosophical thought, and their perspectives have much to contribute towards many of the concerns that have plagued Western philosophy for the past 2,500 years. If for nothing, seeing oneself through the lenses of the others can enrich one's horizon and be source of growth. The growth could be in the form of greater confirmation of existing perspectives or it could warrant a change and adjustment of view of oneself.³⁵⁷ The lesson here emphasised aptly captures the goal envisioned in this thesis as it seeks to apply Popper's philosophy as basis to revisit the relationship there can be between an African tradition of knowledge and Western science as ultimately important for the problem of science in Nigeria. The relevance of Popper's intervention in creating conducive epistemic environment for conversation/dialogue is germane and it echoes the point emphasised by Brown in the foregoing on what relevance African perspective can initiate, its volume notwithstanding.

While the next chapter will provide further details, it is important to highlight at this point, that several studies have clearly showed incontrovertibly the connection between culture and science and how they interact and affect each other.³⁵⁸ In the learning of science too, cultural factor has been shown to play a very important role. Experts in science education and many disciplinary interests in science have also clearly demonstrated this all-important role of culture in the learning and advancement of science. Thus, the advancement or underdevelopment of science can be richly analysed from the perspective of culture. Jegede has demonstrated along with many others on the need to pay attention to the context of the learner of science if the effort must be successful. He therefore argued that whatever catalyses the learners' environment should be considered. Not a few

³⁵⁷ Brown, *African philosophy: new and traditional perspectives*, 4.

³⁵⁸ For example, Horton comparative exercise that claims that the traditional religious beliefs and action are akin to explanatory theories in the sciences on the strength of his continuity theory that lays claim to theoretical connection and similarity between these systems of knowledge. See more, R. Horton, 'African Traditional Religion and Western science', *Africa* 37, 1, 2 (1967), 50-71 & 155-187. It is important to note as Appiah asserts of religion in the African context is peculiar because of the extent to which beliefs, activities, habits of the mind, and behaviour in general are shot through what others will refer to as religion. K. A. Appiah, *African studies and the concept of knowledge*, 23.

literatures abound in this regard on the place of contextual learning of science especially from the experiences of societies where Western modern science is foreign.³⁵⁹

3.2.5 Some Important Principles in African Philosophical Thought

The various thoughts are based on some underlining characterisation regarded as principles and are always at the background of the thought system. They are important keys to reflecting on the various beliefs, practices, traditions and ideas no matter how problematic they get in an intercultural context. The task here is to attempt to present and critique them in the light of theoretical lens of Popper's philosophy in relation to how these principles connect with the problem of science in Nigeria (African context). That there are these principles is not strange when we consider philosophy's fundamental role in most areas of human endeavour. And so, there is philosophy of many areas of life and society. For instance, philosophy of photography, mind, beauty, mathematics, social science, culture; all of which have become areas of interest for philosophy.

The conceptual framework of African philosophy displays ontological and epistemological commitments that are slippery in terms of how they are understood and characterised. For a greater appreciation of the perspective will demand the adoption of the principles of charity and generosity in the meeting of cultures. The lack of the exercise of these in understanding contributed to the misrepresentation suffered by African thought systems. What was prevalent were reductive translations and replacements (among other things) with all the dangers of losing important parts of these thought systems which were not immediately understood. In the contemporary times however,

³⁵⁹ O. Jegede, 'The knowledge base for learning in science and technology education', in P. Naidoo & M. Savage (eds.), *African science and technology into the new millennium: practice, policy and priorities* (Cape Town: & Co Ltd. 1998), 151-153. The school science taught in Africa is predicated on western worldview that lays claim to superiority in comparison with other knowledge tradition with its own worldviews where it is taught; that is, African worldview for instance. Its claim to be universal and therefore enjoys the right to be imposed on other traditions without due diligence to the knowledge base of such a cultural setting it is imposed cause disruptions and dislocations in the knowledge situation of such societies, sometimes deliberately, colonialism for instance; some other times, not deliberate.

efforts are directed at enhancing greater understanding as these principles underlie cross cultural exchanges.³⁶⁰ The view of the thesis in relation to some of these principles and values is that a patient and close attention to them will reveal some elementary forms that need not be supplanted but built upon and refined for a better relationship with the new values inherent in Western modern science playing supplementary or complementary roles. Examples of the presence of these abound in the areas of Agricultural practices, unorthodox traditional medicine, and in other areas of life. Azenabor writes glowingly on the principles of African philosophy but at the risk of over-simplification as;

one that thrives on African traditions, history and cultural experience. Its ontology is holistic and more coextensive with nature than conquest, more of collectivism rather than individualism, more of holism rather than atomism, more of relations rather than separation, more of synthesis rather than analysis and more of unity than monism or dualism.³⁶¹

Wiredu insists that caution be taken as many concepts employed to describe the details and contents of African thoughts are still in need of conceptual decolonisation. For instance, the metaphysical categories of the binaries of religious/secular; mystical/non-mystical; natural/supernatural; being/non-being (nothingness); physical/spiritual are superimposed dichotomies. Their usage is at least intelligible within philosophical tradition, the onslaught on Logical Positivism notwithstanding. It is instructive that a note of caution which underpinned Behren's analysis of African relational environmentalism, as ethics of environment located between anthropocentric and holist perspectives of ethics³⁶² seems more appealing. Due reflection must characterise the appropriation of these conceptual frameworks to show what is beneficial and what is not on the one hand and what is authentic on the other in Western and African philosophical tradition

³⁶⁰ G. Azenabor, 'African philosophy in African language', *Indian Philosophical Quarterly*. XXVII, 3 (2000), 325.

³⁶¹ Azenabor, *African philosophy in African language*, 321-322.

³⁶² K. Behrens, 'Exploring African holism with respect to the environment', *Environmental Values* 19, 4 (2010), 465-484.

respectively in the cross-cultural infiltration that characterise the world today.³⁶³ Brown presents a vivid picture which we will see briefly of what happens when there is an appropriation of a conceptual scheme in a cultural context which it is not found. To do that is to neglect Wiredu's cautionary remarks on the task of decolonising language in Africa. In another breadth Narh, argues that attention is to be given to African epistemologies with their ontologies as a commitment to the constructivist position as against the positivist presuppositions in the development of knowledge in/on Africa.³⁶⁴ The context dependency view defended by Narh seems to defend constructivism, a viewpoint which is rather synonymous with relativism, a position I seek to avoid in the way I understand it. In this light, it creates a critical problem, of relativism. The emphasis in making such constructivist position as an end in itself, tends towards relativism. However, when conceived as means towards an end, the relativism can be bypassed. Otherwise, there are some dangers as Brown writes,

if having powers to bring about changes in others by casting spell is not significant within a culture, then reducing talk about witches to talk about psychotics works well. However, psychotics do not have the powers purportedly had by witches, so something fairly important gets lost when witches become mere psychotics-people with a specific kind of delusional perspective on life... they can destroy components of a culture that are essential to the survival of the culture, and often what is gained by the reduction does not offset the loss that results from the reduction. Again, replacement idioms typically have problems of their own and they themselves are typically replaced in some future by something else. Such transitions get us farther away from being able to understand what was of significance in the original conceptual language, and that gets us further away from being able to understand what was important to the people of the culture out of which the language emerged.³⁶⁵

The implication of the above for the possibilities of providing explanations for events and some experiences continue to pose challenge to the conceptual frameworks of the Western tradition in understanding some views held within African thought systems. The

³⁶³ K. Wiredu, 'Toward decolonising African philosophy and religion', *African Studies Quarterly, The Online Journal of African Studies*, 1, 4 (1998).

³⁶⁴ P. Narh, Philosophical foundations of knowledge creation on Africa, *Farafina Institute Discussion Papers Series*, No. 3, June, 2013.

³⁶⁵ Brown, *African philosophy: new and traditional perspectives*, 8-9.

evaluation of these issues directly feed on some conclusions that have been adduced by some scholars that have analysed the phenomena of magic, witchcraft, or paranormal occurrences usually attributed to African belief systems and the place of science in an African context.³⁶⁶ For instance, Menkiti argues how some kind of

misunderstanding of the conceptual framework of African thought systems is responsible for the characterisation as superstitious, supernaturalism, magic and metaphysics as these do not provide explanations amenable to the Western empirical science model. Contrary to the popularly held belief, the ontological frame of Africans is even empirically justifiable. For the role of the ontological commitment in shaping what can be seen and valued is crucial and an appreciation of this leads to enhanced knowledge of human nature and thus able to say why certain phenomenon are ascribed with certain potentials by the inclinations of Africans as regards their conceptual schemes.³⁶⁷

Similarly, Mosley argues that context is important but it is not the entirety of all that is required in the evaluation of African conceptual framework. To take conceptual schemes out of the context that gives meaning and structure to them is unjustifiable.³⁶⁸ (The problem of language remains intractable and is at the root of the misinterpretation of African thought systems as making ontological commitments of the empirical kind conceptualised as supernatural. Issues that come up naturally are whether to redefine causation, proof and evidence and experiment, etc).³⁶⁹ Given the problem of language, - for lack of a better way to express the ways of knowing in an African context, Bakari is of the view that the way and manner spirituality and ontology are represented often do make use of symbolic imagery; a way to conveying precise rationale; objectification of

³⁶⁶ The error of positivism attacked by Popper as used to draw a line of demarcation is warmly embraced by the penchant to quickly compare and contrast African traditional thought against Western modern science. In which case, what happens is category mistake at a fundamental level. This does not in any way defend the entrenchment of traditional thoughts practices that are atavistic and injurious to advancement of science be preserved or retained.

³⁶⁷ I. Menkiti, 'Physical and metaphysical understanding: nature, agency, and causation in African traditional thought', in L. Brown, (ed.), *African Philosophy: New and Traditional Perspectives*, 107-135.

³⁶⁸ A. Mosley, 'Witchcraft, science, and the paranormal in contemporary African philosophy', in L. Brown, (ed.), *African Philosophy: New and Traditional Perspectives*, 136-157.

³⁶⁹ K. Gyekye, *Culture, religion, and the pursuit of science*, has shown how experience and observation form an important basis for African epistemology. This however is never stretched to its limit and hence, the nature of causation taken seriously and profoundly important is agentive causation rather than empirical causation and this has remained the bane of science in many African societies as they have perpetuated a mix between religion and all of nature, (155).

the subjective subliminal nature of Africans. Its use does not preclude recognition and use of rationality or scientific logic.³⁷⁰ As Appiah argues that though symbolism may arise out of the fundamental nature of religious beliefs, these fundamental beliefs are not themselves symbolic.³⁷¹ In all, one cannot agree less with Wiredu that constant vigilance and thorough piecemeal analysis of these conceptual categories are watch-words, as African philosophy continues to search for authenticity and as it grapples with the challenge of language amongst others. For instance, the binary of natural/supernatural does not for instance square with the ontological framework of many African thought patterns. The ontological picture of African traditional thought suggests rather a world continuous, interpenetrating and interactive³⁷² with this physical world in some relations blurred but not of the utter supernatural frame that the traditional binary category suggests. Given this background, quite a lot of the issues in African philosophical tradition can better be understood and appreciated once we are disposed to adopt of some of the epistemic principles available from Popper's philosophy in our epistemic practice.

3.3 The State of Science in Nigeria (Africa)

In this section, I will examine briefly some broad themes to include; science policies in Nigeria, science developmental interventions and programmes/projects, science education situation and general outlook and practices of science culture in Nigeria. There is caveat to be noted as the discussion progresses with the use of the terms science and technology. For my immediate purpose, the usage of the terms is loose in the sense that I assume that there is a fundamental link between the two in such a way that these two

³⁷⁰ S. R. Bakari, 'Epistemology from an Afrocentric perspective: enhancing black students' consciousness through an afrocentric way of knowing', *Different Perspectives on Majority Rule* 1997, Paper 20 Available online: <http://digitalcommons.unl.edu/pocpwi2/20> [Accessed 12/11/2015]

³⁷¹ K. A. Appiah, African studies and the concept of knowledge, in B. Hamminga (ed.), *Knowledge cultures: comparative Western and African epistemology*. (Poznan Studies in the philosophy of the sciences and the humanities 88, Amsterdam/New York: Rodopi, 2005), 29, 36-38.

³⁷² K. Wiredu, 'Philosophy and authenticity', *Shibboleths: A Journal of Comparative Theory*, 1, 2 (2007) 72-80.

concepts flow into each other. Thus, when science is used, its assumed connection with technology is taken for granted and implied. Aware of the tenuous debate about the technicality of the relationship; it is however to be, again, noted that my aim is not to resolve the debate. The adopted usage gives a rather simple reading of the terms. I make deliberate attempt to provide concrete reflection of the deep and related issues of epistemological and political nature as it considers the problem of science advancement in Nigeria. Therefore, underneath the largely descriptive discourse is the presupposition of the fascinating connection there is between Popper's epistemological thought and his political philosophy relevant to the problem under consideration. More so, the need to instantiate with concrete examples the problem under consideration in this thesis makes it an important consideration at this juncture.

3.3.1 Science in Practice and Science Education in Nigeria

The science education setting will open the discussion of the other themes. The volume of literature on the state of education at the foundational or lower levels (secondary and primary) preparatory for the tertiary level of training and education in science are too numerous to exhaust suffice it to note that the story of the state of these levels of education are not better. From challenges of infrastructure, ill-equipped and inadequate and poorly motivated human resources to deliver the contents in ways that is relevant and inspiring, the curriculum and pedagogical challenges, and funding,³⁷³ general interest in science and technology related courses continue to witness low interests right from these early stages of education in Nigeria. Omoifo demonstrates this fact with evidences in a detailed historical and analytical presentation of the poor state of science education in Nigeria with

³⁷³ M. B. Ogunniyi, 'Two decades of science education in Africa', *Science Education*, 70, 2 (1986), 118.

particular emphasis on the curriculum, teacher-student factors, and environment/context of science learning as responsible and inadequate for the 21st century.³⁷⁴

One interesting story told decades ago with a freshness that still reflects the testimony of the state of science and science education in many African countries, particularly Nigeria, will be revisited since it does exemplify the central concerns. It is quite captivating that will warrant retelling verbatim: The story of Jacques de Certaines, a French biologist who studied at the University of Dakar, Senegal:

In the African university where I trained, there was a scientific teaching quite valid in the subject matters I had to learn, but it taught rather dependence than real science. I mean that, for three years, I was told how biology had developed through works implying the use of facilities which did not exist on the spot. Therefore, in order to do such biology, students would have to go abroad. Such and such scientific results were published in such and such journals, but these journals were European or American, and one had to read them abroad. In short, during three years, thanks to lecturers and professors who were good ones, and who were also Africans up to 60%, I received good teaching and learnt, at the same time- but for me this was, of course, not so serious as for my fellow students who were not to come back to France- I learnt that finally, all that I could do as a biologist in the future, I should have to do under the dependence of American centres, American periodicals, with European facilities, and all that I could ever do at the university of Dakar was to repeat European works, or initiate small works to be submitted, for publication, to European journals. All these apparently good teaching only led to a feeling of dependence towards those places where science was really being done. I was told, in a way: here, you are working on the margins of science, but if you really want to reach the heart you will have to go. All my fellows of that time have continued doing biology, some of them became secondary school teachers, but those who wanted to do research actually left. How could such a dependent teaching lead to real development?³⁷⁵

As troubling as the story seems, the important thing to note is to ask whether the story has changed significantly after nearly half a century of trying to catch up with modern Western science. Not much I think given the complexity of various factors and challenges of poor services delivery, absence of adequate investment and infrastructure to revolutionise the leap, lack of commitment to prioritise science and so the prevalence of

³⁷⁴ C. N. Omoifo, 'Dance of the limits: reversing the trends in science education in Nigeria', University of Benin 125th Inaugural Lecture series, Benin: Uniben Press, 2012.

³⁷⁵ P. Hountondji, 'On the universality of science and technology', in B. Lutz (ed.), *Technik und Soziales Wandel* (Frankfurt & New York: Campus, 1987), 382.

low level of scientific literacy and other daunting indices that suggest not much has really changed for good. Of course, this near pessimism does not deny the occasional exceptionalism we have recorded in a number of areas, for instance, the excellence of many in the diaspora who are on the frontline and expanding the frontiers of scientific knowledge in different parts of the world. My consideration is the extent to which the culture of modern Western science can be said to permeate through the larger segment of the society and have these values reflecting and informing how our affairs and developmental challenges are understood and dealt with nationally and as a people.

The point of the story catches the state of science education and its direct relevance for development in Nigeria after about three decades of the related experience. A cursory reflection will reveal the poor state of performance of many African countries with regards to science and technology which is partly a consequence of the inadequate foundation and development of the requisite education needed for science and technology's transformation. The attestation of the Secretary General of African Academy of Sciences confirms that "inadequate scientific and technological activities (research and development) and lack of conducive atmosphere together keep Africa behind other continents".³⁷⁶ Thus, there is a huge reliance on external resources for the science and technology needs of most African countries despite the presence of many institutions charged with primary tasks of growing the science culture and educating people in critical scientific and technological needs in Africa. Little wonder then it is said that, "Africa has had very disappointing records in science (and consequently technology on a large scale)".³⁷⁷ For Kaputa, the education in many African countries is underlined by inappropriate epistemology as what is in operation does ignore some good items

³⁷⁶ S. A. Olende, *Lack of science capacity threatens Africa's development* (2012). Available online: scidev.net/global/funding/news/lack-of-science-capacity-threaten-Africa's-Development.html. [Accessed 6/11/2015].

³⁷⁷ P. Naidoo & M. Savage (eds.), *African science and technology education in the new millennium: practice, policy and priorities* (Cape Town: Juta and Company Ltd. 1998), xiii.

important to Africans, hence it does not produce competent thinkers and problem solvers.³⁷⁸ One major cause of this, according to Rambene and Mashige is the pedagogical model which disempowers and alienates in ways the cultural heritage of the people are presented as opposed and lacking in scientific and mathematical thinking. Contrary to such model are evidences of the presence of mathematical and scientific thoughts in the socio-cultural setting of African learners of science.³⁷⁹

In an incisive assessment of science education vis-à-vis its relevance for the needs of emerging postcolonial Nigerian society, it was discovered not only to be inadequate but also poorly grounded to deliver on its promises.³⁸⁰ Jeffrey James in his book, “The State, Technology and Industrialisation in Africa”³⁸¹ makes a distinction between the bureaucratic man and the engineering man, the former being the bane of technological advancement in Africa.³⁸² Giving a more vivid picture of the situation with particular reference to Nigeria, Weaver further observes that the popular trend in science education programme in Nigeria is one in which,

Certification through passing of examinations at all cost with a rigid system of evaluation or gradation in lieu of gaining employment into the government civil service has continued to ensure low productivity at very huge cost to Nigeria. The situation is one which those who trained in the science and technological/technical areas are drained off into the administrative, procedural, maintenance, supervisory areas related to their professions. They end up as functionaries of the professions, not practitioners while the expatriates practice the profession. The laboratories are not laboratories, the experiments are not practical, and the demonstrations are

³⁷⁸ T. M. Kaputa, ‘An appropriate epistemology in African education’, *Zimbabwe International Journal of Open and Distance Learning*, 1, 2 (2011), 67.

³⁷⁹ D. T. Rambene & M. C. Mashige, ‘The role of mathematics and scientific thought in Africa: a renaissance perspective’, *International Journal of African Renaissance Studies*, 2, 2 (2007), 189-199.

³⁸⁰ Weaver, *Science education in Nigeria*, 351-353.

³⁸¹ J. James, *The State, Technology and Industrialisation in Africa* (New York: St. Martins Press, 1995).

³⁸² The idea seems consistent with the sociological analysis of the impact colonialism on the emergence of a unique historical configuration in postcolonial Africa as ably demonstrated by P. E. Ekeh, ‘Colonialism and the two publics in Africa: A theoretical statement’, *Comparative Studies in Society and History* 17, 1 (1975), 91-112. Ekeh particularly makes a useful distinction between perceiving education as an avenue for success on the one hand and education as guarantee of success. Accordingly, to say that education is an avenue to success is to invite the benefactor of the educational system to earn his/her success by treating his/her education as achievement as a baseline for advancement to treat education as guarantee of success is to invite the benefactor of educational system to demand advancement once the requisite educational standards is achieved; which according to Ekeh is an ideologiucal invention of the Western educated bourgeoisie class to legitimate its rule based on its colonial education.

merely visual devices for confirming what is already known. Basically, it is a science programme that is verbalistic, memoritor, and authoritarian with just one lesson, that of conformity.³⁸³

The penchant for managerial, rather than productive character is strongly connected to the higher and immediate rewards along the social stratification of a typical postcolonial African society. It provided speedy access to wealth and privilege at the expense of productivity and the long-term sustenance of the system.³⁸⁴ This was particularly the case with the products trained in the humanistic disciplines that dominated the scene once the colonial system created space upon exit.³⁸⁵ Hence, with few, adequately trained and experienced to grow productivity and advance science and technology became very daunting a challenge. The situation led to the absence of well and deeply thought plans for the transformation of the society bequeathed to them. Hence, the drive was poorly conceptualised visions of westernisation. According to July, the policies of Westernisation pursued were imperfectly understood and too quickly pursued.³⁸⁶ Coupled with the overweight of traditional communalistic values, it was within a short period that decline set in and over all, a dysfunctional state apparatus became the order of the day coupled with the entrenched structures of coloniality.

What Weaver's remarks say of the state of science and the kind of education in place is one that is very factual and real as it challenges the status quo to reinvigorate its drive to promoting the value and culture of science as well as preparing adequately trained human

³⁸³ Weaver, *Science Education in Nigeria*, 359-360.

³⁸⁴ P. Ekeh, 'Colonialism and the two publics in Africa: a theoretical statement', *Comparative Studies in Society and History* 17, 1 (1975), 91-112. Eke draws our attention to an important distinction between education as guarantee to success versus education as avenue for success. The former was a creation of the colonial system that impacted strongly on the traditional society wherein the training and certification became the new standard of success in the new society that was created.

³⁸⁵ A. Wad, 'Science, technology and industrialisation in Africa', *Third World Quarterly*, 6, 2 (1984), 333-335. Here, the example of specialised technological institutions in Nigeria derailing from their original founding mandates in establishing faculties and departments with no bearing with learning or expertise in technology are illustrative of this problem and challenge.

³⁸⁶ R. W. July, 'Toward cultural independence in Africa: some illustrations from Nigeria and Ghana', *African Studies Review*, 26, 3-4 (1983), 129. Ogunniyi calls such 'zealots of technological transfer'. See, M. B Ogunniyi, 'Two decades of science education in Africa', *Science Education*, 70, 2 (1986), 118.

resources for the scientific and technical needs of the country. In Nigeria specifically, there is a yawning gap in terms of investments in the area of science and technology education. For the purpose of exemplification, the results of such interventions, evident in the contribution of those who return back to the country with excellent results from abroad do not translate into significant effects in the critical areas for which they are supposedly educated/trained.³⁸⁷ The reason for such may not be far-fetched considering the claim of Masoga and Kaya that, there is generally a crisis of confidence or psychological alienation that has come to characterise the prevailing paradigm of development across Africa (science and science education inclusive). Development calls for consummate confidence and high sense of seriousness which the prevailing system discourages.³⁸⁸

As a way out therefore, Nyamnjoh tasks Africans to design an education system relevant to the science and technology policies with specific African themes addressing her contextual needs. The dominant epistemology of education characteristically, Western typology lacks the appropriateness to serve the purpose of development relevant to Africa. Writing about the weaknesses of imported Western epistemology in the educational sector compared to the traditional epistemologies in Africa, Nyamnjoh has this to say,

it tends to limit reality to appearances, which it then seeks to justify (without explaining) with meta-narratives claiming objectivity and a more epistemologically secure truth status. Under this kind of epistemology, reality is presented as anything whose existence has, or can be, established in a rational, objective manner, with universal laws operating only in perceived space and time.³⁸⁹

³⁸⁷ W. Gitari, 'Some issues of science education in Africa', in S. N. Dlamini (ed.), *New directions in African education: challenges and possibilities* (Calgary: Calgary University Press, 2008), 42.

³⁸⁸ M. A. Masoga & H. Kaya, 'Building on the indigenous: an appropriate paradigm for sustainable development in Africa', in G. Walmsley (ed.), *African philosophy and the future of Africa* (Washington DC: The Council for Research in Values and Philosophy, 2011), 154.

³⁸⁹ F. B. Nyamnjoh, 'Relevant education for African development: some epistemological considerations', in L. Keita (ed.), *Philosophy and African development: theory and practice* (Dakar: CODESRIA, 2011), 140. This critique offered here reaffirms Popper's assessment of positivistic idea of science not only in operation in the hard/natural sciences but also in the social sciences as made popular through the instrumental assistance of the pretensions of the Logical Positivists. Nyamnjoh while referring to Hawking seeks to demonstrate how the narrow view of science regarded as highly technical and mathematical has

Going further, Nyamnjoh adds,

the science inspired by such an epistemology has tended to celebrate dichotomies, dualisms, teleologies and analogies, dismissing anything that does not make sense in Cartesian or behaviourist terms, confining to religion and metaphysics what it cannot explain and disqualifying as non-scientific more inclusive epistemologies. The world is perceived and presented as real and unreal. The real is the rational, the natural, the physical and the scientific; the unreal is the irrational, the supernatural, the religious, the metaphysical and the subjective. The logic of this epistemology is simple: if the truth is one and universal, then there should be a one-way best way of attaining it; and those who have been there before are the best guides of the rest still in search of truth. This evokes the image of a Jacob's ladder to heaven, where those highest up the rungs are best placed to tell everyone else what paradise is or could be. We may all be blind and animated by partial theories- like 'the six blind men and the elephant', but some are more likely to claim authority and to silence the others about the nature of the universe and the underlying order of things, thanks to the hierarchy of blindness made explicit in this epistemology.³⁹⁰

The sense of Nyamnjoh's contribution is not to be taken as outright condemnation and hence call for a rejection, rather it is a critique that sets out to show the need for caution as efforts are made to embrace the project of Western modern science within the African setting in view of development different from what it has been. Wad lends credence in this regard thus, "traditional knowledge can have immense value for self-reliant development but has often been suppressed by modern science and technology."³⁹¹

According to Sillitoe, one of the major motivations for engaging the indigenous knowledge context is to facilitate the people to own and take possession as this will ensure that all interventions will work harmoniously.³⁹² For example, the critique of development underpinned by modern Western science which promotes an excessively materialistic outlook with unbridled exploitation and capitalistic depletion of the earth's

long been overtaken by science's broader concerns in the areas of dark energy, black holes and quantum levels, meanwhile, the positivistic use of science is retained and defines the epistemic attitude, social sciences, policies and relations of the West and the rest (Africa). In other words, this highly positivistic understanding constitutes the defining line of demarcation of what is entertained as relevant body of knowledge or not. This is central to the heart of Popper's philosophy. See also, F. B. Nyamnjoh, 'Potted plants in green houses': a critical reflection on the resilience of colonial education in Africa', *Journal of Asian and African Studies*, 47, 2 (2012), 129-154.

³⁹⁰ Nyamnjoh, *Relevant education for African development*.

³⁹¹ Wad, *Science, technology and industrialisation in Africa*, 349.

³⁹² P. Sillitoe (Ed.), *Local science vs global science: approaches to indigenous knowledge in international development* (New York, Oxford: Berghahn Books, 2009), 1-2.

finite resources is argued to be partly connected to the crossroad the world seems to be at the moment. In fact, as a result of this challenge there is a growing call for fundamental choices to be made with respect to carbon emission and related issues.³⁹³ Colucci-Gray contends that,

the complexity, uncertainty and urgency of global environmental problems challenge the foundations of reductionist Western science. To facilitate sustainability demands collaborative efforts across paradigms and disciplines characterised by respectful dialogue between experts and non-experts in the construction of new scientific knowledge. Or generally, the need for epistemological and methodological changes in the production and utilisation of scientific knowledge for humanity is called upon.³⁹⁴

The effects of climatic changes are enormous for all and the choices to be made as regards energy options vis-à-vis the quest for development of less developed countries raise several concerns. The challenge is serious and even dire for less developed countries; this is because many depend on exploration of raw natural resources with little or no technical or scientific manpower to even exploit and deploy, as they depend largely on other advanced nations and multinational scientific/technological resources for the exploration of these primary/unfinished products linked to these issues.

Another important dimension is the asymmetry of the global power order and intellectual property rights in relation to questions of exploration of the benefits of what is deliberately christened ‘folk knowledge’ projected as good, only as satisfying anthropological curiosity while expropriating the benefits therein for profit in what scholars now refer to as “bio piracy”.³⁹⁵ Mgbeoji argues that there are salient epistemological consequences of a patency system wherein a dominating model, which

³⁹³ A distinction is often made between instrumental rationality as characteristic of modern science motivated by the attempt to overcome human finitude has come to have very pervasive influence in today’s culture but at some costs and communicative rationality (one which defines who we are and what our subjectivity is) of the Habermasian model is often made in the light of such developments, See, L. Simpson, *Technology, time and the conversations of modernity* (New York: Routledge, 1995), 75-120.

³⁹⁴ Colucci-Gray, *Science education for sustainability: epistemological reflections and educational practices*, 127, 129.

³⁹⁵ For instance, in K. Bates, ‘A penny for your thoughts: private and collective contracting for traditional medicinal knowledge modelled on bioprospecting contracts in Costa Rica’, *Georgia Law Review*, 41 (2007), 961.

is Eurocentric, flourishes at the expense and underrepresentation of the less developed countries where some of these valuable plants and other knowledge forms are extracted for profit.³⁹⁶

More interestingly, the call for sustainable development urges the search for values that can broaden/enlarge the horizon/scope of science for the benefit of humanity and nature at the same time. Hence, the presupposition that some of these epistemic values which can contribute to an appropriate approach can be found in non-Western knowledge systems; African and many others hitherto ignored and despised.³⁹⁷ Central to this de-privileging claim is that the demarcatory project by which what is considered knowledge and therefore to be taken seriously, underscores also the problem of reason, its identity and operations relative to the African perspective.

Again, one crucial point worth noting is that this call for reconstruction has the virtue of promoting the epistemic discipline on the part of the Western approach to learn how to listen to the other. In a similar vein, Lauer expresses concern for the consequences of the commoditisation of knowledge and the push to align institutional education in Africa along that line. For Lauer therefore, wonder over nature and normative concerns risk being valued no more as ends in themselves and as such the liberatory role of education in science and technology as envisioned by Nkrumah and Galileo for instance, may get

³⁹⁶ I. Mgbeoji, *Global biopiracy: patents, plants, and indigenous knowledge* (Ithaca: Cornell University Press, 2006).

³⁹⁷ For instance, the noticeable failure of one-size-fit-all approach adopted by a number of international organisations in Africa with recommendations for the development of various segments of the society; from economy, politics, to employment and more importantly to education is partly related to this approach. Thus, some of these knowledges needed to be rediscovered, revised as complementary with the popular Western knowledge system, to solving some of the problems in Africa. See J. E. Stiglitz, *Globalisation and its Discontents* (London: Penguin Books, 2002) xiv. In the work, the author claims that the force of globalisation runs on ideology and bad science and as such globalisation remains a potent force for good as well as bad depending on how it is managed. Again, recently, some of the visions of the earlier work are further expanded as learning by doing approach is advanced to promote competitions as it relates to economic dynamics and societal advancement through technological or innovative interventions and government support in promoting competitiveness in the international context. See More, J. E. Stiglitz & B. C. Greenwald, *Creating a learning society: a new approach to growth, development, and social progress: basic concepts* (New York: Columbia University Press, 2014).

endangered. The result will be the perpetuation of error and injustices of all kinds in Lauer's view and quite rightly so.³⁹⁸

3.3.2 Some Interventions Programmes for Science Advancement in Nigeria

That there seems to be very little to show relative to the numerous interventions for science advancement in Nigeria is not an inconvertible position to hold. The stakes to grow the science culture in Nigeria is very high because of inadequate funding, but more importantly, the approach adopted in meeting this critical seems to beg the question. This approach basically is one of template transfer; that is, the knowledge or technology transfer model which has hardly led to self-reliance because in the end, rather than obliterate dependence, it perpetrates and deepens dependence.³⁹⁹ In this regard, many African countries especially, Nigeria seems to have a rather poor investment drive attitude in terms of resources to support and promote research and development in science, technology, science education and education generally. Even the little it has and deploys to training and developing human resources, the deplorable social environment, coupled with other challenges lead to the migration of her human resources to other climes; that is, the "brain drain" phenomenon.⁴⁰⁰ It has often been recommended and rhetorically echoed in a number of continental agreements and programmes that at least 1% of the country's Gross Domestic Product be spent and gradually increased to support research

³⁹⁸ H. Lauer, 'Cause and effect between knowledge traditions: analysing statements that address the regression of science and technology in Ghana', *Transactions of the Historical Society of Ghana, New Series*, 8 (2004), 273-274. She emphasises the vision of education and experimental method of Nkrumah and Galileo respectively as what empowers one to be able to control external influences and control, towards greater emancipation contrasting such a vision with the prevailing practice of managing the university as a business enterprise.

³⁹⁹ O. Oyeshile, 'The development of science and technology in Africa: the phenomenological option', *Sophia: An African Journal of Philosophy* 5, 2 (2003), 89-108; S. Koch & P. Weingart, *The delusion of knowledge transfer: the impact of foreign aid experts on policy making in South Africa and Tanzania* (Cape Town: African Minds Publishers, 2016). The title of the text is illustrative of this viewpoint.

⁴⁰⁰ *The African Union Report: The Revised Migration Policy Framework for Africa and Plan of Action, 2018-2017: Draft*, aptly acknowledges the phenomenon and the challenges it poses for the future of the continent while proffering possible solutions that will facilitate the retention of the critical human resources the continent urgently needs. Whether those responsible to actualise these visions can deliver remains to be seen. Sourced from: https://au.int/sites/default/files/newsevents/workingdocuments/32718-wd-english_revised_au_migration_policy_framework_for_africa.pdf [Accessed 20/02/2018].

and development. The lack of commitment and absence of the much needed political will to vigorously pursue such means the inability to provide the requisite environment for the practice and advancement of the culture of science and technology. In cases where funds (no matter how little) are made available, the incidence of corruption continue to burden and frustrate the progress and success of these efforts at the continental and national levels.⁴⁰¹

In January 2007, at an African Union (AU) conference in Addis Ababa, African countries were again strongly, urged to allocate same 1% percent by 2020 and today, two years before this time target, no African country has met the target.⁴⁰² This clearly indicates the lackadaisical attitude and in fact how science and technology is appreciated by the political leadership as something of great value to development is urgently needed on the continent. Little wonder, Africa is behind other continents of the world in many areas; especially, in the area of science and technology. From the home front, Nigeria's developed national science policy document emerged in 1986. Revised a couple of times, with the latest version in 2011. For example, it was revised in 2003 and recently updated in 2005 with contribution from UNESCO to its refinement. Interestingly at its launch, the government pledged to establish a National Science Foundation after the US example and approved a five billion dollar fund. For well over a decade, action is yet to be taken to give life to the science and technology foundation or the fund. Even though, the mandate in the document captures a comprehensive review of the previous national science and technology plans with details of clear government policies, funding routes (oil revenues,

⁴⁰¹ R. A. Aborisade & N. B. Aliyuu, Corruption and Africa, in O. Akanle & J. O. Adesina (Eds.), *The development of Africa: issues, diagnoses and prognoses* (Cham: Springer, 2018), 227-254.

⁴⁰² G. Mutume, 'Africa aims for a Scientific Revolution: more funding needed for research institutes and universities', *Africa Renewal*, (2007). Available online: <http://www.un.org/africarenewal/magazine/october-2007/africa-aims-scientific-revolution> [Accessed 01/06/2015]. The author aptly enumerates the impact of "brain drain, weak link between industry and science/technology institutions, low number of women and girls in science, dwindling funding, general low level of literacy and inadequate infrastructure" as some very concrete challenges that have continued to plague African countries in their quest for science and technology advancement.

donors and private companies), emphasis on revised curriculum of research institutes and educational institutions nationwide. Regrettably, none of these items seems to have received the needed commitment or support and there are no positive signs that the nation is on the path towards actualising these goals. The general attitude has been one marked by very outlandish science promises, visions, and pledges which are never translated into concrete and viable science programmes of development that are implemented/executed with time lines for evaluative and progressive assessment purposes.⁴⁰³

What is clear from the above is the lack of needed commitment towards practical implementation of all the lofty ideas and visions adumbrated in the many mechanisms and policies in place. In other words, there is a yawning gap between political rhetoric and the actions on ground.

The external support towards the state of science in Africa has also come under severe scrutiny. For instance, Khumbah and Foote challenge America's various interventionist programmes for the promotion of aid in Africa to be short term value only. To deliver long term value, it is their considered view and rightly so, that these donor-initiated projects should reflect African nations' own shifting priorities toward improving their indigenous science and technology capabilities.⁴⁰⁴

Needless to say, that the underlying epistemology of developmental assistance with respect to science needs is one that is very paternalistic with grave implications. Such an epistemology is reminiscent of the intellectual heritage that underlined how Africa and

⁴⁰³ W. Siyambola et al, 'Science, technology and innovation indicators in policy-making: the Nigerian experience', *Palgrave Communications* 2 (2016), 1-9. Available online: <https://www.nature.com/articles/palcomms201615.pdf> [Accessed 23/05/2018].

⁴⁰⁴ N. Khumbah and K. P. Foote, *Africa needs science, not aid* (2014). Available online: https://www.nytimes.com/2014/08/01/opinion/africa-needs-science-not-aid.html?_r=0 [Accessed 29/11/2015]. The point at the heart of this contribution speaks to Moyo's overall argument on the type of aids that works in Africa as one which is projected to ensure the circle of aids do not continue as against what is in practice.

Africans are perceived as discussed earlier in this chapter. Despite the outlandish political aspirations of the top-down approach (donor-aid driven) and hard ware perspectives in promoting science and technology in Africa, there is an obvious neglect of the local knowledge culture because it is non-participatory and democratic in how priorities and agendas are set, as such, it remains the bane of science and technology advancement in Africa.⁴⁰⁵ One can then begin to see the broader consequences of the kind of epistemology of developing science in Africa as one which does not seek to promote ownership or rightly motivate Africans in finding solutions to Africa's problems. In fact, as Ogunniyi declares that virtually all the steps that have been taken towards transforming science in many African countries lack epistemological foundation that is viable and feasible. Many of the policies lacked any scientific approach in how they are conceptualised and implemented or executed.⁴⁰⁶

This dependence as ironically preached or supported by the institutions of globalisation under the pretext of seeking to assist and transform the state of affairs in many third world countries in Africa as the evidence many drawbacks indicate. The contradictions that accompany the liberalisation policies strongly supported by these institutions seem to favour the developed economies while aggravating the challenges of development in many African countries.⁴⁰⁷ For instance, the Ebola crisis⁴⁰⁸ confirms Hountondji's claim of "extroversion logic", wherein, African scientists in the absence of world class

⁴⁰⁵ I. Scoones, Debating science and technology for development in Africa, in old questions: building capacities, facilitating technology transfer finance and training: today's politics and democratisation of policy processes: What Technology, for whom? These discussions took place at the STISA-2024 workshop on the theme: *Debating Africa's "blueprint" for science, technology, & Innovation* at the University of Sussex, July 2015. Science, technology, and innovation strategy for Africa; STISA -2024 is a ten years programme adopted by the leaders of the various African nations in 2014, as part of the long-term strategy for Africa's development plan 2063.

⁴⁰⁶ Ogunniyi, 'Two decades of science education in Africa', 119.

⁴⁰⁷ J. Pierre, 'Science, technology and development: stakes of globalisation', in L. Keita (ed.), *Philosophy and African development: theory and practice* (Dakar: CODESRIA, 2011), 210.

⁴⁰⁸ T. Fouad, *Ebola Outbreak Highlights Struggle for science in Africa and inequalities in global health research*. Available online: https://www.huffingtonpost.com/tamer-fouad-md/ebola-outbreak-highlights_b_6083218.html [Accessed 01/06/2015].

laboratories and research centres are consigned to gathering of information and data for onward transfer to be processed in research centres in the metropolises. These African scientists only get occasional token acknowledgement as they are on the receiving side of knowledge as mere consumers and not producers of knowledge.⁴⁰⁹ The implication of this challenge include, the tendency to come to a conclusion that suggests that people in the sub-altern position are at best capable of being consumers of knowledge rather than knowledge producers themselves, the lack of attention to the science needs and priorities in these societies with the result that not very much is likely to change as the Ebola case showed if fundamental and radical changes do not happen at various levels.

3. 3. 3 Some Problems with African Traditional Thought/Beliefs

While there are numerous aspects that need to be done away with, there are important ones that are epistemically valuable. It is this acknowledgment that I specifically emphasise as crucial to the project of popularising science in a non-Western society. It can then guarantee the owning of the entire process while increasing participatory learning experience. When this epistemic attitude is undermined, the basis of dialogue becomes shaky and ill-fated to compromise the overall project in the first place. For instance, many of the worldviews held by the people are daily reinforced by the overwhelming religious outlook of the society. Thus, it is not uncommon to find fundamentalist attitude among the populace. The ideological and dogmatic tendencies of these views can be countered appropriately by the proviso of Popper that seems to be against any form of authoritarian, dogmatic or ideological standpoint. However, as the analysis in the foregoing clearly shows, these outlooks characterise the context within which Western science is taught to learners in schools. In fact, Ogunniyi establishes that “the lack of reinforcing home

⁴⁰⁹ P. Hountondji, ‘Dialogue with Lansana Keita: Reflections on African development’, in L. Keita (ed.), *Philosophy and African development: theory and practice* (Dakar: CODESRIA, 2011), 93.

environment”⁴¹⁰ is one of the challenges of science education in Africa; that is, the fact of border crossing in the learning of science in an African context.

In Nigeria the prevalence of this worldview at the base of many beliefs come handy with a frequency that is troubling. For instance, it was widely reported in many dailies in Nigeria whether or not Professor Nebo was speaking in metaphors, given his remarks at the Senate of Federal Republic of Nigeria, (January 24, 2013) that witches and demons hinder electricity reforms in Nigeria. A professor of metallurgical engineering trained in School of Mines and Technology, South Dakota and former Vice Chancellor of a university, Professor Nebo said, “some highly placed Nigerians believe that when there is outage, it is caused by witches and demons, given my record of doing same in UNN where I drove witches and demons, God will give me power to drive out the demons in the power sector”.⁴¹¹ In some reactions, Nwogwugwu was of the view that, ‘despite the obvious warning signs, the senate, which like most Nigerians, cannot separate the ethereal from plain logic, the upper legislative chamber still made the unfortunate mistake of confirmation of Nebo who did not seem to know that economic development does not call for the ‘casting and binding of demons’ as a requirement. What is interesting to note includes the diagnosis of the problem predicated on a worldview quite prevalent in the society. This was a clear manifestation of a misplaced thinking and he was never rebuked and asked to go somewhere else as the power sector was no religious arena by the legislators. Again, the magnitude of the problem is when a professor of engineering who teaches, but operates with such ‘logic’ of a spiritual/mystical nature; one can imagine the harm done to the responsibility of teaching science to university students and the expected implications thereof.⁴¹² In the same vein, the growing incidences of human rights abuse in the name of witch-hunting in many African societies and in fact, in the UK, is traceable

⁴¹⁰ Ogunniyi, ‘Two decades of science education in Africa’, 118.

⁴¹¹ I. Nwogwugwu, ‘Of Nebo and his demons’, *Thisday Live* Newspaper, 01/08/2013.

⁴¹² I. Nwogwugwu, ‘Of Nebo and his demons’, *Thisday Live* Newspaper, (01/08/2013).

to the activities of religious associations from Nigeria. This was confirmed by Gary Foxcroft, Executive Director of the *Witchcraft and Human Rights Information Network*.⁴¹³ Writing along this line, Gyekye states, "... scientifically trained people that are expected to think and act scientifically giving-way resorting to supernatural, mystical causal explanations"⁴¹⁴are a common place in many African societies.

To evaluate this part of the section, it has been highly represented that these sorts of beliefs and values have been identified as injurious and incompatible to the project of science advancement in Africa, nay Nigeria.⁴¹⁵ For instance, Weaver writes, "many aspects of family and tribal life in Nigeria have anti-scientific bases in superstition, 'juju', anachronism, anthropomorphism, dualism and reliance upon witch doctors and quarks, for many of the important services affecting everyday life and this is debilitating to say the least".⁴¹⁶ No doubt, the excessive religious outlook and the esoteric or personalised nature of the knowledge claims in many traditional societies that is overwhelming does not promote the culture of intellectual engagement; that is, public exchanges and experimental review required for science and technological advancement. Appiah outlines these differences in terms of an accommodative tendency and the adversarial feature that the mode of knowledge preservation and transfer promoted in these traditions are significant in how they promote or mitigate the advancement of science.⁴¹⁷ In the review of the various positions, Mapadimeng concludes that the position of those who hold that these values are inhibitive of development can hardly be sustained in the face of evidence and appropriate interpretation of the role of these values in African cultures to

⁴¹³ B. Ezeamalu, 'Nigerian churches, others causing witchcraft persecution in UK', Available online: <http://www.premiumtimesng.com/news/top-news/191396-nigerian-churches-others-causing-increased-witchcraft-persecution-in-uk-group.html>. [Accessed 12/10/2015].

⁴¹⁴ Gyekye, 'Culture, religion, and the pursuit of science', 151.

⁴¹⁵ K. Gyekye, 1997, 27-29; R. Horton, 'African traditional thought and Western science' in R. R. Grinker, & C. B. Steiner (eds.), *Perspective on Africa- a reader in culture, history and representation* (Oxford: Blackwell, 1997).

⁴¹⁶ Weaver, *Science education in Africa*, 353.

⁴¹⁷ Appiah, *African studies and the concept of knowledge*, 52-54.

wit, 'reference to spiritual forces/powers e.g. ancestors, does not have such inhibitive effects'.⁴¹⁸ And as Hallen has shown with the study of the Yoruba herbal practitioners, the continual reference to such powers, is appreciated for its functional significance to further growth and development of herbal practices and the community.⁴¹⁹ The misleading tendency to perceive as intrinsically African what is traditional and modern as intrinsically Western Eurocentric is problematic.⁴²⁰ Finally, on the basis of the evidences provided by creolist theory with implications for such distinction and separation of these issues between what is superfluous/redundant and what is essential to clear the Aegean staple of the confusions and misrepresentations so that the real can be brought to fore. The focus is to delimit areas of mutual benefits and cultural vitality that abound in cultural conversation/dialogue. There is however a caveat to this sort of project as several other aspects of the culture that are inimical to the project of advancement need to be done away with as Wiredu and Gyekye argue sufficiently defend in many presentations.⁴²¹ Agbakoba has also shown how inadequate such particularistic ideology provided by African traditional perspective is with respect to developing the technical disposition with which development in Africa can be hinged and better positioned.⁴²² It is important to note however, that as an explanatory system, it may be plagued by under determination of theories such that it amounts to methodological mistake to assume the irrationality of traditional beliefs at the start of the study of the society. As Appiah argues

⁴¹⁸ M. S. Mapadimeng, 'Indigenous African cultures and relevance to socio-economic development in contemporary era', presented at the 2nd International conference on African culture and development, Accra, Ghana, 15-18th November, (2009) 22.

⁴¹⁹ B. Hallen, 'Analytic philosophy and traditional Thought: a Critique of Robin Horton', in P. English & K. M. Kalumba, (eds.), *African philosophy: A classical Approach* (New Jersey: Prentice Hall, 1996).

⁴²⁰ S. I. Udoidem, 'Wiredu on how not to compare African thought with Western Thought: a commentary', *African Studies Review*, 30, 1 (1987) 101-104; Udoidem's commentary was on the original title as it appeared in R. Wright (ed.), *Philosophy and an African culture* (Cambridge: Cambridge University Press, 1984); J. E. Wiredu, 'How not to compare African thought with western thought', *Transition*, 75-76 (1997) 320-327.

⁴²¹ Mapadimeng, 'Indigenous African Culture', 23.

⁴²² J. C. A. Agbakoba, 'Towards a philosophy of technology and development for Africa', in J. O. Oguejiofor (ed.), *African philosophy and public affairs* (Enugu: Delta Publications, 1998), 236.

that "... if we were to persuade traditional thinkers about some of their beliefs, they might become sceptical of the theories held in their own culture. But we cannot begin by asking them to assume their beliefs are false, for they can always make numerous moves in reasonable defense of their beliefs. It is this fact that entitles us to oppose the thesis that traditional beliefs are simply unreasonable".⁴²³ Doing such is counterproductive for science as well, as McLeish warns that it leads, in part, to optionalism that we see in some public and political attitudes towards science, from climate change to vaccination. It damages the educational experience of children and it impoverishes the understanding of science's historical context.⁴²⁴

3.4 Conclusion: African Philosophical Context in relation to Science

Problem in Nigeria

The chapter has reviewed the intellectual context of the discourse of the problem of science advancement in Nigeria. African philosophical heritage was examined through engaging the major debates on what the nature of the concerns of philosophy in an African context generally is, situated and challenged along the areas of relevance and contemporary questions. The state and nature of science problem in Nigeria was another area that was attended to in the foregoing. Many nuances and issues exposed suggest the problematic nature of the problem under consideration. A lot of debates demonstrate how exciting the meta-methodological concerns about philosophy have thrived vibrantly within the context of the project to legitimise African philosophical tradition.

It is to be emphasised then, that African philosophy cannot live on decolonising conceptual frameworks alone for it must also attend to reality directly by way of distilling particular analysis of the many problems in Africa; that is, the question of science in

⁴²³ Appiah, *African studies and the concept of knowledge*, 36.

⁴²⁴ T. McLeish, 'Thinking differently about science and religion', *Physics Today* 71, 2 (2018), 10-12.

Nigeria as an exemplar. While the situation presents opportunities for African philosophy to engage in self-reflective engagement (of the past and the present), there are also challenges of normative concerns as it looks to the future.⁴²⁵ The urgency of addressing the place of science as an important component of the quest for sustainable development in Africa is an important area African philosophy cannot afford to pay less attention. More so, the intellectual heritage of the people as embodied by African philosophical thought has had to face fundamental question as to its possibility and reality given its historical experience of the West. Science and technology's development raise questions that continuously put to task what role philosophy in culture and in this particular case, African philosophy can play in the comity of disciplines at a time there is a growing culture of considering as knowledge only what is measurable in utilitarian and quantifiable terms. The underlying epistemological issues that relate fundamentally with the various internal and external factors that have continued to affect the advancement of science in Nigeria were analysed and explored as a demonstration of philosophy's role as a relevant inquiry. The basis of the failure of many interventions seems to reiterate the presupposition that Popper's philosophy provides a veritable framework to engage the various factors at play in the problem of science in Nigeria.

It particularly identified the faulty epistemological basis of the kind of science education in Nigeria as problematic. In addition, the lack of political will and commitment to drive policies' implementation and execution were highlighted. Thus, the general failure of political governance which is also indicative of an inadequate epistemological preparedness has combined to decrease the capacity to grow science and technology and hence inadvertently created fertile ground for the increase and flourishing of an excessively religious-metaphysical thinking prevalent in Nigeria. It however notes that there is need to be cautious in the categorisation of all knowledge claims within the

⁴²⁵ Balogun, *Rethinking the tasks of African philosophy*, 45.

African intellectual heritage as averse to promoting science and technology. It acknowledges that quite a lot of these stuffs need to be excised but at the same time the mix may contain some critical knowledge items even though not immediately amenable to the Western model of science are valuable and should accorded as such. This way, the epistemic attitude and pedagogical model is likely to be more productive as far as the learning of science is concerned. The next chapter will focus particularly in developing an appropriate philosophy of science premised on the dialogical provenance of Popper's philosophy as bridge to aid the kind of exchange and conversation between the traditions of knowledge critical to science advancement in Nigeria.

4.0 Towards an African Philosophy of Science Perspective: Dialogue of Knowledge Traditions

‘Find a scientific man who proposes to get along without metaphysics ... and you have found one whose doctrines are thoroughly vitiated by the crude and uncriticised metaphysics with which they are packed’, Charles Sanders Peirce: **Notes on Scientific Philosophy**.

4.1 Introduction

This chapter addresses dialogue, the conditions and pragmatic issues of dialogue to the problem of science advancement in Nigeria. The broad aim is to provide details about the nature and consequences of such a dialogical encounter between the traditions of knowledge. Prior to this point, my thesis has taken for granted the idea of Popperian dialogue, there is therefore need for detailed demonstrations of the desirability as well as the imperative nature of the dialogue model advocated in the thesis towards characterising an approach to science different from the one in operation. Thus, the concern of this chapter is to provide further exposition and elaboration through assessment of the nature and conditions that facilitate the dialogue of knowledge traditions and show the presuppositions that such a dialogical encounter means for a new approach to science. Through this, the thesis attends to the problem of science advancement in Nigeria as well as argue for broader image of science.

By way of a recap, the focus is to argue that an open account of science culture is an imperative for relating the two traditions, that is, Western approach and African knowledge tradition as analysed in earlier chapters of this thesis. The details and conditions for this dialogue and the pragmatic challenge for science are envisaged. To do this, some of the major means by which science culture is promoted, science education, for instance, will be specifically evaluated in the light of Popper’s thought vis-à-vis the prevailing valuation of Western modern science. With this focal task in mind, Matthews

writes, “the vitality of the scientific tradition and its positive impact on society, depends upon children being successfully introduced to its achievements, methods and thought processes, by teachers who understand and value science. The history and philosophy of science contributes to this undertaking and valuation”.⁴²⁶ Chang makes a similar case by way of spreading the need for the appreciation of the history and philosophy of science as key component of science project serving basically as complementary science.⁴²⁷

Historically, as the political situation began to change in Africa, there was a gradual appreciation of the need to advance science and technology as it relates to development through the instrumentality of education and deliberate political supports. Science with its culture does not just happen to a society. It demands well-articulated science policies, programmes and coordinated efforts in education generally and science education particularly through various phases of implantation. In actualising this, the contextual environments are critical as these matters are not in themselves neutral. So, there are important questions to ask as a society decides to develop and promote science as means to advance humanity. This is an important question among many other questions will provide guide in the ensuing reflection. Some of these questions include; what model of science is relevant to the society? Why was science not an important component of the formal education introduced by the colonial system? What efforts are important towards making science relevant to the Nigerian context? The point to figure out is why Africans have remained on the side lines of science and are consumers of science and its related activities. Western modern science is not ours, we draw on the successful knowledge

⁴²⁶ M. Matthews, *Science teaching: the role of history and philosophy of science* (New York & London: Routledge, 1994), xv.

⁴²⁷ H. Chang, ‘Scientific pluralism and the mission of the history and philosophy of science’, the 2012 Inaugural Lecture of the Department of History and Philosophy of Science, University of Cambridge held on the 11th October, 2012; Also, another title, ‘Who cares about the history of science?’ the 2015 Wilkins-Bernal –Medawar lecture organised by The Royal Society. Source: <https://royalsociety.org/science-events-and-lectures/2016/05/wilkins-bernal-medawar-lecture-prof-hasok-chang/> [Accessed 15/02/2016].

tradition of other well-advanced societies, this, we try to do but fail to recognise that the viability of such efforts depends on the contextual adaptations of these projects and programmes. Since science learning and appropriation do not happen in an epistemological and cultural vacuum, it is then important to re-examine the philosophical basis of science and science education in the Nigerian context because the prevailing model has not facilitated the desired ownership and transformation.

The challenge to decipher the dynamics and character of knowledge places huge burden on those interested in its sustainable growth and advancement in any society. Thus, the problem of science advancement in Nigeria is as important as it is critical to understanding why it keeps eluding many African societies, or why it is in its present inchoate state despite the various efforts to advance it. The contention here is that Western science in an African context to borrow Mgbеoji's terms, is "culturally and philosophically Eurocentric",⁴²⁸ that is, essentially it means it is still colonised. In fact, it is yet to be liberated. The example of knowledge and technology transfer strategies and efforts with little impact in many African societies is indicative of this assertion.

In the light of the foregoing, this thesis explores some themes in Popper's thought in order to address the idea of dialogue, the conditions and the challenges of the new approach or attitude to science advanced in this thesis. As noted earlier, the educational system is where the benefits of critical rationalism, for instance, can be positively harnessed for science generally as well as the science situation in the Nigerian society. The extent to which science education meets this vision and is able to inspire the needed change is one major concern of the chapter as will be made clear shortly. Now, given that philosophy usually thrives well on questions rather than answers, it is crucial I sound a cautionary note, as regards the expected deliverable of the chapter because it is important that the

⁴²⁸ I. Mgbеoji, *Global biopiracy: patents, plants, and indigenous knowledge* (Ithaca, New York: Cornell University Press, 2006), 2.

expectations of the chapter be matched with a not-too-ambitious one, so that, in the final analysis, hopes and expectations are not undermined. In all however, the chapter's central interest is to provide a modest response, which is a position Popper advocates as the rule of the thumb in making any epistemic claim after all.

4.2 On the Idea of Dialogue, Popperian Dialogue and Other Matters

Arising

At this point it is important to clarify how I construe the idea of dialogue and how that understanding squares with the thought of Popper, which facilitates the possibility of dialogue. Also, I identify and highlight some of the challenges that can be associated with dialogue, some awareness of such issues can be helpful in how we approach dialogue and what we expect from dialogue. I will however be quite brief in the exploration of these themes because of the constraint of space.

Dialogue simply means a deep, participatory exchange of meanings that can take place in one, between two or more persons, institutions, cultures or societies considered as peers aimed at learning, understanding and solving problems among other things. It goes beyond mere discussion or debate that takes places between two or more people.⁴²⁹ Dialogue understood in this sense is, therefore, co-extensive with the understanding of philosophical discussion as espoused by Johnstone Jr as, “a collaborative effort to maintain the conditions under which disagreement is possible”.⁴³⁰ Hence, it is not always the case that common frame work of meaning must be shared before such deep exchanges and profound communication can take place. For as Popper writes,

⁴²⁹ D. Bohm, *On dialogue* (London & New York, Routledge, 1996). Dialogue understood in this way helps to guide against the fears or risks associated with dialogue as enumerated by A. Appadurai, ‘The risks of dialogue’, *New Stakes for Intercultural Dialogue* (2006), 33-37.

⁴³⁰ H. W. Johnstone JR, *Validity and Rhetoric in philosophical argument: an outlook in transition* (University Park, Pennsylvania: The Dialogue Press of Man & World, Inc., 1978), 19.

I do admit that any moment we are prisoners caught in the framework of our theories; our expectations; our past experiences; our language. But we are prisoners in a Pickwickian sense: if we try, we can break out of our framework at any time. Admittedly, we shall find ourselves again in a framework, but it will be a better and roomier one; and we can at any moment break out of it again.⁴³¹

To stress the point further, bearing in mind, the epistemic conclusions that can be drawn from holding a view that two different frameworks cannot have any meaningful exchange,

Popper adds,

the myth of the framework is, in our time, the central bulwark of irrationalism. My counter-thesis is that it simply exaggerates a difficulty into an impossibility. The difficulty of discussion between people brought up in different frameworks is to be admitted. But nothing is more fruitful than such a discussion; than the culture clash which has stimulated some of the greatest intellectual revolutions.⁴³²

With the foregoing brief clarification, my idea of Popperian dialogue encapsulates what Popper understands to mean rationality in an attempt to explain what constitutes objectivity. In fact, one of the high points in Popper's philosophy was the unique epistemic route to dealing with the problem of objectivity. As it is well established the problem of objectivity is an interesting one within general philosophy of science but the Popperian approach to it accounts for the idea of rationality of dialogue. For instance, Sheamur contrasts this approach of Popper to the Cartesian approach wherein the latter emphasises "cutting himself off from others, and re-creating knowledge from what seemed undeniable. The former, that is, Popper's view suggests we should, as it were, go out into the street and try to learn from dialogue with others... in this way, objectivity is a social product – achieved intersubjectively.⁴³³ In his *Open society and its enemies*, rationality is considered as an attitude of readiness to listen to critical arguments and to

⁴³¹ K. Popper, Normal science and its dangers, in I. Lakatos & A. Musgrave (Eds.), *Criticism and the growth of knowledge: Proceedings of the International Colloquium in the Philosophy of Science*, London 1965 (Cambridge: Cambridge University Press, 1970), 56. I also strongly think this type of idea of minimising the overwhelming place of certain values in relation to scientific claims and practices as advanced by a number of renowned feminist scholars like H. Longino on the importance of democratisation and diversity of scientific communities seems to me to intersect very strongly with the view of Popper as cited in the work.

⁴³² Popper, *Normal science and its dangers*, 56-57.

⁴³³ J. Sheamur, 'Popper, Social epistemology and dialogue', *Social Epistemology Review and Reply Collective*, 6, 9 (2017), 4.

learn from experience. It is fundamentally an attitude of admitting that I might be wrong and you may be right, and by an effort, we may get nearer to the truth.⁴³⁴ As Waldron argues, “in Popper the whole point of dialogue is to bring contrast and disagreement into the open”.⁴³⁵

The import of the foregoing analysis is that there are important conditions to be met for the kind of exchange implied by such a conceptualisation of dialogue. These conditions can be considered to include the ground rules for the conduct of dialogue. In Popper’s thought, openness and the epistemic acknowledgement of the human condition of fallibility make it even more pressing, so with collaboration and cooperation which dialogue implies, there are immense benefits. On this point, Mungwini reminds us that despite its potentials “we should not be oblivious of the fact that dialogue can be a talismanic term because it can be manipulated to mask and smooth over the hegemony that still defines the world”.⁴³⁶ No wonder then Popper argues that “the value of dialogue depends to a great extent on the diversity of competing opinions. If the tower of babel had not existed, we would have to invent it”.⁴³⁷ This therefore allows for differences which of course has cognitive as well as methodological implications. The immediate manner in which we can begin to appreciate some of these implications are related to issues of plurality of knowledge claims and diverse ways by which we can appreciate such accordingly.

In addition, the idea of mutual respect is another critical item because the participants in a dialogue have to share as common what Waldron terms, Popper’s proviso that says, I

⁴³⁴ K. Popper, *The Open society and its enemies, vol. 2: Hegel & Marx*, 5th edition (London: Routledge & Kegan, 1966), 225.

⁴³⁵ J. Waldron, Tribalism and the myth of the framework: some Popperian thoughts on the politics of cultural recognition, in P. Catton & G. Macdonald (Eds.), *Karl Popper: Critical Appraisals* (London & New York: Routledge, 2004), 223.

⁴³⁶ P. Mungwini, ‘Dialogue as the negation of hegemony: an African perspective’, *South African Journal of Philosophy* 34, 4 (2015), 395.

⁴³⁷ K. Popper, *Conjectures & Refutations; the growth of scientific knowledge* (London: Routledge & Kegan Paul, 1969), 352.

may be wrong, you may be right but together we can get nearer the truth as “ethics of reasoning”.⁴³⁸ The relevance of this condition cannot be over emphasised because among other things it emphasises respect for the content as well as the epistemic agent no matter how different the view point such an agent represents. It means that the ‘other’ is a potential source from which learning can take place if only there is some genuine readiness to explore. Thus, in Popper’s own words, “the fact that the rationalist attitude considers the argument rather than the person arguing is of far reaching importance. It leads to the view that we must recognise everybody with whom we communicate as a potential source of argument and reasonable information; it thus establishes what may be described as the rational unity of humankind.”⁴³⁹ What this means therefore includes the elimination of such epistemic attitudes or beliefs that scientifically, there is nothing to learn from ‘them’ unless it is already “ours” or comes from “us”.⁴⁴⁰

Again, another point worth highlighting is the role of truth and its implication for the kind of epistemic attitude that should guide dialogue. Newton-Smith reads quite rightly Popper’s position on truth as the aim of science but the scientific condition is one of ignorance.⁴⁴¹ As argued in this thesis, truth serves as an ideal, in which case, there is no basis for the epistemic hubris on the part of any knowledge tradition to lay exclusive claim of the possession of truth. The direct import of this is the need for the practice of epistemic virtue of humility. Thus, Waldron argues that participants are to operate with Popperian spirit of tentativeness as failure to do just that justifies the claim wherein,

⁴³⁸ Waldron, *Tribalism and the myth of the framework*, 224-226; See more, K. Popper, *The myth of the framework. In defense of science and rationality*, ed. M. A. Notturmo, (London: Routledge, 1994), 34; Popper, *The Open Society and its enemies*, two volumes, (Princeton: New Jersey: Princeton University Press, 1996), 238.

⁴³⁹ In Popper’s formulation, he refers to ‘mankind’, which I have revised to humankind. See more, Popper, *The Open society and its enemies*, 225.

⁴⁴⁰ Mudimbe tags such intellectual attitude as Western epistemological ethnocentrism. See more, V. Y. Mudimbe, *The invention of Africa: gnosis, philosophy, and the order of knowledge* (Bloomington & Indianapolis: Indianan University Press, 1990), 15.

⁴⁴¹ W. H. Newton-Smith, *The rationality of science* (London & New York: Routledge, 1996), 44.

the culturalist may argue that requiring a minority culture to involve itself and its component practices and traditions in critical engagement with other cultures and in particular with mainstream culture of Western multicultural society is, in effect, a death sentence. For in any such engagement, the odds are rigged overwhelmingly against the minority culture – first, because the very terms of engagement are modern Western ideas and thus systematically biased against minority cultures, and second, because even if the terms of engagement are neutral, the partisans of mainstream Western traditions have shown over and over again an unwillingness to practice the spirit of open engagement with alien ideas that they so piously preach.⁴⁴²

One major prerequisite for the realisation of dialogue is the consideration of the kind of intellectual atmosphere prevalent in the society where there is interest and agenda for science advancement. It is such that any epistemic disposition as sustained and promoted by the educational culture in such a setting can either help or hinder the realisation of dialogue. For as Barnes argues, “systematic-theoretical thought is not easily sustained in a culture, such thought may be part of the natural cognitive capacity of every human group, but it does not come ‘naturally’ as we say it. It requires cultural elements to sustain it”.⁴⁴³ What this therefore means, is that, to acquire a scientific culture requires a perennial philosophical attitude to sustain it otherwise in its absence it can degenerate and wane. Recall Ferguson’s reflection referred to in the opening chapter of this thesis about the possibility to download or delete any of what he calls the killers apps!⁴⁴⁴

Of course, one key method of sustaining this is through education – education of a certain sort. For example as Popper argues, “reason, like science, grows by way of mutual criticism; the only possible way of planning its growth is to develop those institutions that safeguard the freedom of this criticism, that is to say, the freedom of thought”.⁴⁴⁵ No doubt, part of the notion of cultural elements includes the philosophical disposition prevalent in the society is reflected in the educational and socialisation institutions through which epistemic heritage and other values are transmitted down from one

⁴⁴² Waldron, *Tribalism and the myth of the framework*, 224.

⁴⁴³ M. H. Banes, *Stages of thought: the coevolution of religious thought and science* (Oxford: Oxford University Press, 2000), 139.

⁴⁴⁴ N. Ferguson, ‘The great divergence: The West and the rest’, TED talk.

⁴⁴⁵ Popper, *The Open society and its enemies*, 227.

generation to the other. In other words, the question involves the consideration of the quality and character of the cultural elements which are capable of sustaining or stifling the culture of science in the context of Nigeria.

4. 3 An Overview of Philosophical and Cultural Context of Science

Education

The immediate question here is to ask, - whether the promotion of say, specific science courses like, mathematics, chemistry, physics, and biology requires context as an important dimension that adds to the success story of science and why the thesis demands that the context of science learning and teaching in Nigeria be taken more seriously if ownership and responsibility of science is to happen in Nigeria.⁴⁴⁶

This is an important question with respect to Western science in a non-Western context as there are several interrelated factors (socio-cultural, political, gender, philosophical, etc) that are relevant in the efforts and achievement in science disciplines. Increasingly, calls to decolonise the curriculum sometimes do highlight the problematic issue in the sort of question above. In other words, it is suggested that contextualisation of what is taught has a crucial role in the success or otherwise of science education. For science to be made more relevant, appreciated and deeply understood by students in their contexts poses both philosophical as well as cultural challenges in practice. This is illustrated by

⁴⁴⁶ Experts and researchers in educational pedagogy are likely to suggest that prior knowledge or context can be an important component in the teaching and learning of science subjects. For example, G. Bethell, *Mathematics Education in Sub-Saharan Africa: Status, Challenges and Opportunities* (Washington: The World Bank, June 2016); E. N. N., Dzama & J. F., Osborne, 'Poor performance in science among African students: an alternative explanation to the African worldview thesis', *Journal of Research in Science Teaching*, 36 (1999), 387-396; G. Emeagwali, E. Shizha (Eds.), *African indigenous knowledge and the sciences; journeys into the past and present* (Rotterdam: Sense Publishers, 2016)P. M., Keys, 'Are teachers walking the walk or just talking the talk in science education?', *Teachers and Teaching: Theory and practice*, 11, 5 (2005), 499-516; R. J., Osborne & M. C., Wittrock, 'Learning science: a generative process', *Science Education* 67, 4 (1983), 489-508. This view seeks to provide a much more profound rationale for the poor state of science in Nigeria than the mundane factors of poor funding, inadequate or poorly resourced and motivated human and material resources for promoting science. Even when many scientists and engineers are trained or schooled in various institutions abroad, a simple stretch of our imagination will suffice if we contemplate a situation where all foreign personnel were to leave the country, it is best left to our imagination what will happen in Nigeria. A section in chapter four provided insights into this aspect of the challenge of science in Nigeria.

an image of Western science which Elkana describes in these words, “Western scientific culture underwent a positivistic purge, culminating in the belief that science has found a method whereby universal truths are written down in objective documents which carry a message open to, and capable of being shared by, all mankind”.⁴⁴⁷ Basically, the point is not just about facts that we stick to but the process we come to accept or reject them as such is what is at stake here. Popper complains about the fixation with the learning of facts and the associated attitude as posing great danger especially its possibility of becoming normal.⁴⁴⁸ Swann warns of the danger of imposition in the context of educational curriculum. For instance, when the student perspective is not considered in an educational setting. Influenced by Popper’s evolutionary epistemology, Swann argues that the expectations, aspirations that students bring into the learning environment are critical desiderata in the practice of learning and teaching enterprise and they are to be taken seriously.⁴⁴⁹

Furthermore, we can endeavour some sorts of meta-philosophical exercise as a way of demonstrating the relevance of Popper’s thoughts for the project under review. It is important to recall that Popper was particularly interested in showing the differences and connection there is between the psychology of discovery and the logic of discovery. This was particularly important because of the continuity there can be between some kind of metaphysics and science. To appreciate this, Popper relies on Kant’s ideas with the revision that,

Our theories are man-made. What we do is to try and impose those on the world, and we can always stick to them dogmatically, if we so wish, (even if they are false as are not only religious myths, it seems, but also Newton’s theory, which is the one Kant had in mind). But as first although we have to stick to our theories -

⁴⁴⁷ Y. Elkana, ‘A programmatic attempt an anthropology of knowledge’, in E. Mendelsohn & Y. Elkana (Eds.), *Sciences and Cultures: sociology of the sciences*, Vol. 5, 1981), 33.

⁴⁴⁸ K. Popper, ‘Normal science and its dangers’, in I. Lakatos & A. Musgrave (Eds.), *Criticism and the Growth of knowledge: Proceedings of the International Colloquium in the Philosophy of Science*, London, 1965 (Cambridge: Cambridge University Press, 1970), 52-53.

⁴⁴⁹ J. Swann, ‘Student-Initiated curricula: a corner stone of learning for democracy’, *An Inst. De 1st. G. Bantiu, Sin Clug-Napoca, Series Humanistica*, VI, 2008, 43-52.

without theories we cannot even begin, for we have nothing else to go by – we can, in the course of time, adopt a more critical attitude towards them. We can try to replace them by something better if we have learned, with their help, where they let us down. Thus there may arise scientific or critical phase of thinking, which is necessary preceded by an uncritical phase.⁴⁵⁰

Continuing, Popper argues, “our theories are own inventions; but they may be merely ill-reasoned guesses, bold conjectures, hypotheses. Out of these we create a world; not the real world, but our own nets in which we try to catch the real world”.⁴⁵¹

From the foregoing it is apparent that the encounter or the experience of the external or the real world is more often a mediated encounter. A point on which Popper agrees that Kant was right in a sense and wrong in another sense. In the former sense, it was impossible that knowledge was as it were a copy or impression of reality. Thus, to hold the belief that knowledge was genetically or psychologically a priori, Kant was right. In the latter sense, to suppose that any knowledge could be a priori valid is wrong.⁴⁵²

A rather general review of the experience of the teaching and learning of science in an African context bring to the fore the complex connections and interrelationships of contextual factors, worldviews or frameworks that are often glossed over or ignored to the detriment of the actual appreciation of what is taught. It is however insightful that practitioners and professionals in science education are beginning to pay attention to some of these values and their place in science education. In fact, it is to be noted that practitioners in the field of education seem to be leading the way in the consideration of these values as important ingredients in the teaching and learning of science in non-Western societies.⁴⁵³ It may not be totally surprising for this to be the case because there

⁴⁵⁰ K. Popper, *Unended quest: an intellectual autobiography* (New York and London: Routledge, 1992), 64.

⁴⁵¹ Popper, *Unended quest*, 65.

⁴⁵² Popper, *Unended quest*, 64-65.

⁴⁵³ O. J. Jegede & G. S. Aikenhead, ‘Transcending cultural borders: implications for science teaching’, *Research in Science and Technological Education*, Vol. 17, 1 (1997), 45-66; F. Abd-El-Khalick & N. G. Lederman, ‘Improving science teachers’ conception of the nature of science: a critical review of the literature’, *International Journal of Science Education*, Vol. 22, 7 (2000), 665-701; D. Baker et al, ‘The effect of culture on the learning of science in non-Western countries: the results of an integrated research review’, *International Journal of Science Education*, Vol. 17, 6 (1995), 695-704; O. J. Jegede, ‘Collateral

is some insights in the saying that one who wears the shoes knows where it pinches most, after all, they are on the field and directly have these experiences while undertaking science teaching to students in non-Western contexts.

What however remains to be seen is the quality of philosophical enrichment of such interventions and discourses. It is in this sense that there is an urgent need for greater engagement of philosophy, history, anthropology and sociology of science with science and science education in such contexts such as the one under consideration in this thesis. Through this type of cooperation and engagements from multiple disciplines concerned with science, the burden of advancement of science is shared such that practitioners and those on the field will always have the fundamental theoretical resources to draw upon to continually enrich their work and activities in engendering a culture of science that is appropriate among learners. I will now quickly begin to examine how philosophy can engage in this sort of theoretical intervention and enrichment particularly lacking and absent so as to improve science and the culture of science in the context of Nigeria.

4. 4 Scientism versus Excessive Religiosity: Popper and Philosophy's

Relevance

Philosophy played enormous role in the historical development of science and continues to be part of the project of science in many respects.⁴⁵⁴ Though sometimes, its identity and place is subject to suspicion by some scientists, it however remains an important ally

learning and the eco-cultural paradigm in science and mathematics education in Africa', *Studies in Science Education*, Vol. 25, 1 (1995), 97-137; M. Ogawa, 'Toward a new rational of science education in non-Western society', *European journal of Science Education*, Vol. 8, 2 (1986), 113-119; M. B. Ogunniyi, Teachers' stances and practical arguments regarding a science-Indigenous knowledge curriculum, Parts 1 & 2, *International Journal of Science Education*, vol. 29, 8 & 10 (2007), 963-986; 1189-1207 and several others I will not be able to mention for reason of space.

⁴⁵⁴ I acknowledge such a remark could be construed as misleading but it is made realising how as natural philosophy, they were together as the scientific practice in the modern era developed. However, philosophy of science does not pretend to be science but remains particularly relevant as complementary science, a position I borrow from H. Chang. See more, H. Chang, History and philosophy of science as a continuation of science by other means', *Science & Education*, 8 (1999), 413-425; Chang, 'Complementary Science', *The Philosopher's Magazine*, 40 (2008), 17-24.

to science broadly, especially from the perspective of the philosophy and history of science.⁴⁵⁵ The tradition of scepticism that philosophy has helped to nurture is in no small way part of the story of science, especially as a buffer against dogmatism. On this Popper writes, "... the appeal to authority is the dearth of knowledge ... the growth of knowledge depends entirely upon disagreement".⁴⁵⁶ It is one that is to be encouraged especially in the context under reflection where cautious intellectual vigilance is called upon to delineate the excesses of two extremes; that is, scientism especially in the methodological fashion on the one hand and the tendentious excesses of religiosity on the other. How well this tradition is understood and imbibed as an important component among the many items in the tools box for science advancement in a society that aspires to become an active player in the global scene is of concern to philosophy and other related disciplines that study science too.⁴⁵⁷ Hence to conceptualise the problem of science in Nigeria partly demands developing an appropriate philosophy of dialogue that can accompany and facilitate the efforts to advance science in an African context.

On this score therefore, philosophy is explored as a critical aspect of the project of science because of its ever-challenging characteristic as an open ended and self-reflexive intellectual endeavour. The advantages include its potentials for the facilitation of

⁴⁵⁵ P. B. Medawar, *Induction and intuition in scientific thought* (London: Methuen, 1969).

⁴⁵⁶ K. Popper, *The myth of the framework: in defence of science and rationality* (London: Routledge, 1994), x. On this account, the research's preference for Popper is also highlighted and obvious.

⁴⁵⁷ Some of the contributions in this regard have focused almost exclusively from historical, sociological and anthropological perspectives whereas the intellectual impulse of science, technology and society studies encompasses several disciplines, intersecting and creating a well-rounded account of science in any society. The concern here is to provide the philosophical dimension to these ongoing debates and the insights from which the African perspective can benefit. For these other perspectives, see more; G. Bassala, 'The spread of western science: a three-stage model describes the introduction of modern science into any non-European nation', *Science* 156 No. 3775, (1967), 611-622; D. Chambers & R. Gillespie, 'Locality in the history of science: colonial science, technoscience and indigenous knowledge', *Osiris* 2nd series, *Nature and empire: science and colonial enterprise*, 15 (2000), 221-240; S. Shapin, 'Here and everywhere: sociology of scientific knowledge', *Annual review of sociology*, 21; 289-321. S. Seth, 'Putting knowledge in its place: science, colonialism, and the postcolonial', *Postcolonial Studies*, 12, 4 (2009), 373-388; H. Tilley, 'Ambiguities of racial science in colonial Africa: the African research survey and the fields of eugenics, social anthropology, and biomedicine, 1920-1940', in B. Stuchtey (ed.), *Science across the European empires, 1800-1950* (German Historical Institute, London: Oxford University Press, 2005), 245-288; B. Latour, *Science in action: how to follow scientists and engineers through society* (Cambridge MA: Harvard University Press, 1987); S. Harding, *Science from below: feminism, postcolonialities, and modernities* (Durham, NC: Duke University Press, 2008).

educational system that celebrates curiosity, questioning, or scepticism which are trademarks characteristic of philosophy and other related disciplines.

For instance, there is a yawning gap between theory and practice of science learning or education and the practice of science in Nigeria. This is evident in the significant training of many Nigerians abroad in the area of science disciplines (theory) who upon return do not bring to bear such expert training, learning in science related courses (practice). Even if they do or try to do, it is often short lived. From a long-term perspective however, there is a challenge regarding the transfer and sustenance of the culture of science acquired from wherever they may have received training and scholarship.⁴⁵⁸ The worry then, is, to ascertain what may be responsible for such failure in terms of the long-term benefits and of course, why the crisis of science advancement has prevailed despite such interventions. Jegede considers this phenomenon as collateral learning/border crossing. It is often as a result of inattention to the socio-cultural factors with which science learning take place among many Africans. This produces paradoxical results among such learners. Hence, the prevalence of a situation whereby an excellent scientist may not enthusiastically display associated values and attitudes connected to science— as same individual can at home be a traditionalist without feeling of cognitive dissonance or perturbation.⁴⁵⁹ Thinking about the peculiarity of this challenge Hountondji argues “in all countries in the world, modern science, namely organised, systematic and formal research activity, when it exists, is carried out jointly with knowledge that may be described as traditional. However, in the context of Africa arrangements for that coexistence have peculiarities

⁴⁵⁸ This issue has been tackled in detail by A. R. Choudhuri, ‘Practising Western science outside the west: personal observations on the Indian science’, *Social Studies of Science*, 15, 3 (1985), 475-505. The context though Indian, aptly reflects the experience of Nigeria. This may be as a result of the common British colonial experience. One must however acknowledge the significant rise of India in the science and technology world and that far outweighs the state of science and technology in most parts of Africa. Another apt piece that touch on this same theme but from the Korean perspective is illuminating too, is, K. Hwang, ‘International collaboration in multi-layered center-periphery in the globalisation of science and technology’, *Science, technology, & Human Values*, 13, 1 (2008), 101-133.

⁴⁵⁹ O. J. Jegede, ‘School science and the development of scientific culture: a review of contemporary science education in Africa’, *International Journal of Science Education*, Vol. 19, 1 (1997), 10-11.

that require close examination”.⁴⁶⁰ One example that immediately comes to mind is the medium through which much of science teaching and learning takes place in these societies. Though views on this vary but the extent to which this plays any role remains a topical issue.⁴⁶¹

There is therefore the need to pay attention to the educational culture or the general cultural outlook vis-a-vis the science situation in societies. This is crucial because of the challenge of balancing these values such that while efforts are being directed to achieve the goals of science education, other important cultural values are not sacrificed. Against this backdrop, there has been an increasing worry about the promotion of an excessive religiosity or simply, the mystical consciousness/outlook at the expense of the promotion of an intellectual culture sufficient for science and technology to thrive in Nigeria. Relevant literatures and reports in the media on African issues can confirm this observation about the elevation of values of a mystical kind compared to values of philosophic or scientific nature broadly construed. A few examples will suffice to illustrate this point. Among many others, Anele⁴⁶² and Ijabla,⁴⁶³ whose reflections and blogs reflect radical, critical voices have taken scathing swipes and rightly so at this trend, that is, the excessive religiosity that tend to dominate the public space over and above

⁴⁶⁰ P. Hountondji, ‘Global knowledge: imbalances and current tasks’, G. Neave (Ed.), *Knowledge, power and dissent: critical perspectives on higher education and research in knowledge society*. (UNESCO publishing, 2006), 50.

⁴⁶¹ O. Jegede, The knowledge base for learning in science and technology education in P. Naido & M. Savage (Eds.), *African science and technology education into the new millennium: practice, policy and priorities*, (Cape Town: Juta and Co. Ltd, 1998), 151-176.

⁴⁶² D. Anele, ‘How religion underdeveloped Nigeria’ (I-III), *The Vanguard Newspaper*, 22 December, 2013; December 29, 2013; January 5, 2014. The third series, January 5, 2014, Anele writes, “...reliance on supernatural assistance for exemplary leadership tends to discourage critical and creative thinking that can generate valid solutions to the problem of haphazard development”. Recently, the Nigerian parliament threw out a bill on gender equality on the flimsy excuse that it contravenes religious sensitivities as contained in the constitution of the federal republic of Nigeria. (See more, www.independent.co.uk/news/world/africa/nigerian-senate-cotes-down-gender-equality-bill-due-to-religious-beliefs-a6936021.html [Accessed 17/03/2016]. The disturbing dimension of some of these issues is the inability to entertain or have any intellectual debate on issues of immense importance to humanity without the delimitation of an overbearing religiosity in Nigeria.

⁴⁶³ R. Ijabla, ‘Religion: the bane of Africa’s development?’ Available online: <http://saharareporters.com/2013/07/14/religion-bane-afica%E2%80%99s-development-ijabla-raymond> [Accessed on 12/03/2016].

critical intellectual outlook in Nigeria. The ends to which such a frame of mind-set operates aligns closely with some of Popper's take on dogmatic and fanatical tendencies versus values of critical rationalism, recurring theme in Popper's political as well as epistemological discourses.⁴⁶⁴

As a consequence therefore, values of curiosity, imaginative capacities and critical intelligence are sacrificed because they are not encouraged. What is more, when these values come under the weight of an epistemic regime that adorns and over prices religious authority, characteristically dogmatic and totalitarian, free enquiry, imaginative or curious capacities get stifled in significant ways with enormous consequences for the entire society. Little wonder, the government in Nigeria seems more interested in the sponsorship of religious pilgrimages at the expense of ventures with pragmatic national returns/benefits as pursued by other nations. The massive investments and coordinated support in promoting basic science and other applied science activities (like the effort to study the increasing resistance of strains of infections to antibiotics and efforts to tackle the debilitating effects of the rise of HIV/AIDS or other infectious deadly diseases) with direct relevance are hardly prioritised by government in Nigeria. The kind of support and attention given to religious issues is never seen to be given in the area of education and most especially towards the advancement of science and technology education in Nigeria. In cases where such little supports and programmes in education or science and technology are well crafted in policy documents, they are at best as lofty rhetoric and at worst, never implemented/executed.⁴⁶⁵

⁴⁶⁴ R. J. Ormerod, 'The history and ideas of critical rationalism: the philosophy of Karl Popper and its implications for OR', *Journal of Operational Research Society* 60, 4 (2009), 441-460.

⁴⁶⁵ The political remarks that greeted the presentation and launch of the new national science policy in Nigeria is illustrative of the view that in Nigeria, the leadership glory more in making promises that are never kept. See, The Presidential statement on the new national policy on science, technology and innovation, Science, technology and Innovation Policy, 2012. The leadership as problematic in Nigeria was aptly captured by Chinua Achebe in his work with the title: *The Trouble with Nigeria*, 1983. Quite old a piece but so valid after a generation.

To this extent it is safe to say that directly or indirectly, the mental outlook and epistemic attitude promoted in the larger society and particularly in higher institutions in Nigeria are a far cry from the ones capable of leading Nigeria out of the crisis of science development and advancement since they are not so supportive of the critical elements needed for science improvement or attend to these concerns with some sense of urgency.⁴⁶⁶ Obviously, the result is that the entire package taught in schools and obtainable at the societal level do not reinforce critical consciousness, which again makes peaceful exchange and conversation rather tedious or difficult. Hence, the society is not reaping the benefits of a culture of critical rationality and engagement as it is rather quick to rely on other values quite antithetical to the workings of a society urgently in need of development.⁴⁶⁷

Given the foregoing scenario, the lessons of Popper's thought are not far-fetched to addressing the issue of excessive religiosity promoted in the Nigerian society. For a broader appreciation of the relevance of a seemingly long narrative, it is helpful to quickly point out the intriguing quarrel between "evolutionism versus creationism" as a case in point. Especially, why the former is interested in outdoing the latter as a fundamental frame of biological science in science education and the fruitful role inherent in the

⁴⁶⁶ R. Ijabla, 'Superstitions and the sorry state of tertiary education in Nigeria', December 24, 2014. There is a perpetration of a one metaphysical dimension to the explanation of all that there is as in the final analysis the supreme is considered to be in such a position to absolutely remote-control all of human actions and human affairs. Available Online: <http://theunilaglss.com.ng/2014/12/26/superstitions-and-the-sorry-state-of-tertiary-education-in-nigeria-by-dr-ijabla-raymond/> [Accessed on 12/03/2016]. On Asouzu's part, this mind-set so described is "wrong metaphysics and wrong metaphysical approach and application". See more, I. I. Asouzu, 'African metaphysics and challenges of science', in I. I. Asouzu (ed.), *Ikwa Ogwe, essential readings in complementary reflection. A systematic methodological approach* (Calabar: Saesprint publishers, 2007), 121.

⁴⁶⁷ Asouzu, *African metaphysics and challenges of science*, 119. He writes, "... in African set up, metaphysics remained and still remains relevant, yet in a manner that contrasts with the understanding of metaphysics as a tool for a rational explanation of reality itself. Here, metaphysics takes the form of a set or body of belief or practices in relation to the ultimate reality. Whenever this happens metaphysics tends towards subsuming the dynamism of nature into the all explicating ultimate reality. In this form, the dynamic constitution of nature, whose self-explanatory force is fundamental for scientific growth is replaced by belief in a dynamic force in the form of a persona; god, spirit of other agencies responsible for explanation of the reality of things. This form of metaphysics concentrates in grasping the nature of the being responsible for the existence of the world, it is comfortable with taking stock of the very attribute of this personal being, his relationship with man, or nature".

humanities (philosophy/Popper) that can be tapped into to help deal with issues of interest and motivation to engage in science related disciplines and even support the values of democratic politics.⁴⁶⁸

A cosmetic view of the situation in Nigeria so described, one may want to dismiss any linkage but a deeper assessment will establish that the prevailing worldview as it is presently constituted is partly responsible for the crisis of science advancement. It is therefore safe to say that the prevailing metaphysical outlook both in the larger society and one which specifically underpins education in Nigeria is ‘excessively religious ‘and quite problematic.⁴⁶⁹ For when the larger section of the society give in to magical thinking than critical thinking, then there is an obvious problem for the possibility of growing and advancing science in such a society. In other words, where the scientific literacy among the populace is very low, the tendency to have other considerations trump the prioritisation of science and the aggressive commitment it deserves. As Ijabla bluntly puts it,

if the people who teach science discredit evolution but argue that their pastor’s car can drive without fuel or that their pastor has resurrected people and cured every disease through prayer and fasting, what values are they imparting to you, for the purpose of education is to overcome ignorance and not to validate it.⁴⁷⁰

⁴⁶⁸ M. C. Nussbaum, *Not for profit: why democracy needs the humanities* (Princeton: Princeton University Press, 2010); C. A. Bleckmann, ‘Evolutionism and Creationism in *Science: 1880-2000*’, *BioScience*, Vol. 56, 2 (2006), 151-158. Also some details are contained in a chapter of a book, D. M. Raup, *The nemesis affair: a story of the death of the dinosaurs and the ways of science* (New York: Norton, 1986), ‘Belief systems in science’, where Popperian insights were drawn upon by a judge while assessing the place of science or prayers (religion) in a lottery case.

⁴⁶⁹ Asouzu, *African Metaphysics and challenges of science*, 122.

⁴⁷⁰ Ijabla, R. (December 11). Pentecostalism is a doctrine of greed which is destroying critical thinking. *Sahara Reporters*. Available online: <https://twitter.com/SaharaReporters/status/940400738639011844> [Retrieved on 14th December, 2017]. This claim is quite similar to the concerns that were raised by a group of scientists and experts about the increasing popularity of belief in astrology despite the advancement in science and education in Western societies. Interestingly, P. Feyerabend responded to their arguments pointing the fallacies in their views. Without prejudice to argumentative strategies of the group of scientists and the remarks of C. Sagan and Feyerabend, the concerns raised by the experts my mind were legitimate and worrisome because of the possibility of people coming to believe anything and adopting epistemic attitudes that are not in sync with the values Popper advocates to include, readiness and openness to severest of criticism and severest of test among others. It is important to add that there are indications that Popper’s liberalism may have played some role in Feyerabend’s views but he pushed his liberalism to the extreme in my view. See more, P. Grim, *Philosophy of science and the occult* (New York: Suny Pres, 1982), 19-23.

Such reading explains the indisposition to establish philosophy as a course of study or the tokenistic attention it gets in many universities or in other institutions of higher learning where teachers in science disciplines are trained and prepared for the huge task of producing and transmitting knowledge. The consequences are huge and are obviously manifest in the some of the challenges Nigeria continues to face and tackle.

There are important lessons from Popper's work to countering the onslaught launched by the Vienna Circle that are very useful and helpful in the context under consideration.⁴⁷¹

What this perspective represents is well known to rehash entirely here, suffice it to note, however, that Popper amongst others successfully insists and thereby defends metaphysics, and repositions the integrity of philosophy as an important part of the business of science and scientific inquiry. By this, he undermined the 'scientisation' of philosophy; that is, the purported unity of science project championed by the Logical Positivists, which was to be achieved through the elimination of metaphysics. Metaphysics was considered to be the main source of error and ambiguity in philosophical discourse according to the proponents of a unified positivist science project championed in the Vienna Circle movement.⁴⁷² By this, philosophy was to be reduced to a 'positivistic' discipline of some sort. On this, Champion argues that "in keeping with Hume their mission was to purge science of metaphysics and place it on the firm positive foundations of sensation".⁴⁷³ Arguably, scientism of the methodological kind advocated

⁴⁷¹ S. Gaukroger, *The emergence of a scientific culture: science and the shaping of modernity, 1210-1685*, (Oxford: Oxford University Press, 2006), 12. Here Gaukroger reflects on the project of the Vienna Circle as represented by Rudolf Carnap whose suggestion was to the effect that scientists are the best candidates to do philosophy rather than philosophers!

⁴⁷² W. C. Kneale, 'The demarcation of science', P. A. Schillp (ed.), *The philosophy of Karl Popper*. Book I (La Salle, Illinois: The Open Court Publishing Company, 1974), 206.

⁴⁷³ R. Champion, *Reason and imagination: commentary on the work of Karl Popper and William W. Bartley* (Sydney, 2015), 14.

by the proponents of Logical Positivist the movement was contested and challenged by Popper in ways that puts philosophy as metaphysics back into the science project.⁴⁷⁴

As earlier noted with regards to the disciplinary integrity of philosophy as well as that of other disciplines in humanities, it is important to draw attention to the corrosive or imperialistic move of making philosophy in the image and likeness of any positivistic discipline. In the same way, the appeal to the same logic suggests that any move to remake in the image and likeness of religion every intellectual discipline keeps the culture of science low as it is the case in Nigeria. Hence, the failure to draw a line between religious matters from metaphysical issues that could be relevant to science is not only faulty but very problematic. Even in the face of the slippery nature of these related matters, one can conveniently and reasonably insist that the concern of metaphysics consistent with its history is very different from the area of religious studies. Kenny articulates this position quite brilliantly in these words,

metaphysics is the corner stone of philosophy department. Without it, other courses like, philosophy of mathematics, philosophy of law, could be dispersed to their corresponding departments. Epistemology and philosophy of science could be handled in the methodology of physical science. The philosophy department now melted down to bankruptcy could shut its doors. Modern science like its ancient predecessors, for the most part dodges the task, Aristotle complained the physical scientists ran away from dealing with it. He endeavoured to do it, and his intellectual heritage persisted through Arabic and European philosophy to the Middle Ages.⁴⁷⁵

The dynamic relationship between the imperialist expansionist programmes of various academic disciplines or intellectual endeavours and their practical consequences in several areas and regions around the world have had immense changes for the world. The

⁴⁷⁴ Effectively, Popper's intervention calls into question scientism. Scientism though may have various emphasis as some authors have identified. For instance, M. Stenmark, *Scientism: science, ethics and religion* (Aldershot: Ashgate, 2001), 1. My usage of scientism and emphasis on the methodological is not absolutely exclusive of the various ways in which scientism can apply. In fact, my main point is that, it is almost impossible to be committed to methodological scientism without necessarily being committed to ontological or epistemological scientism at the same time. In other words, there is a connection among the various forms or expressions I consider to be arguably necessary.

⁴⁷⁵ J. Kenny, 'Philosophy, bridging the arts and sciences', O. Oyeshile & J. Kenny (Eds.), *The idea of a Nigerian university: a revisit*, 73.

central issue to emphasise here is the question of power and how this affects knowledge. Subtly but real, this kind of influence is not only within the Western imperialist context that we can understand this to be happening but also the intellectual heritages within national territories too are involved. For example, the case of religion in Nigeria influencing and defining almost every aspect of the national experiences is a case in point. The extent to which this is allowed to determine many things that happens in various spheres of our national life reveals the unfettered influence of religion and religious presuppositions. By this same token, it can be argued that the “intellectual endeavours epitomised by Western modern science do dominate the power play to the extent that most disciplines crave to be made in modern sciences’ image and likeness”.⁴⁷⁶

Within the context of Nigeria, the knowledge tradition suffers as a result of the integration goals of the dominant knowledge system. For instance, what is to be taken seriously epistemically is according to its own terms/conditions/standards. The sum of this analysis simply reveals how disciplines too, can become caught up within the web of imperialistic tendencies. After all, they are constitutively intertwined with the whole intellectual and cultural movement and context that began as a result of the enlightenment with the world’s cultures and peoples defined and identified accordingly. What then, is the way out? Or put in another way, is it possible to disentangle the various intellectual disciplines from the alluring reign of power epitomised by Western modern science? In other words, can the Western modern science be decolonised epistemically in such a way that its domineering and denigrative outlook be vitiated so as to predispose it to motivate ownership and responsibility in the context of Nigeria? The response is in the affirmative. In the thinking of this thesis, this can be achieved through deploying Popper’s tool of intellectual vigilance inspired by the preponderance to be perpetually open and readily disposed against the ideological tendency of any viewpoint; that is, through genuine and

⁴⁷⁶ C. Finn, *Science studies as naturalised philosophy* (Dordrecht: Springer, 2011).

consistent openness to the possibility of refutability/falsifiability broadly understood. Here the thesis does not see falsificationism as an end in itself, after all, the many flaws are incontestable. But when viewed as a means, or part of an entire philosophic system or thought of Popper's philosophy, it has something positive to add. It is important to reemphasise therefore that Popper did not present his critical rationalism as a theory of rationalism but rather as a fundamentally epistemic 'attitude'.⁴⁷⁷ This epistemic virtue is an indispensable tool to achieving the decoupling of Western modern science from any overbearing epistemic outlook, that has been the bane of science advancement in the African context, Nigeria.

To show it more vividly, Cunningham examines Western medicine within its broad intellectual history, and attempts a demonstration of the symbiotic relationship between the history of imperialism and the discipline of Western medicine that embodied the kind of power at the heart of the imperialist agenda in the Asian context.⁴⁷⁸ It is worth reiterating here that much of the papers and works in this area of scholarship, philosophy and history of science have paid little or no attention to the nature of the African experience compared to the attention given to the experiences of people from the other regions like Asia, India and others.

The intervention by Popper makes allowance for an openness to the accommodation of other possible sources of knowledge or ways of knowing.⁴⁷⁹ Thus, Koertge's position that science needs more unorthodox ideas and a greater plurality of approaches is not only

⁴⁷⁷ Popper, *The myth of the framework*, xii.

⁴⁷⁸ A. Cunningham & B. Andrews, (eds.), *Western medicine as contested knowledge* (Manchester and New York: Manchester University Press, 1997), 'Preface', 'Introduction', 1-23; A. Cunningham, *The identity of the History of science and medicine* (Famham: Ash gate Press, 2012).

⁴⁷⁹ See more, W. I. B. Beveridge, *The art of scientific investigation* (New York: W W Norton & Company Inc., 1957).

Popperian⁴⁸⁰ but a vindication of the argument in the foregoing about Popper and the possible role of metaphysics in science.

However, one other interesting lesson in Popper's intervention in the foregoing demonstrates the perennial role of philosophy as a moderating intellectual endeavour. While it remains relevant as a probing and questioning subject that can mitigate the dogmatic or institutionalised authoritarian claims of possession of truth by an excessively religious outlook, it can also serve regulatory role by moderating any excessive and exaggerated epistemic claims and applications of the sciences as exemplified in the positivistic agenda of the Logical Positivists.

The extent to which this is appreciated plays significant role in promoting the culture of both critical engagement of problems of knowledge, nature as well as human/social problems. So, it is able to facilitate the entrenchment of values of liberal discursive practices within the larger society.⁴⁸¹ Through this double-faced feature of the kind of philosophy that Popper defends, philosophy's influence and ability to empower an intellectual outlook capable of undermining any ideological or dogmatic tendency is made more prominent. Against this backdrop, societies are categorised either as closed or open societies depending on whether criticisms are allowed to flourish in such contexts. Albert reflecting on Popper suggests that Popper's social philosophy based on his epistemology, challenged totalitarian/absolutist ideologies of totalitarian systems from a critical perspective. This he was able to do with his notion of an open society where critical discussion of political problems and political reforms are allowed without the feeling of being compelled to postulate an ideal communication community and to invest

⁴⁸⁰ N. Koertge, 'Theoretical pluralism and incommensurability: implications for science and education', *Philosophica* 31, 1 (1983), 85-108.

⁴⁸¹ J. Steyn & J. de Klerke, 'Karl Popper's views on an open society and their implications for the democratic transformation of South African Education', *Education as Change*, 9, 1 (2005), 151-167.

it with transcendental aspirations.⁴⁸² Going further, he adds that only in an open society is it possible, namely, to exploit epistemological progress in the science, not only from a technological perspective to improve the living conditions of its population but above and beyond that to implement enlightenment. To appreciate its significance, it is only necessary to imagine the political dangers due to religious fundamentalism which arose after the collapse of socialist systems in many parts of the world.⁴⁸³

What the foregoing therefore demonstrates, is, the need to guard against what Weiler calls the homogenisation of knowledge. In our case therefore, either by deploying excessive religious narrative or a reductive strategy that embodies scientism. This arose according to Weiler in “the epistemology of the classical natural sciences and its subsequent extension to the social, (humanities) and behavioural sciences, while relying on Parsons’ review of Max Weber that there is not *natural* or *cultural* science; that there is only science or non–science and all empirical knowledge is scientific in so far as it is valid”.⁴⁸⁴

When these reflections are contextualised in the Nigerian setting, we have two problems to deal with; while there is a penchant for scientism of some sort typified by reductive Western modern science; the second is the fundamental drive to make religion the common denominator of all experiences exemplified by the holistic African knowledge tradition.

In appreciation of the value of critical rationalism, Asouzu’s distinction between metaphysics as a body of beliefs and as an exploratory tool comes insightfully handy. Asouzu writes with an undertone of Popper’s idea of critical rationalism thus, “one of the basic conditions of scientific growth is therefore the willingness and ability of individual

⁴⁸² H. Alberts, ‘Karl Popper, critical rationalism, and the positivist dispute’, *Journal of Classical Sociology* 15, 2 (2015), 216.

⁴⁸³ Alberts, *Karl Popper, critical rationalism, and the positivist dispute*, 216-217.

⁴⁸⁴ H. N. Weiler, ‘Challenging the orthodoxies of knowledge: epistemological, structural and political implications for higher education’, G. Neave (ed.), *Knowledge, Power and Dissent: Critical perspectives on higher education and research in knowledge society* (UNESCO publishing, 2006), 63.

methods to be responsive to criticisms and self-criticisms. Here African scientific endeavours have to meet certain minimum standards to be relevant”.⁴⁸⁵ One of the ways this can be achieved is to acknowledge and contend with the fact that the challenge for Africa’s future lies with the quest to acquire the curious philosophical attitude that is capable of helping our knowledge to grow through self-criticism, inculcation into the African thought pattern the ideas of infinite perfectibility of the human spirit.⁴⁸⁶ The role of philosophy well understood can be deployed in service of this aspiration and this is expressly obvious in the foregoing analysis. For instance, much of the borrowed systems and policies we adopt to address various problems are hardly implemented, or when we try to, we do such very poorly. There is hardly any systematic criticisms to test and evaluate the grounds for failures or ascertain their status/viability so we can advance and make progress with them in a piecemeal manner as recommended by Popper.⁴⁸⁷ This is important because of the penchant disposition to always rely on providential events and happenings to effect or bring about change and progress.

By this, philosophy meets one of the many appeals as a potential tool for social change and engineering. It does this by facilitating the trial and error evolutionary changes that occurs in an atmosphere of openness as against the radical revolutionary utopian model of change that any closed system promises. Thus by drawing on Popper’s contributions in the restoration of philosophy and its many lessons for the project of science in society, the thesis would have made its modest contribution.

To revisit a claim made earlier with respect to the place of philosophy in some universities in Nigeria. For an obvious reason as a course it is capable of breeding restless and curious

⁴⁸⁵ Asouzu, *African metaphysics and challenges of science*, 134.

⁴⁸⁶ Asouzu, *African metaphysics and challenges of science*, 137, 139-140.

⁴⁸⁷ Popper makes a distinction between radical social changes and piecemeal social engineering, preferring the latter as a more secure, safe and reliable means that guarantees incremental changes within society. It is underlined by a critical intellectual character that is perpetually open to being tested, tried and corrected model of bringing about social change in societies.

minded people whose stock-in-trade can undermine the social and religious status quo; it has remained largely suspect. It is not lost on me that the overwhelming influence of these pervasive social, cultural and religious beliefs, values and sentiments have direct relevance for the entire country in a number of ways. On this note, Akinwale holds a strong view that education is in chains and thus in need of liberation. This sort of liberatory aspiration can be realised in part by drawing on the rich tradition of philosophy which unfortunately is not promoted in many universities in Nigeria as in some other countries in Africa. He mentions the Republic of Chad as his particular example.⁴⁸⁸ As a demonstration of what philosophy can contribute to the situation, UNESCO realises and underlines the value of philosophy for the development of human thought, for each culture and for each individual set aside the third Thursday in November each year as world philosophy day.⁴⁸⁹

Philosophy properly understood is to be embraced and celebrated, after all, criticisms and questioning are not always employed to achieve destructive ends. They can indeed be constructive evaluations and deep reflections on religious, cultural, epistemological, political and scientific beliefs. As indicated, questioning is key in the project of critical inquiry, serves as antidote of dogmatic and fundamentalist attachment to certain knowledge claims or beliefs. Ikuenobe's discussion presents the experience of Socrates and how intellectual alertness can be characterised by use of questioning as an indispensable asset in philosophy. When conceived in the right manner, it serves a useful intellectual purpose of encouraging a disposition that is persistently open to inquiry, learning and acquisition of knowledge. Hence the value of philosophy cannot be over

⁴⁸⁸ A. Akinwale, 'Knowledge, power and the state of university education', O. Oyeshile & J. Kenny (Eds.), *The idea of a Nigerian university: a revisit* (The Council for Research in Values and Philosophy: Washington DC, 2013), 85.

⁴⁸⁹ Learning to Live Together: Philosophy Day at UNESCO. Sourced from: <http://www.unesco.org/new/en/social-and-human-sciences/themes/most-programme/humanities-and-philosophy/philosophy-day-at-unesco/> [Accessed on 22nd November, 2017].

emphasised.⁴⁹⁰ In this regard, philosophy is able to put every aspect of the society related to science into proper perspective while ensuring that the integrity of science in its developmental course is not compromised by any overzealous predilection of any kind. In other words, philosophy or religion in right proportion does not constitute any threat to the progress and development of science. Historical evidences are replete in several literatures on this position as how they can be complementary partners rather than competitive rivals.⁴⁹¹

However, the immediate worry is to settle the question that arises as to how one measures or determine the proportion that is balanced, right and appropriate in such a manner that no aspect constitutes an unnecessary hindrance for the project of science. Could the idea of Ockham's razor be a relevant standard or criterion for striking a balance, to ascertain what may be right and appropriate? This question may be rather rhetorical but its inherent cautionary admonition can serve a heuristic purpose. After all, Popper's insistence on the importance of metaphysics contrary to the Logical Positivists may have some lessons for us. For as Morganti suggests, metaphysical ideas do play constructive role in science itself, at least in heuristically guiding it in the formulation of proper hypothesis and theories.⁴⁹²

As challenging as this worry may be, one legitimate means to deal with this challenge is to appeal to some historical lead as provided by Gaukroger's argument that religion played a significant role in the emergence of science as a cognitive standard during the enlightenment as it consolidated to become an intellectual practice as well as a cultural

⁴⁹⁰ P. Ikuenobe, 'Questioning as an Epistemic Process of Critical Thinking', *Educational Philosophy and Theory*, 33, 3/4 (2001), 325-341.

⁴⁹¹ K. Popper, *The myth of the framework: in defence of science and rationality* (London & new York: Routledge, 1994); T. Nickles, 'Philosophy of science and history of science', *Osiris: Constructing Knowledge in the History of science*, 10 (1995), 138-163; M. R. Matthews, *Science teaching: the role of history and philosophy of science* (London & New York: Routledge, 1994), 84.

⁴⁹² M. Morganti, *Combining science and metaphysics: contemporary physics, conceptual revision and common sense* (New York: Palgrave Macmillan, 2013)

product. Accordingly, religion provided some strong legitimacy credentials and impetus to the sustenance of the scientific revolution that blossomed in the West. This way, religion or philosophy was not so much of any significant obstruction as compared to the role of history in the way of the emerging science culture.⁴⁹³ In fact, many philosophers or experts in science were popularly known to have engaged in the business of natural philosophy that extended beyond the remit of natural philosophy. The contributions made by many of these experts over time cut across various subjects.⁴⁹⁴ As the word ‘scientist’ came later to be connected to Whewell whose use of it was derogatory in the Eighteenth Century.

It is with the foregoing sensitisation in mind that one can better appreciate Asouzu’s analysis of the African state of affairs that

... the very factors that hinder progress and growth, can at best be identified as by-products of a myth-founded metaphysics. Africa is renowned as a continent with lots of natural resources and manpower. Lack of metaphysical insight makes it impossible to understand the fundamental issues concerning the need to solve one’s problems with one’s resources. As long as one believes that solution can come per chance, through the application of magical wand (belief that a supernatural being should do everything, even as little as what humans can expectedly do for themselves as propagated and promoted in the many religious teachings embraced by many people in Nigeria) and through uncoordinated attempt at understanding what makes a good life and in what such a good life subsists, what makes a good government, why a good government is necessary, why there is need to improve one’s conditions and the need for concerted efforts to tackle such problems, Africa’s backwardness shall persist. Whenever the answers to these questions are superficial and are based systematically on recycled knowledge, the effect on the lives of individuals would always follow the nature of the answers given. My action follows what I know, hence my basic understanding about the world can determine my method of approach towards the world and even the type of result I envisage and in which I might be interested in my exploration of the world.⁴⁹⁵

The tone which underlies Asouzu’s remarks may sound quite pessimistic and really gloomy but it also bears the seed of challenge that a viable philosophical culture I

⁴⁹³ S. Gaukroger, *The emergence of a scientific culture: science and the shaping of modernity, 1210-1685* (Oxford: Oxford University Press, 2006), 3.

⁴⁹⁴ Gaukroger, *The collapse of mechanism and the rise of sensibility: science and the shaping of modernity, 1680- 1760* (Oxford: Oxford University Press, 2010)

⁴⁹⁵ Asouzu, *African metaphysics and challenges of science*, 130.

advocate in the thesis brings to the fore and can fruitfully be taken as fundamental in successfully tackling the challenges of development on the continent, one of which is, science development. The historical insights of Gaukroger based on Huff's comparative analysis of different cultures and how the culture of science can be supported or discouraged accordingly, do illustrate the value and role that philosophy for instance can play in the development of science in Nigeria. The highlights of the analysis identifies adversarial culture, institutional structures and a general atmosphere of neutral zones of free enquiry as key facilitators of the culture of science.⁴⁹⁶ In other words, the place of open critical engagement and free exchange of ideas; essentially, a philosophic ambience has a direct role to play in the encouragement or otherwise of science culture.

4. 4. 1 Relevance of History & Philosophy of Science in Science Education

Interestingly, there is a growing appreciation of the role of philosophy and history of science as fundamental to the teaching of science in a much more holistic manner. This has been demonstrated by scholars⁴⁹⁷ whose empirical researches show that the nature of science in the teaching of science influences positively the promotion of science culture. In such research projects, the centrality of the discipline of philosophy is not in contention.⁴⁹⁸ The appropriate attitude to science and science culture can be promoted within the context of a reformed approach to science where the two traditions, that is, Western modern science and an African knowledge tradition interact and dialogue. It is in this light that the hitherto overwhelming denigratory epistemic feature ought to be

⁴⁹⁶ Gaukroger, *The emergence of the scientific culture*, 32-34; Toby E. Huff, *The Rise of Early Modern Science: Islam, China and the West* 2nd ed., (Cambridge: Cambridge University Press, 2003).

⁴⁹⁷ M. R. Matthews, History, philosophy, and science teaching: the present rapprochement, *Science & Education*, 1, (1992), 11-47; *Science Teaching: the role of history and philosophy of science* (New York: Routledge, 1994).

⁴⁹⁸ M. L. Bentley & J. W. Garrison, 'The Role of Philosophy of Science teacher education', *Journal of Science Teacher Education*, 2, 3 (1991), 67. This has remained central in the interventions of Professor Hasok Chang's presentations. For instance, 'History and philosophy of science as a continuation of science by other means', *Science & Education* 8, 4 (1999), 413-425. In the paper, the Chang argues strongly that history and philosophy of science provide complementary intervention to what science does not do or do very well; a commitment and openness to liberal science education after the example of Conant's model in Harvard.

repealed and discouraged. The impact of this on the development and advancement of science in Nigeria can then be enormous. Amongst other things, the motivation to own, take responsibility and domesticate the culture of science on a large scale can be unleashed and society stands to benefit maximally from it. According to Adejumobi, in a knowledge driven world, a colonially moulded education which litters the entire continent of Africa can hardly help us take the driving seat in sciences/technology matters. Commenting further on the form and matter of education generally and science education in our context, Adejumobi argues;

it is a law and order educational system meant to serve specific form of political regime and society. Africa needs to reinvent its educational system towards a modern competitive age. Africa can start closing the gap with the right set of policies, out of which producing a skilled workforce comes a top priority. The education that Africa needs is one that is skills-based, scientifically/technologically grounded and globally competitive.⁴⁹⁹

Among many ways to actualising this new form of education will mean we begin to pay attention to how societies constantly revise and reinvigorate the system to serve particular purposes from time to time. It is one which also does not ignore the trend and practice in place in societies where science and science culture are well advanced. In these societies there seems to be a resurgence of interest in the promotion and revival of philosophical elements as constitutively important not only in the training of teachers but as crucial educational elements to encourage and inspire students interests in science, technology, engineering and mathematics (STEM) related subjects.⁵⁰⁰

⁴⁹⁹ S. Adejumobi, 'Rich getting richer, poor getting poorer? Africa's inequality struggle', Milena Veselinovic. May 12, 2015. Available online: <http://edition.cnn.com/2015/05/12/africa-inequality/index.html>. [Accessed 03/06/2015].

⁵⁰⁰ H. Siegel, *Educating Reason: Rationality, Critical Thinking and Education* (London: Routledge, 1988); H. Siegel, 'Philosophical questions underlying education for critical thinking', *Informal Logic*, 11, 2&3 (1985), 70-81; though quite old a published text, the relevance even in contemporary times was aptly defended in the terse text by J. L. Prevost, 'A Review of Educating Reason: Rationality, Critical Thinking and Education', *Educational Studies: A Journal of American Educational Studies Association* 50, 2 (2014), 187-191; M. Matthews, *Science teaching: the role of history and philosophy of science*, 5-7.

Science education, therefore, cannot afford to pay little or no attention to the developments and debates in the history and philosophy of science.⁵⁰¹ Two authors, worthy of note among others, Bentley and Garrison argue that values and assumptions as constitutively part of the nature of science and so they are fundamental to advancing science and science education. Disturbed by the falling interest in STEM courses as well as growing culture of anti-science, these scholars propose that there is the urgent need to introduce the history and philosophy of science to science education programme which can contribute to highlighting the values and assumptions that underpin science generally as interest triggering considerations.

They particularly argue that the teacher training perspective is critical in the effort to intervene on the nature of science as key aspect of the curriculum of any science education programme. With extensive empirical research, these scholars evaluated the science texts and instructional handbooks on science used in the teaching environment and found the near absence of this important component to science education. While these science texts were replete with inductive assumptions, passive and sketchy reference to tentative nature of theories, inductive reasoning and inference model which of course has some inherent problems; for example, fallacies/faulty logic, and confirmatory bias amongst others. These are in obvious total neglect of Popper, who in their view is an important figure in the project of understanding the problems of scientific method and the general attitude of scientific culture.⁵⁰² In other words, the nature of science or scientific knowledge which is often the subject matter of the history and philosophy of science is crucial in the learning and teaching of science. So, this is also important in the preparation of teachers who in turn have the responsibility to teach students and so, this becomes one of the many

⁵⁰¹ M. Matthews, 'Thomas Kuhn's impact on science education: what lessons can be learned?' *Science Education*, 88 (2004), 90-118.

⁵⁰² M. L. Bentley & J. W. Garrison, 'The role of philosophy of science in science teacher education', *Journal of Science Teacher Education* 2, 3 (1991), 67-71.

steps towards tackling the lacuna in many science texts used in the teaching of science and related subjects. What is obvious therefore is the critical role of teachers and the primacy of teaching science. As Chitpin cites Popper “I believe that teachers are duty bound to educate young people to think critically, so that they can make a contribution to the Open Society in the future”.⁵⁰³ Training in hypothetical deductive reasoning as espoused by Popper aids positively the advancement of science and scientific inquiry. In the empirical study, Popper’s hypothetical deductive model was vindicated as extremely important in the reasoning and scientific enquiry, even though many scientists may not be conscious of this. The reasoning skills of H-D among students and how science is taught contributes significantly to the project of scientific enquiry. Thus exposure to these skills contributes to advancing science and scientific enquiry.⁵⁰⁴

Drawing upon this idea of paying attention to the underlying epistemic values and other fundamental assumptions whilst we make effort to develop generally, Hountondji suggests the need for a change in approach different from what has been the case. In his words,

no problem will be truly settled in the field of development without the critical appropriation by the societies themselves of the whole available technological and scientific heritage. This will require a special effort by the societies in question to enrich the heritage themselves, in a way that enables them to bring about the connection with traditional knowledge and know how. This calls for a change of attitude, a new way of doing science.⁵⁰⁵

At another level, as fruitful as the adoption of the scientific method by other disciplines is, it can become counter-productive largely when we fail to recognise the peculiarities of the subject matters. However philosophy can rise to this occasion as Agbakoba reflecting on the nature of ideologies and empirical sciences extols Popper’s ideas thus,

⁵⁰³ S. Chitpin, *Popper’s approach to education: a cornerstone of teaching and learning* (New York: Routledge, 2016), 2.

⁵⁰⁴ A. E. Lawson, ‘What is the role of Induction and Deduction in Reasoning and Scientific Inquiry’, *Journal of Research in Science Teaching*, 46, 6 (2005), 737-738.

⁵⁰⁵ Hountondji, *Global knowledge*, 53-54.

“... epistemic and methodological assumptions and attitudes, such as the observations about the rationality of science displayed in what Popper describes as conjecture and refutations, provide a model of auto-correction that scholars can adopt and adapt in other forms of study. In addition, the tentativeness of scientific truths has led it to settle for incremental objective truths as in science”.⁵⁰⁶ On a similar note, Rowbottom and Aiston suggest that, “rather than remain fixated on the distinction between science and non-science, critical approach to every knowledge claim should be standard for any good inquiry”⁵⁰⁷ within educational research context. This will facilitate going beyond the limitation of what is science and what is not science. After all, the question of what is scientific about science is not a settled question. For as Popper argues, “thus in science as distinct from theology, a critical comparison of the competing theories, of the competing frameworks, is always possible. And the denial of this possibility is a mistake.”⁵⁰⁸

While Laudan considers this problem of demarcation to be rather uninteresting and capable of some judgmental evaluations for insisting to sort what is science and what is pseudo-science, philosophy can do well to better engage more fruitful and interesting exercises. However, in an interesting response to the foregoing, Pigliucci argues that in fact what makes philosophy interesting and a worthy and relevant discipline is its ability to engage in such tasks as this problematic in an attempt to sort out what is science and what is pseudo-science. In his contribution, the author defends the family resemblance Wittgensteinian model of science. Broadly assessed, the view of Pigliucci is not in any way opposed in this thesis as amongst other things, philosophy is being projected as an indispensable tool in sorting the science question in Nigeria.

⁵⁰⁶ J. C. A. Agbakoba, ‘Ideology, empirical sciences, and modern philosophical systems’, *Journal for the Study of Religions and Ideologies*, 10 (2005), 124.

⁵⁰⁷ D. P. Rowbottom & S. J. Aiston, ‘The myth of ‘scientific method’ in contemporary educational research’, *Journal of Philosophy of Education*, 40, 2 (2006), 137-156.

⁵⁰⁸ Popper, *Normal science and its dangers*, 57.

Again, deploying the linkage between epistemology and political thought of Popper as key to the science problem in Nigeria reiterate some aspects that Laudan's view seems to ignore but I consider as an important task of philosophy to tackle such a problem as the one under consideration. The overall contribution of the thesis that defends plurality instead of relativism or universalism as it suggests some notion of truth, the difference seems to be only in degrees rather than one of kind.

According to Kosso, what is common to the sciences is the basic structure of how they study and the standards they use to judge acceptable results which include a mix of observation, evidence, testing and logic. Induction does not tell the entire story of the scientific method. For instance, the key role of evidence may come after the idea is proposed rather than before', e.g., Kekule's intuition/hallucination.⁵⁰⁹ Again, disconfirmation seems so easy and so definitive only because we have ignored many of the important details; theoretical and practical of how the prediction was deduced and practical details of how the experiment was done. Filling these will show that disconfirmation of a hypothesis is no more decisive than confirmation.⁵¹⁰

One way in which philosophy is relevant to science and science education can be further grounded in the notion of critical rationalism as emphasised in Popper. It serves a purpose as an educational ideal especially in science education. On this note, once again the choice for Popper in this thesis is also made more poignant as Seigel argues that Kuhn's view of science and science education are antithetical or conflicts with the ideal of critical thinking".⁵¹¹ This is the case given Kuhn's insistence that sciences be taught as rhetorical conclusions; that is, for him, questioning assumptions of the framework within which one operates is not encouraged. It can therefore be conjectured that such a system of science

⁵⁰⁹ P. Kosso, *A summary of scientific method. Springer briefs in philosophy* (Dordrecht: Springer, 2011), 9-10.

⁵¹⁰ Kosso, *A Summary of scientific method*, 15.

⁵¹¹ H. Seigel, *Educating reason, rationality, critical thinking and education* (London: Routledge, 1988), 99.

education and model is rather totalitarian and dictatorial, a winner takes all kind of model which is never pluralistic.

While expressing reservation for both Kuhn and Popper, Rowbottom insists that the two main heavy weights when contrasted do present half truths about the problematic of science (criticism and the growth of knowledge) predicated on the nature and activity of the individual scientist and the disposition of the scientist in how he/she deals and relates with any theory for instance. This formed the basis upon which the idea of scientific practice was defined. However, at a group level with the task of attending to functional segments of the practice of science, these two positions do not do justice at all and through this shift from individual level to the group level, it is possible to resolve the dispute between Popper and Kuhn. Hence, their opposing views concerning criticism and dogmatism can in fact be resolved at the group level.⁵¹² This problematic debate remains so because of the role truth plays in Popper, one which, Kuhn rejects vehemently. In Popper, truth is transcendent and operates as ideal regulation for the community, whereas in Kuhn, truth is found within the paradigm, that is, immanent within the paradigm. These views seem to be two sides of looking at the same world.

4. 5 Transiting from a Universalistic to Pluralistic Approach of Science

To be able to resolve the crisis of science advancement in Nigeria demands an urgent need to decouple and interrogate the issues of power and knowledge broadly and the nature of the relationship between the two. To be more precise, the effort to advance science that comes with a baggage of Western approach pitched against a culture of knowledge indigenous in an African context and the power contradictions therein is not an easy task. For instance, the demarcation project as underlined by the contribution of

⁵¹² D. P. Rowbottom, 'Kuhn vs. Popper on criticism and dogmatism in science: a resolution at the group level', *Studies in History and Philosophy of Science*, 42 (2011), 117.

Popper taken up in this thesis sheds some light on the problem of knowledge and cultural differences in contemporary modern societies that have become largely multicultural.⁵¹³

As evident in the structure of this thesis, it is safe to argue that the history of the development of the culture of science is a story of demarcation and so, subtle notions of power cannot but underpin such practice. That is, the expedience of what is considered rational, what is to be taken seriously as certain, true, valid, and relevant knowledge and thus supported and promoted is one caught up within the matrix of power relations. While this summary seems to present a rather complicated discourse in a simplistic manner, there is no contention that the epistemological perspective of this long and chequered history of science has other important and interesting dimensions that include the cultural as well as the political. These aspects will receive substantial attention in the final chapter. For now suffice it to note as van Eijck & Roth confirm, “in postcolonial contexts, there has been an ongoing debate between proponents of universalism and multiculturalism in relation to science and science education”.⁵¹⁴

The question that has become a household familiarity is one that is not only important but critical and worthy of repeating here for the purpose of establishing clearly the central concern for this part of this thesis, “whose science/knowledge?”⁵¹⁵ The question properly understood and conceptualised is not to be seen as though science is a property of any person but the cultural context within which it is meant to advance necessitate the question, given the tension of knowledge tradition which has continued to militate against

⁵¹³ K. Abimbola, ‘Medicine and culture: transcultural needs in modern Western societies’, *AvMA Medical & Legal Journal* 13, 3 (2007), 112-117; Also, D. Gillies, The demarcation problem and alternative medicine, conference paper on the theme: *Karl Popper: Revision of his legacies*, La Coruna, Spain, 2003. Both papers emphasise the philosophical attitude we should adopt towards alternative medicine.

⁵¹⁴ M. van Eijck & R. Wolf-Michal, ‘Keeping the local local: recalibrating the status of science and traditional ecological knowledge (TEK) in education’, *Science Education*, 91 (2007): 926-947; Also, Cobern & Loving, *Defining “science” in a multicultural world: implications for science education*, 50-67.

⁵¹⁵ S. Harding, *Whose science? Whose knowledge?* (Ithaca: Cornell University Press, 1991); T. Okere too has shared some insights from the perspective of the African experience in his essay, ‘Is there one science, Western science?’ *Africa Development* 30, 3 (2005), 20-34.

its advancement in these societies, such as Nigeria. The status quo in terms of the character and identity of science as it has operated needs to undergo some transition which this segment of the chapter seeks to show and argue for. Ryan, is of the view that commonly held misconception of Western science as a body of rational universal truths has contributed to policy makers' and educators' lack of understanding of the social and cultural influences that surround the way human beings make meaning in their life experiences. Western science tends to see human beings as separate from the land, and to see the material world separate from the spiritual. In many ways, this has narrowed and fragmented Western perceptions of the world. Stories found in societies such Papua New Guinea and other non-Western societies contain no such fragmentation.⁵¹⁶ There is a direct relationship with nature and education is based around sacred rites and the oral transmission of rich multi-layered stories embedded in direct experience of the surrounding environment. This is such that at various levels to advance development, these experiences, practices, beliefs and traditions if not recognised and acknowledged accordingly, the successes of the developmental efforts may be greatly hampered.

The broad philosophical arguments in the foregoing seems to consist of the contentious relationship and debates between "absolutism (universalism) and relativism".⁵¹⁷ The former inherently excludes while the latter can be excessively permissive. In assessing the pragmatic movement, Thayer-Bacon comes very close to Popper's position in the evaluation of implications of fallibilism. She defines epistemological pluralism as the

⁵¹⁶ A. Ryan, 'Towards working in space between and both', *Cultural studies of science education*, 3 (2008), 700; Also, same author, 'Indigenous knowledge in the science curriculum: avoiding neo-colonialism', 663-702. Environmentalists also fond of making similar criticisms, yet a key part of modern Western science is the idea that human beings are just part of nature. So, the real issue is the agentive character often given to the understanding of nature is rather different from the kind of material character by which nature is generally construed within Western modern science.

⁵¹⁷ Two positions Popper tackles Kuhn on in the 1965 debate, see more, K. Popper, 'Normal science and its dangers', I. Lakatos & A. Musgrave (Eds.), *Criticisms and the growth of knowledge* (Cambridge: Cambridge University Press, 1976), 56.

belief in the impossibility of attaining knowledge that is universal.⁵¹⁸ Thayer-Bacon's commitment to fallibilism and pluralism has come under severe attack by McKenzie as rather inconsistent and somewhat contradictory on its own terms. McKenzie notes, "... to claim that it is impossible to attain knowledge that is universal, may as well run into trouble as 'No knowledge can be universal' seems itself to be a claim about knowledge that is universal".⁵¹⁹ This critique is clearly the application of logical technicality by McKenzie to undermine Thayer-Bacon's position. However, Thayer-Bacon's critical rejection of the view that exclusion and inclusion do not have necessary connection with truth of knowledge, except in terms of moral issues alone. No matter how contentious this may sound or seem, the insight remains highly instructive in negotiating with caution the thin line between 'relativism and pluralism'.⁵²⁰

I say this because, Thayer-Bacon later notes that naïve relativism is to be eschewed and in fact, replaced with 'restricted relativism'. Such a remark leaves one rather more confused as relativism remains what it is no matter the qualification one tries to give it. For Thayer-Bacon, naïve relativism (all contributions are equally valid) is to be replaced with 'qualified relativism (all contributions are fairly considered as possibilities).⁵²¹ To give it more context in relation to the knowledge situation in the African context. The overriding goal of the thesis is to suggest that ultimately the need for openness on the part of Western modern science in a non-Western context cannot be over emphasised. This is key if the epistemic outlook/attitude of Western modern science is not to be considered absolutist. In other words, it should not project a mono or single epistemic emphasis in

⁵¹⁸ B. Thayer-Bacon, J., *Fallibilism entails pluralism*, a paper presented at the Annual conference of the American Educational Studies Association, held in Vancouver, November 1-5, 4 (2000), 1-17.

⁵¹⁹ J. McKenzie, 'Barbara Thayer-Bacon on Knowers and the Known', *Educational Philosophy and Theory*, 34, 3 (2002), 308.

⁵²⁰ The immediate impression in the use of much contested terms of 'isms' may be confusing. The researcher takes note but uses them advisedly following Popper's disavowal over quarrelling over definitions or meanings as unnecessary. This however does not say one should not make effort to be precise, clear and simple. The terms are used to connote the nature of epistemologies in educational context of science learning and teaching.

⁵²¹ Thayer-Bacon, *Fallibilism entails pluralism*, 13.

respect of our understanding of the truth/reality. For an absolutist outlook suggests that only one approach alone and it alone exhaust the possibility of truth or access to reality.

On the other hand, a relativistic position suggests the idea of many equally valid truths of knowledge forms. A view point this thesis has consistently insisted it does not subscribe to; rather, it supports and defends a pluralistic approach. It is an approach that tends to be in the middle of these two extreme positions of absolutism and relativism, as can be gleaned from the philosophy of Popper. Marglin succinctly argues,

... to be successful, diffused and transplanted, they must be decoupled from their negative political and cultural entailments. This is seldom if ever done, probably because of the widespread perception that more efficacious technique reflect superior forms of knowledge. This superior knowledge must supplant older, backward, obsolete forms of knowledge. Forms of knowledge are not graded on an evolutionary inclined plane with the Western sciences at the upper end and the non-Western forms spread on the lower end.⁵²²

According to Ryan, it is this taken-for-granted authority that ought to be challenged by developing “hospitality of mind” that sees beyond the story telling practices commonly adopted by Western science educators and that reflects a desire for ‘one true story’. This practice has not been seriously challenged over the years and has continued to drive Western scientific endeavour in non-Western societies.⁵²³ This notion of hospitality of the mind seems closely related to Popper’s emphasis on epistemic virtue of humility akin to the Socratic view on knowledge and ignorance. Thus, in keeping with Popper’s reservations for relativism, this thesis insists that relativism is epistemologically suspect as it is capable of compounding the entire engagement of an African knowledge tradition with the Western modern science in the quest for science advancement in Nigeria. The

⁵²² F. A. Marglin, Small pox in two systems of knowledge, in F. A. Marglin & S. A. Marglin (Eds.), *Dominating Knowledge: Development, Culture and Resistance* (Oxford: University of Oxford University Press, 1990), 141.

⁵²³ A. Ryan, ‘Indigenous knowledge in the Science Curriculum: Avoiding neo-colonialism’, *Cultural Studies of Science*, 3 (2008), 680.

bucket theory of the mind⁵²⁴ is at the root of cultural relativism and the connections of these thoughts with postmodernist's inclinations are obvious. As it is known, Popper rejects this position because it denies any objectivity as it reduces everything to the context of the framework from which all knowledge feeds in through the senses alone. In Popper's evolutionary account, while using an amoeba and Einstein, he insists there is an inborn disposition of expectation through which the mechanism of trial and error form a basis of our knowledge, learning from our adaptive mistakes or errors to a problem situation and the accompanying modification. While referring to the influence of the bucket theory of the mind, Davies argues that Feyerabend adopted its attitude, Kuhn inadvertently endorsed the potentials with his theory of incommensurability.⁵²⁵

Applying the proviso of Popper, that is, holding an epistemic claim which does not lay claim to possess truth in an exclusive fashion or more precisely, held as a tentative claim, open to be challenged through tests and other means therefore, the thesis can sidestep this problem of relativism without any damage really. To my mind, this Popper's position can be arguably shown to be evident in Thayer-Bacon's work but perhaps not readily admitted by her. This is evident when we closely evaluate what she writes, "our standards need to be continually questioned and this can only happen at a deep level, re-examining foundational background assumptions, if we allow in outsiders' perspectives ... for in the disagreement and disharmony come the situation of more awareness and growth, and the chances of improving our selected interests".⁵²⁶ One is then surprised why Thayer-Bacon still subscribes to what she terms, 'qualified relativism', when Popper's idea of tentative epistemic outlook which underpins fallibilism is reasonably safe to deal with the problem at hand. As Ben argues, "even when we reject relativism we should allow some life. At

⁵²⁴ K. Popper, *Objective knowledge: an evolutionary approach* (Oxford: Clarendon Press, 1978), 60-61. Popper uses the analogy of the empty bucket into which the senses provide the ultimate means through all knowledge come to us. Another term he uses for it is the *tabula rasa* theory of the mind.

⁵²⁵ B. E. Davies, *Why beliefs matter* (Oxford: Oxford University Press, 2010), 68.

⁵²⁶ Thayer-Bacon, *Fallibilism entails pluralism*, 12.

its best, this spirit is one of intellectual humility and moral toleration”.⁵²⁷ Continuing he writes,

it is good to see that one’s own way of doing things may not be the only proper way, and good (at least sometimes) to cultivate toleration towards those who do things differently. Equally important, however, is to see that none of this entails moral relativism. You can be fallibilist about the best way to lead your life- that is, you accept that your moral judgments may be mistaken- without being remotely relativistic about morality. The distinction is subtle but crucial for our purpose.⁵²⁸

The view of Benn though a reflection in ethics or moral theory seems to have insights of global applications when issues of epistemic validity and truth claims are in contention. In fact, its semblance with the epistemic formula, “I might be wrong, you might be right” of Popper is also illuminating for the present purpose. It is well grounded that Popper is of the view that science does not rest on rock solid foundation is a position entailed by fallibilism.⁵²⁹ With this, we arrive at a hypothetical position that assumes that once we are able to broaden our understanding of Popper’s thought as I advocate herein, it is not difficult to connect with the call for Western modern science to be open to the potentials and possibilities of the background knowledge tradition within which it strives to advance. It is with such an attitude and outlook that there can be the possibility of transition from a mono-universalistic position to one that is pluralistic and thus more accommodative and ready to engage and dialogue with the ‘other’.

4. 6 Knowledge Traditions in a Handshake: From Rhetoric to Praxis of Dialogue

The aspiration to engage these knowledge traditions in the context of dialogue has a lot of challenges similar to the proverbial adage of dancing on ice. How to engage in the

⁵²⁷ P. Benn, ‘Ethics’, in John Shand (ed.), *Fundamentals of Philosophy* (London & New York: Routledge, 2003), 97. (94-121)

⁵²⁸ Ben, *Ethics*, 97-98. What comes out clearly in Benn’s analysis is the distinction between multiculturalism which necessarily entails relativism, absolutism which is to be eschewed for a pluralistic position that is neither relativistic or makes universalistic claim that is inherently absolutistic.

⁵²⁹ K. Popper, *The logic of scientific discovery* (London: Routledge Classic Edition, 2002), 94.

praxis of dialogue without falling into the very crisis that necessitates the worry in the first place is key, and at this juncture, needs further elaboration. Given that the discussion thus far has been basically to argue against epistemic domination, the crucial point to clarify is why dialogue is the more appropriate model compared to integration which has some potential appeal as well as the practical issues associated with the model chosen. Of course, it is the case that the nature of interaction between these knowledge traditions can take various forms. While there may be other models of interaction, these two identified seem popular in the literatures and so worth highlighting in this thesis. There can be integration wherein the identity of one is eclipsed by the domineering knowledge tradition on the one hand. While in the dialogic form of relationship, the preferred option defended in this thesis, the various knowledge traditions retain their individual identities while engaging in this sort of interaction even though there are undeniably changes that can possibly occur but happens in both ways none the less.

Reviewing the huge literature on the renewed interest in indigenous knowledge in relation to Western science on development, Agrawal argues that the logic of discussion appear to be contradictory as it is unhelpful for any genuine practical dialogue and its relevance for science development. In his view, the effort to sift the various important elements of this knowledge tradition runs afoul of its initial vision and goal; most especially, when it fails to recognise the strong connection between power and knowledge in the discourse of science and development. This is so evident thus,

the neo-indigenistas undermine their own arguments, almost unconsciously, because of their desire to hold on to the dichotomy between indigenous/scientific, and traditional/Western; and because they are unwilling to recognise the intimate links between knowledge and power. Their attempt to classify, therefore fails to rise above the structures of knowledge that it initially condemns, and ultimately seeks to transcend. It remains mired in the rhetoric of documentation and storage, management and dissemination, centralisation and bureaucratisation; it ultimately authorises science and method, dooming itself to a perpetual state remaining, simply, a desire. Non-recognition of the relationship between knowledge and power blinkers them to the fact that their own strategy of locating the knowledge

of indigenous peoples is centralised, international archives would only reproduce the control which elites exercise over scientific knowledge.⁵³⁰

In defending the view expressed above, Agrawal strongly contends that attention must be given to both the epistemology as well as the political dimension of the debates between the dichotomy between science and indigenous knowledge. Agrawal further argues that there is need to

recognise the multiplicity of logics and practices that underlie the creation and maintenance of different knowledges. For it is only when we move away from the sterile dichotomy between indigenous and Western, when we begin to seek out bridges across the constructed chasm between the traditional and the scientific, that we will initiate a productive dialogue to safeguard the interest of those who are disadvantaged.⁵³¹

The argument here makes two important points; while knowledge is power, there must also be an acknowledgement of how power/politics produces knowledge as well, that is, power is knowledge. The latter, is a crucial point the neo-indigenistas do not seem to pay any attention in the analysis of how to appropriate and preserve these knowledge forms which of course presupposes certain relationships of power and control.⁵³²

Therefore, the model of dialogue envisaged in this thesis comes with its own challenges as it is explicitly dicey and delicate but worthwhile given the urgency of attending to the problem of science in Nigeria. For instance, in the UK's context, Taber discusses the sensitivity of the dialogue model proposed and defended in this thesis. Taber reports that Professor Reiss, Director of Education of the Royal Academy of Science in 2008 resigned as a result of the outrage caused by his recommendations that teachers should explore the dialogue option in a science classroom. This was based on the fact on increasing number of pupils from other cultural contexts in British schools. For Reiss, the dialogue option was important because the teaching of science as rhetorical conclusions does not provide

⁵³⁰ A. Agrawal, 'Dismantling the divide between indigenous and scientific Knowledge', *Development and Change*, 26 (1995), 430-431.

⁵³¹ Agrawal, *Dismantling the divide between indigenous and scientific knowledge*, 433.

⁵³² The term *neo-indigenista* as used by Agrawal describes the new advocates of indigenous knowledge system in science and development discourses. The term as employed is for convenience's sake in his essay, whose project though set out to achieve the goal of dialogue but advanced the integrative model instead.

opportunities to demonstrate the weaknesses or faulty nature of the background commitments of teachers or learners who may hold creationist or intelligent design account as against the evolutionary worldview. Professor Michael Reiss, an avowed advocate of evolution and an accomplished science educator, was pressured to step down from his role as the director of education, because as Taber confirms, ‘the learner’s worldview, i.e. religious commitments, for instance, need to be considered in the science classroom, but the impression given by the action and response of the Royal Academy of Science that any suggestion that teachers enter into dialogue about the learner’s background beliefs for rejecting or questioning evolution was unacceptable and anathema’. The dangers of not keeping science open in the teaching and learning context give an unintended authoritarian outlook to science with huge consequences for the kind of epistemic emphasis of the dialogue model here defended.⁵³³

The ideas of dialogue have theoretical as well as practical relevance. Thus, there have been some efforts to put into practice these ideas and ideals of Popper. For instance, Mcnamara attempts the application of some aspects of Popper’s thought to education in the UK.⁵³⁴ Also, some pragmatic relevance of Popper’s thoughts have been explored in the operation of a school system called *Sir Karl Popper Schul* in Vienna.⁵³⁵ More recently, Chitpin adopts the objective knowledge growth framework in Popper as an empowering

⁵³³ K. S. Taber, ‘The relationship between science and religion- a contentious and complex issue facing science education’, B. Akpan (ed.), *Science Education: A Global Perspective* (Abuja: Next Generation Education Ltd, 2013), 42.

⁵³⁴ D. R. Mcnamara, Sir Karl Popper and education, *British Journal of Educational Studies* 26, 1 (1976), 24-39.

⁵³⁵ Such experiment has also been attempted in other climes and cultures. For example, C. M. Lam’s work set in the Asian-Confucian context, *Childhood, Philosophy and Open Society: Implications for Education in Confucian Heritage cultures*, (Dordrecht: Springer, 2013) the work explores the sociological, pedagogical, epistemological implications of Popper’s themes in the promotion of critical thinking in children by the growing interest in philosophy for children projects and programmes.

model of education capable of outdoing and outperforming the inductive model of education which is popular within the Canadian educational system.⁵³⁶

In a number of empirical researches that assess the practical challenges of science learning and teaching in Africa, there have been attempts to demonstrate that the knowledge of science in any African society must pay attention to the cultural beliefs and values cherished by the people. These works acknowledge that there are two worldviews in an African setting, the Western science worldview and the traditional African worldview. The latter includes; teacher's background, cultural beliefs and values which impact significantly on the transfer of science knowledge in the classroom setting. With reference to traditional cultural beliefs on sex roles, for example reveals that in most African societies, teachers reflect the body of beliefs which are problematic for the culture of science as these influence teachers' primary tasks of teaching in many ways.⁵³⁷ An example is the cultural default perception and encouragement of the boy-child over the girl-child to pursue STEM related careers which accounts for the gender gap issues in science related career with society and thereby short changing itself by this sort of practice.

Every effort to grow Western modern science in such a context will have to engage with these values and not merely dismiss them with a wave of the hand or to declare them as superstitious. Such an attitude is not only ignorant but arrogant. For Shumba, the cosmological authoritarian feature of traditional beliefs where elders are respected, and never questioned, does not encourage critical rationality important in the task of engaging in abstract problem solving roles. So, for instance, questions are hardly asked by students

⁵³⁶ S. Chitpin, *Popper's approach to education: A cornerstone of teaching and learning* (New York: Routledge, 2016). In the book, the education system in Ontario, Canada was the context of the assessment but the message and relevance goes beyond the contextual location.

⁵³⁷ A. Ekine, 'Enhancing girls' participation in science in Nigeria: a drive for national development and social equality', Working Paper from the 2013 Echidna Global Scholars edited by X. Ackerman & N. A. Abay Brookings Center for Universal Education.

who prefer to remain passive, more so that prodding is considered as an act of impertinence. No wonder then, 'tradition' in form of, 'so the ancestors did it' is order of the day. Such educational situation does not help the culture of science as strongly argued in this thesis. This state of affairs aptly describes the tendencies of a closed society, or system of knowledge that Popper will challenge for want of flair, creativity and imaginative deployment of the intellect. Another example I find in Shumba which depicts what happens in many communities in Africa is during a time of crisis, the people whether educated or not resort to traditional beliefs and practices acquired from their indigenous culture.⁵³⁸

In such context therefore, dialogue rather than integration option is pertinent or an imperative as Shumba argues, worldviews must be taken seriously if science education in an African setting is to improve by concluding that, "what we have to think of, therefore, is much more of a symbiosis between the scientific subculture and the other subcultures with which it is surrounded and with which it interacts, rather than any sort of conquest of the other cultures by a kind of universal church or a culture of science".⁵³⁹ What is obvious from the various examples therefore is the undying or continuing presence of these values, despite the onslaught they suffer under the reign of a dominating model of epistemology of science.

This aspiration is a sort of radical and evolutionary consideration for the state of science in an African setting. Rightly then, Etounga-Maguella thinks that education is one area in which revolution akin to the scientific revolution is to occur. For a scientific approach to be encouraged demands that aspects of religious and some traditional institutions that perpetrate anachronism, totalitarianism and authoritarianism be consciously worked upon

⁵³⁸ O. Shumba, 'Relationship between secondary science teachers' orientation to traditional culture and beliefs concerning instructional ideology', *Journal of Research in Science Teaching*, 36, 3 (1999), 333.

⁵³⁹ Boulding (1970) cited in Shumba, *Relationship between secondary science teachers*, 334.

in ways that acknowledges them, but engages them in some sort of conversational exchange that reveal and inspire inner momentum for change. An example is found in the popular African novel by Chinua Achebe titled, 'Things fall apart', where the stage for the end of human sacrifice was to happen with the violence that accompanied it without the unnecessary tension that arose from the forced tension between African traditional values and the Christian modern values represented by the colonial system in South Eastern Nigeria.⁵⁴⁰ Curriculum then is to be modified should not only emphasise science but necessary changes of some African societal values. There is need to imbibe a rigorous approach to issues otherwise the change will not come, which brings about growing from within.⁵⁴¹

As noted earlier, Western science is undeniably relevant in furnishing us with significant aspects of reality, it does not exhaust all of what reality is.⁵⁴² Following the fallibilist argument, both knowledge traditions should be critically engaged in a dialogical/conversational affair since evidences of efforts to advance science show clearly the nullity of the view that the abandonment of traditionally held views is a necessary precondition for the embrace of the spirit/culture of Western science. Thus, Popper's analysis of tradition or what generally can be regarded as background knowledge is critical to our efforts to advance science. After all, Popper views scientific theories as not just the results of observation. They are, in the main, the products of myth-making and of tests.⁵⁴³ In fact, Shumba argues that the culture deficit model with its value judgment

⁵⁴⁰ This is an essential understanding of the importance and place of tradition in Popper's philosophy. See more, Popper's chapter, 'Towards a rational theory of tradition', Cf., *Conjectures and refutations*, 128. Importance of tradition in science but not one to be unchallenged, uncriticised and unexamined.

⁵⁴¹ D. Etounga-Manguelle, 'Does Africa need a cultural adjustment programme?' L. E. Harrison & S. P. Huntington (Eds.), *Culture matters: how values shape human progress*. (New York: Basic Books, 2000), 76-77.

⁵⁴² Popper maintains that the world in which we live is extremely complex, Cf. *Conjectures and refutations*, 129. Popper also emphasises that our knowledge of this complex world with infinite richness and beauty is never final and full, See more, *Conjectures and refutations*, 194.

⁵⁴³ Popper, *Conjectures and refutations*, 50, 128. Also, Popper's view that ideas emerge in a dialectical context, represented by his schema, PP-TT-EE-P2 suggests the idea of dialogical exchanges that is emphasised in the thesis. See more, *Objective knowledge; an evolutionary approach*, 297.

is at the base of science curriculum and education in many developing countries in Africa. For him, this remains the bane of science advancement in these societies. Shumba further adds,

... assuming the business of science education is to support rather than supplant cultural thought and belief patterns demonstrates a serious negation as well as undervaluation of cultural thought. And this undervaluation of local knowledge and thought may be what has been so wrong with science education in the developing non-Western countries (in Africa) so far.⁵⁴⁴

The understanding of dialogue advanced in this thesis does not encourage any attempt to supplant but one quite supportive to what is already contained in the background knowledge of the people. It is both mutually enriching and interdependent. An exploration of this notion is one we can easily relate with is evident in even Gadamer. In fact, this understanding of dialogue in Gadamer already has some semblance with Popper's thoughts as outlined in the earlier part of this chapter. As Nielsen argues, "Gadamer's philosophical hermeneutics and dialogical model of understanding demands the constant/persistent questioning of the self which acknowledges both the ontological and epistemological limitation through which the self and the other can co-create new language willingly and openly".⁵⁴⁵ Thus, Waldron advocates that "the Popperian position must surely be that we proceed in a tentative spirit".⁵⁴⁶ There is no question that this epistemic acknowledgment on the part of the self in relation to the other re-echoes the imperative basis of cooperation and collaboration as consequences of some of the epistemological dimension as well as some practical lessons about the viability and potentials of Popper's thought; especially, the dialogical programme it can engender between two apparently different traditions of knowledge in question.

⁵⁴⁴ O. Shumba, 'Critically interrogating the rationality of Western science vis-à-vis scientific literacy in non-Western developed countries', *Zambezia*, XXVI, 1 (1999), 56.

⁵⁴⁵ C. Nielsen, 'Hearing the other's voice: how Gadamer's fusion of horizons and open ended understanding respects the other and puts oneself in question', *Otherness: Essays and Studies*, 4, 1 (2013).

⁵⁴⁶ Waldron, *Tribalism and the myth of the framework*, 226.

What comes out clearly therefore is the need for change in attitude as an important epistemic virtue in the scientific project, one adopted in relation to the external world; whether optimistic or pessimistic as it relates to whether the world is able to yield its secrets. The role of religious and cultural orientation in this regard has been well documented by Hogson.⁵⁴⁷ Analysing the thesis of Hodgson, Njoku states, ‘African traditional religion promotes the attitude of worship/reverence of deity, a *noumena* to be kept at arm’s length, the superstitious tendencies of such an attitude have far reaching implications for the kind of epistemic attitude of the people’.⁵⁴⁸ To develop scientifically, there must also be the right attitude of discipline, hard work and others to accompany the view so defended above, the lack of these make remote the possibility to advance science in Nigeria.

One cannot lose focus with one of the basic presupposition of this thesis, which is, the view that the cultural context of the learning and knowing in the different traditions do play some role in the question science in Nigeria. The effort to then advance Western modern science in Nigeria cannot but pay close attention to the background assumption. In this regard, the emphasis on tradition and its importance to advancing science by Popper cannot be over emphasised. As a way of reiterating the assumption, Diederich’s remarks that the problem of scientific knowledge demands paying attention to cultural differences. What we are to encourage is a symbiotic connection between culture and learning/education. Accordingly, the core of any cultural tradition is its methods of educating the young⁵⁴⁹ considered as such, culture is then seen as configurations of

⁵⁴⁷ P. Hogson, *Early Religions and the Rise of Christianity* (Oxford: Oxford: Corpus Christi College, 1995), 2.

⁵⁴⁸ F. O. C. Njoku, “Introduction”, *The Complementarity of Philosophy, Christianity and Science* (1-14), Proceedings of International Symposium held at Claretian Institute of Philosophy, Nekede 13-15th March, 2000.

⁵⁴⁹ R. Diederich, ‘How not to explain the great divide’, *Social Science Information: Theory and Methods*, 40, 3 (2001), 399-400.

theories of learning and cultural differences is accounted for on the basis of the prevailing (meta) theory of learning.⁵⁵⁰

The nature of the knowledge tradition peculiar to Africa has generated interesting reactions and responses that this chapter will not rehash since the previous chapter on African intellectual culture seems quite comprehensive enough, but worth acknowledging however is a particular trajectory some scholars defend in an attempt to showing that ancient Egyptian heritage suffices as adequate justification that indeed, Africa and Africans are indeed not lacking in many areas as many authors would have us believe. As valuable as these intellectual efforts⁵⁵¹ are, apart from the controversies around the perspective, the move, to my mind, amounts to grandstanding. Interestingly, Hallen and Wiredu argue that there is a paradox (to hold such and defend such a position). How to reconcile the grandiose claims made about these heritages as reflective of the whole African heritage and at the same time how we account for a situation whereby in spite of the historical achievements of ancient culture of Egypt, many societies in Africa remain largely deficient science and technology-wise comparatively with indices characterising of the Westerners, at the point of encounter with Europeans during the rise the colonial empires and afterwards.⁵⁵² Thus, while not underestimating the project and intellectual efforts along that line pursued by scholars representative of Afrocentric reconstruction of ancient history, culture and civilisation, this present work focuses rather on the experience and situation of the problem of science in Nigeria (sub-Saharan Africa). The thesis is of the view that the Afrocentric trajectory acknowledged above does not help the case at hand; especially, considered to be enriching a perspective to be able to resolve the

⁵⁵⁰ Diederich, *How not to explain the great divide*, 401.

⁵⁵¹ For example as addressed in the piece by B. Murfin, 'African science, African and African-American scientists and the school science curriculum', *School Science and Mathematics*, 94, 2 (1994), 96-103. Also, M. K. Ashante, *Kemet, Afrocentricity and Knowledge* (Trenton: African World Press Inc., 1990). And of course, many other similar works with the same goal and project.

⁵⁵² B. Hallen & K. Wiredu, *Science and African Culture*. Available Online: http://www.princeton.edu/hos/workshop%2011%20papers/Hallen_Wiredu.doc.pdf. [Accessed 11 July 2015].

problematic paradox noted by Wiredu and Hallen. The challenge to resolve the paradox of science question is one this present thesis responds with the philosophical insights of Karl Popper who problematize it epistemologically as well as politically in a way that is exciting and profound.

Apparently, to avoid any ambiguity, one fundamental area this thesis contributes to the body of knowledge is how it delicately navigates between the two poles; that is, between the orthodox universalist epistemology of Western science on one hand and the alternative epistemologies of pluralist voices on the other hand, with relativistic pit underneath. The position of the thesis is that Popper's philosophy is relevant and appropriate towards ensuring one does not fall into the epistemological pit by insisting that the dialogical imperative arises from the realisation that indeed both poles need to epistemically readjust their attitude/outlook with respect to claims of possession of truth. This is done as precondition to engage in some conversation on the basis of a tentative rather than discordant claims of validity/truth as equally viable scientific frameworks. Truth as used here serves a transcendent, meta-regulative role. This suggests that no one pole or tradition possesses truth since its notion of truth serves as the ideal, beyond, towards which, all perspectives aim/aspire towards (as they only approximates the truth; a crucial and salient point in Popper's thought).⁵⁵³ For as Mcnamara writes,

we must accept Popper's notion of rationality for what it is, which is not a clear linguistic definition of what constitutes rationality. One of the mottoes at the beginning of the Open Society is a quotation from Burke which in part reads: 'I have never yet seen any plan which has not been mended by the observations of those who were much inferior in understanding to the person who took the lead in business.' It is in this spirit that Popper's idea of rationality must be considered.⁵⁵⁴

Rod lends his support to this hermeneutics of critical rationalism and fallibilism as the balanced and well-rounded account of the lynchpin of Popper's philosophy without which

⁵⁵³ Popper, *Conjectures and refutations*, 30, 191.

⁵⁵⁴ Mcnamara, *Sir Karl Popper and education*, 31.

Popper's thought is rendered sterile.⁵⁵⁵ Loving presents a practical concern about this recommendation in a classroom context by querying how both established as alternative frameworks can be served in the classroom? In response to the challenge, Loving states - will a day be set aside for the teaching of indigenous science? Or is it the case that every topic that is universally discussed be presented from all the perspective of the different cultures represented in the room?⁵⁵⁶ Commenting further and specifically on the epistemic claims made by indigenous traditions as evidence of science, to be of equal valid status too, Loving is of the view that, these practices are explainable in common sense. Many lack deep theoretical and systematic understanding or generalisability for why and how the world might work but the excessively narrow definition of science often portrayed in the classroom do a great disservice to the successful teaching of science as a way of knowing. But this misinformation can be traced to poorly prepared teachers who are aphilosophical and ahistorical as this does not come from the universalistic commitment. However, eliminating this unrealistic portrayal of science is essential, by substituting one that acknowledges the diversity within every aspect of the scientific community and captures the dynamic and interpretative nature.⁵⁵⁷ In the teaching of science, the preponderance of inductive reasoning with confirmation bias and inherent tendencies of errors that characterise the science practicals and instructions do not make for a critical assessment of scientific methodology and its problematic nature.⁵⁵⁸

Despite the flaws of falsificationism of Popper, its application in the science classroom bears more positive fruits than the presumptuous applicability of inductive logic. Against this backdrop, Bentley and Garrison argue, "Popper first fully recognised the

⁵⁵⁵ T. Rod, 'What is the relevance of Karl Popper's critical rationalism to management studies and practices?' *Philosophy of Management*, 9, 1 (2010), 5.

⁵⁵⁶ C. C. Loving, 'Comment on "multiculturalism, universalism, and science education"', *Science Education*, 79, 3 (1995), 345-347.

⁵⁵⁷ Loving, *Comment on multiculturalism*, 347.

⁵⁵⁸ M. L. Bentley & J. W. Garrison, 'The role of philosophy of science in science teacher education', *Journal of Science Teacher Education*, 2, 3 (1991), 68-69.

intractability of the problem of induction and rejected verificationism ... There is neither a psychological nor a logical induction. Only the falsity of the theory can be inferred from empirical evidence and this inference is a purely deductive one".⁵⁵⁹ The heuristic here is that the logical rule of *Modus Tollens* is obeyed and it is valid compared to the fallacy of affirming the consequent that inductive reasoning necessarily subscribes to. A summary of Popper's thoughts show in effect that all reasoning is either deductive or defective and that the growth of science consists of a continuing series of conjectures and refutations. There is no more rational procedure than the method of trial and error – of conjecture and refutation; of boldly proposing theories; of trying our best to show that these are erroneous; and of accepting them tentatively if our critical efforts are unsuccessful. The method of conjectures and refutations provides a firm logical foundation for the growth of science⁵⁶⁰ as posited by these two scholars. The views championed and reflected by these experts in the field of science education have direct relevance to the state of science and science teaching in Nigeria.

Bindir observes that the overall nature of education in Nigeria has retained the colonial vision which was purely directed at literacy. Thus, there remains a gap between the popular knowledge that characterises the culture on the one hand and science on the other. This gap must be closed through the documentation and formalisation of these knowledge forms. In addition to mainstreaming such into the science curriculum, they are to be adapted, utilised and taught too. For through this, science will be demystified using existing culture. In some sense, the inculturation of science within the cultural situation can bring about the needed change and whole hearted embrace. As there are lots of opportunities on the traditional side, especially in bridging the gap between our education system and reality. By this, we can make advancement in science, technology and

⁵⁵⁹ Bentley & Garrison, *The role of philosophy of science*, 69.

⁵⁶⁰ Bentley & Garrison, *The role of philosophy of science*.

innovation.⁵⁶¹ To give an example, in colonial Africa, the term ‘native doctor’ was reserved for the so-called ‘juju doctor’. However this has to change as source of knowledge claims may have useful benefits for some of the challenges we face in the world today.⁵⁶²

Conservative estimates suggest that local communities around the world at one time used about 10% of all flowering plants on earth as medicine. Only 1% has been investigated and recognised by modern scientists. The use of medicinal plants for the treatment of common ailments is essentially good. It is a far cry from unsubstantiated claims to cure every disease. There are many who hold the point of view that African healing methods are deliberately concealed by the African, not to protect them from public profanity but as a result of a mixture of fear of and lack of confidence in intruding investigations. In African traditional medicine, there are three chief characters. One person may combine all three or two; a. herbalist b. the spiritualist c. the priest. All three are found in all communities-rural and urban. Folk medicine practitioners recognise the existence of spirits, powers (good and evil); they make use of animals and claim to cast spells on people or remove them – a process known as conjuring. It is my view that African traditional medicine man/woman has a role in the treatment of some psychiatric disorders.⁵⁶³ Given the practical relevance and prevalence of these epistemic traditions, for instance, it will be a great disservice to the body of knowledge to continue to propagate an epistemology of science that is not attentive and sensitive to the epistemic as well as socio-political dimensions of these issues while efforts are being made to grow and deepen the culture of Western modern science in an African context.

⁵⁶¹ U. Bindir, ‘Why Graduates are Unemployable’, November 1, 2014. Sourced: International Centre for Investigative Reporting. Available Online: icirnigeria.org. [Accessed on 29/04/2015].

⁵⁶² A. A. Otu, ‘Surgery in Africa’, 2004 Inaugural Lecture. University of Calabar, June 24, (Professor of Surgery, Honorary Consultant Surgeon/Immunologist).

⁵⁶³ Otu, *Surgery in Africa*.

4. 7 Chapter Summary and Conclusion

The chapter elaborates further on details of the model of dialogue of knowledge traditions. The conditions for the possibility of dialogical exchange identified and analysed. It outlined significantly the broader picture of science generally that will emerge from opening up our conception of science from a one-sided perspective/universalistic to a pluralistic perspective with its emphasis on openness and other accompanying epistemic virtues we draw from Popper. In the process, some of the challenges were identified as regards the pragmatic/practical implementation or application of the proviso of Popper's thought in the science education context in Nigeria. Hence, the place of philosophy as an indispensable ally in the promotion of science consciousness was reiterated. In doing that, several imperialistic tendencies of positivism, dogmatic and authoritarian intellectual culture which are also promoted by a religiously conscious society are to be consistently interrogated by the help of discipline of philosophy among many others. Along this line, the resurgence of interests in philosophy and history of science in the practice of science education was revisited as an important starting point to promote a culture of education that is capable of facilitating the entrenchment of germane values upon which societal development and the advancement of science can be predicated.

In opting for a pluralistic view away from the universalistic approach currently in place, the dynamics of power versus knowledge relations are also highlighted. The delicate terrain within which such contestation of the popularly held view reveals the very nature and consequences of any view that give relativistic impressions were briefly assessed as well. Thus, a defence of Popper, a fallibilist perspective⁵⁶⁴ which is neither absolutistic nor relativistic but factual about the human condition that encourages tentativeness of our epistemic claims and the imperative of openness to criticism was canvassed. This

⁵⁶⁴ Popper, *Conjectures and refutations*, 16.

Popper's position marked out by epistemic values of persistent critical appraisal and openness to possibility of error, amongst others, is elevated and signposted as a more appropriate feature, by which, the effort and drive to transform, change and advance science in the Nigerian context can begin to yield concrete positive fruits. This, in my view, is the appropriate African approach or an African philosophy of science that can enervate the militating conditions for the ownership and help the inculturation of science and science culture within an African (Nigerian) context. Through this, the thesis hopes that science is not only able to advance in Nigeria but its image can generally be enriched, an image and identity of a genuinely global science, on which the next and last chapter will focus.

5.0 Envisioning an Open, Decolonised, Truly Global and Eclectic Science Project for Authentic and Holistic Development

5.1 Introduction

According to Teich,

The adaptation to tangible contemporary scientific-technical advances by ‘primitives’ testifies to lasting legacy of the fundamental transformation of the mode of pursuing natural knowledge, both theoretical and practical, between the middle of the 16th and the close of the 17th centuries. The much maligned scientific revolution remains a useful beast of historical burden.⁵⁶⁵

No doubt, such viewpoint highlights the fundamental context within which the epistemology and politics of demarcatory project is founded. Interestingly, Bala and George argue that the attempt to appeal to a distinguishing feature commenced almost immediately at the very dawn of the emergence of the scientific revolution.⁵⁶⁶ For example, Andresen argues,

the Baconian or mechanistic strain of Western scientific inquiry undergirded the scientific side of European expansion, and certain characteristics of this mind-set rendered colonial Europeans generally unreceptive to non-Western ways of knowing/thinking about the natural world, a situation still common today among many scientists and development specialists.⁵⁶⁷

In such societies as Nigeria, the question of science is therefore critical and must be consistently revisited following the revolutionary contributions of Southern perspective of science and technology studies that benefit immensely from the early contributions of scholars like Joseph Needham and others who sought to underscore the developmental trajectory of science and technology in these societies.⁵⁶⁸ Hence, the central concern of

⁵⁶⁵ M. Teich, *The Scientific revolution revisited* (Cambridge: Open Books Publishers, 2015), 7.

⁵⁶⁶ A. Bala & G. J. George, ‘Indigenous knowledge and Western science: the possibility of dialogue’, *Race & Class* 49, 1 (2007), 39-61: 42. The work goes ahead to examine two levels of demarcation problem; that is, the traditional and the emergent model which arose so as to avoid inadvertently the promotion or support of bioprospecting and epistemic exploitation that the traditional model of demarcation often glosses over, based on the interventions of global institutions in the preservation of cultural diversity and issues of sustainable development.

⁵⁶⁷ J. Andresen, ‘Review article: Science and Technology in non-Western Cultures’, *Zygon* 34, 2 (1999), 345-352: 348.

⁵⁶⁸ Joseph Needham et al are champions of the emerging perspectives in society, science and technology studies in non-Western societies. Sandra Harding has devoted quite a huge amount of interest and

this thesis, is, therefore, well-conceived within a growing body of science and technology literatures, to develop the African perspective which has largely been lacking and virtually absent in the discourses.

Once, the hitherto knowledge legitimising authority was overthrown, understandably, the scientific tradition needed to provide the standard and measures by which the anxieties of people were to be addressed and soothed.⁵⁶⁹ This however over time as a result of a combination of factors became an important aspect of the expanding world such that when it came in contact with the other cultures, the basis of understanding was already created in what Mignolo calls “the colonial epistemic difference”. According to Mignolo, this colonial epistemic difference,

Presupposes a locus of enunciation that controls knowledge and posits itself as the norm, there is need to create the difference. Since the sixteenth century, that difference was bestowed upon non-European population against which Europe built itself as Europe and the rest of world as the fuzzy domain of people with questionable faith and reasoning.⁵⁷⁰

Such, is the very problematic even in contemporary times that, this thesis, contends in order to argue for a feasible and harmonious incarnation of the culture of Western modern science in a non-Western society as Nigeria.

It is against such intellectual bulwarks and essentialism that this chapter attempts to bring to a close the intervention and reflections on the problem of science advancement in an African context, by contesting such hubris and epistemic arrogance which ignore its epistemic self-limitation as well as error proneness of knowledge claims of science with the help of Popper’s philosophy. Within such conceptualisation, the thesis argues that there are lessons for the model of science to be promoted as we seek to understand the

documented elaborate studies on these schools of thought in philosophy of science. See more, S. Harding, *The Postcolonial Science and Technology Reader* (Durham: Duke University Press, 2011).

⁵⁶⁹ H. Luaer, ‘Cause and effect between knowledge traditions: analysing statements that address the regression of science and technology in Ghana’, *Transactions of the Historical Society of Ghana* 8 (2004), 261-262.

⁵⁷⁰ W. Mignolo, The advent of black thinkers and the limits of continental philosophy. In A. Afolayan & T. Falola (Eds.), *The Palgrave handbook of African philosophy* (New York: Palgrave Macmillan, 2017), 292.

advancement of knowledge in an African context. Thus, Popper's thoughts are set against the backdrop of the defining role of science within a very broad setting of the question of human rationality and its cultural impact within and beyond the West. Such a project raises concerns that bothers not only on the theories of knowledge but also practical questions (politics) of issues connected to science policy, and the teaching of science in non-Western societies are necessarily connected.⁵⁷¹

To reiterate two basic and focal points of my thesis; a). Tell an African story of science (science and the challenge of its advancement in Nigeria) with Popper as guide. By that, show that, Popper is more important than have been popularised of him and his philosophy. In other words, this thesis demonstrates that there is more to Popper than the falsificationism/falsifiability principle alone tells of his entire philosophy⁵⁷² and b). Show that the epistemological aspect of the problem of science advancement is an important dimension, often ignored, but, receives attention in Popper along the political dimension of the story of science often implicated and discussed as exhaustively responsible for the poor state of science in Nigeria. With these two objectives, the place of science in Nigeria is directly investigated, the global image of science is critiqued and argumentative demands for a dialogic approach, one which is more inclusive, participative, and more truly global become the basis upon science advancement in non-Western societies especially can best be predicated.⁵⁷³

The idea of positivistic science is summarised by the classical Baconian cliché of knowledge is power, and of course, the power dynamics that is entailed therein. What is

⁵⁷¹ Y. Elkana, A programmatic attempt at an anthropology of knowledge. In E. Mendelsohn & Y. Elkana (Eds.), *Sciences and cultures: anthropological and historical studies of the sciences* (Dordrecht: D. Reidel Publishing Company, 1981), 1-76: 27.

⁵⁷² A. Chalmers and others for instance reduce Popper's thought to falsificationism alone. See more, *What is this thing called science?* 3rd ed. (Queensland: Queensland University Press, 1999), especially chapters five and seven.

⁵⁷³ A. R. Choudhuri, 'Practising Western science outside the West: personal observations on the Indian scene', *Social Studies of Science* 15, 3 (1985), 475-505.

considered knowledge is one made after the image and conforms to the standard of positivistic science, hence, worth funding and enjoys societal support too. The evidence of this is manifest in the challenges of disciplinary marginalisation faced by subjects in humanities in many societies today. In fact, this has also created the methodological crisis for many of these subjects as the adoption of the methodological trappings of science, taken to be the linchpin for the successes in science is gradually becoming the order of the day and demands of relevance made of these disciplines with the tacit standards of functionality underpinned by what science delivers. Here, the cautionary intervention by Haack as observed earlier in this thesis on the marks of scientism, is, therefore, re-echoed. The intellectual background is steep in the historical emergence of a legitimating authority of what is considered knowledge that the science tradition embodies. For instance, we are familiar with the onslaught against metaphysics by the proponents of Logical Positivism which also sits quite well with the general programme of the unity of the sciences as elaborated upon by Comte and others and their continuing influence in one form or the other in what some may regard as “disciplinary imperialism” today.⁵⁷⁴

Against the foregoing, the urgent question that needs to be clarified to give complete background to the focus of this present and final chapter, is to show the extent to which these issues relate or connect to the African context of science under consideration. Of course, there is no question as regards the role and place of positivistic science in the affairs of the Western world in relation to the non-Western societies as it is well documented.⁵⁷⁵ In fact, it has become the yardstick of modernism and all it entails for

⁵⁷⁴ U. Maki, A. Walsh & M. F. Pinto (Eds.), *Scientific imperialism: exploring the boundaries of interdisciplinarity* (Oxford & New York: Routledge, 2018).

⁵⁷⁵ M. Adas, ‘Colonialism and science’, in H. Selin (Ed.), *Encyclopaedia of the history of science, technology, and medicine in non-Western cultures* (Dordrecht, Boston & London: Kluwer academic Publishers, 1997), 215-220; B. Zaheer, *The science of empire: scientific knowledge, civilisation and colonial rule in India* (Albany: State University of New York Press, 1996); P. Kusiak, ‘Instrumentalised rationality, cross-cultural mediators, civil epistemologies of late colonialism’, *Social Studies of Science* 40, 6 (2010), 871-902; G. Basalla, ‘The spread of Western science: a three-stage model describes the introduction of modern science into any non-European nation’, *Science*, 156 (1967), 611-622.

various civilisations and cultures around the world. In relation to Africa and Africans, their cultures and civilisation, the significance of positivistic science as epitomising human rationality, every other is adjudged depending on how well such a people or civilisation measures up to the standard so set/defined by Western modernism.

As counter movement and extreme response, postmodernism can be viewed as set to undermine the monolithic assumptions, certainties, truth of modernism. Hence the views of Kuhn and Feyerabend boldly interpreted to have relativistic implications are therefore sidestepped for the task of the project underway in this thesis, Popper's philosophy is read and conceptualised to be consistent with transmodernism which avoids the pitfalls of the two earlier positions as argued in this thesis. Analysing the kind of response generated in societies directly affected by the colonial experiment, some scholars are quick to depend on postcolonial thinkers as providing formidable intellectual platforms to engage the monolithic view of reason and rationality epitomised by science within those societies.⁵⁷⁶ In a rather unique manner, however, the position of this thesis is in sync with the decolonial thinking that the "post" – of the colonial, seems to be a myth, reason been that it is yet to be over; after all, coloniality remains under theorised in many respects. Here, Popper's political and epistemological interventions can help resolve the problematic of science I argue is in need of decolonisation. In this regard, I agree with Falola that "our task is not to reject modernity but to disentangle it from domination. Ritual archives offer us the possibilities of creating knowledge that can become integrated into the process of that entanglement".⁵⁷⁷

I have shown that Popper's interventions on a number of these issues of domination and others have been central in this thesis. And so, the various chapters of this thesis were

⁵⁷⁶ A. B. Schultz, *Holmes, Alice, and Ezeulu: Western rationality in the context of British colonialism and Western rationality*. MA Thesis submitted to the Faculty of Brigham Young University, 2007.

⁵⁷⁷ T. Falola, Ritual archives. In A. Afolayan & T. Falola (Eds.), *The Palgrave handbook of African philosophy* (New York: Palgrave Macmillan, 2017), 714.

therefore, articulated and developed to demonstrate the connectedness of these issues and the prospects of Popper's philosophy towards developing a new approach, an African perspective that can enrich science, philosophy of science and the science situation in Nigeria. The overall goal remains a commitment to plurality that can serve the cause of epistemic justice broadly.

5.2 The Project of Decolonial Critique of Science

The merit of this type of thesis is not enhanced if conceived as a deliberate attack of science. That is, conceived to contest or challenge the many positive values of Western modern science to humanity. Rather, as it has been made clear, in the preceding chapters, this thesis is domiciled within a body of philosophical conversation with science and its culture; that is, the history, philosophy and anthropology of science, or, more precisely, science studies with a view of articulating an African perspective. After all, the interest to understand and account for the failure of science advancement in Nigeria is itself an obvious endorsement of science. The contention however, has been that the nature of science as popularised by Western modernity needs to be assessed in the context within which it has continued to fail to advance and evince the needed embrace and ownership by the people on a significant scale.

It is important to reiterate that, this thesis sits with existing philosophical literatures in science critique rather than with works in anti-science research.⁵⁷⁸ This clarification is made for a cautious reason. Bell precisely insists that such a salient distinction be underlined in this type of work because ignoring such may cause the sort of misrepresentation which generated and fuelled the much discussed science wars. A debate that basically divided scholars broadly into two main camps; pro-science and anti-science groupings. It is important to therefore state that the issues raised in this thesis do not fall

⁵⁷⁸ D. Bell, *Science, technology and culture* (Maidenhead: Open University Press, 2006), 117.

into any of the warring camps of the science debate. The thesis is not an exercise within the frame of the science wars debate. It is, in fact, one that acknowledges the credibility and eternal relevance of modern science but queries the historical with cultural baggage with which it is promoted and popularised and the role it plays, as the capstone of rationality for instance, in non-Western societies, Africa especially. Also, it is important to note that the philosophical model articulated in the thesis transcends the epistemological limitations responsible for the dissipated intellectual energies that characterised the science war debate. The basis of this claim is substantiated by the reading of Popper's philosophy to be continuous with the decolonial project in a fashion that the modernist-postmodernist tension is safely avoided through the elevation of a dialogical-transmodern model as defended in this thesis.

In fact, Popper's philosophy deployed to assess the problem of science advancement in an African context (Nigeria) is itself an acknowledgment of science, which, he regards quite rightly as one of the most outstanding evidence of human ingenuity. The philosophy of Popper, when well conceptualised is capable of standing in the middle of the different knowledge traditions, has potentials to vitiate the tension between different knowledge traditions especially its capacity to bring about conversation. And so, it is able to provide the rational bridge for the dialogue of knowledge traditions upon which the advancement of science in Nigeria can be negotiated. Importantly too, the idea of the dialogue of knowledge tradition is not one that gives credence to the conformist agenda which underlies the integrative position that appears popular in the literatures that have attempted to examine science development outside the West.⁵⁷⁹

The new model of philosophy of science advanced in this thesis has a number of advantages. For instance, the problematic challenge of intellectual property and its

⁵⁷⁹ J. Kahiga, 'The relevance of Karl Popper's philosophy to African renaissance', paper presented at the Karl Popper's Centenary Congress held in Vienna, July 2002.

predatory tendencies when used in non-Western contexts can easily be dissolved, compared to the other model wherein this crisis is rather heightened.⁵⁸⁰

As was well demonstrated, one important highlight of the thesis is the dialogical model of science project by which the advancement of science is predicated in a non-Western society such as Nigeria as highlighted in the previous chapter. This idea of dialogue is facilitated by an acknowledgment that,

... standards of objective truth and criticism may teach him to try again and to think again, to challenge his own conclusions to apply the method of trial and error in every field and thus may teach him how to learn from his mistakes, and how to search for them may help him to discover how little he knows, and how much there is he does not know may help him to grow in knowledge, and also to realize that he is growing may help him to become aware of the fact that he owes his growth to other people's criticisms, and that reasonableness is readiness to listen to criticisms.⁵⁸¹

This notion of openness to the other emphasised in Popper cited in the foregoing is again reiterated in Abdi's view that,

... it is through an inclusive and epistemically polycentric approach that the space for indigenous knowledge in postcolonial contexts could be elevated. That would undoubtedly engender the emergence of indigenous epistemes and epistemological platforms that enhance, not only the overall quality of the pedagogical and instructional endeavours, but as well, the psycho-cultural and existential relationships African learners would have with their schooling contexts.⁵⁸²

⁵⁸⁰ The integration model is defended in M. Shahidullah, 'Science and Technology development in the Third world: competing policy perspectives', *Knowledge, Technology & Policy* 3, 1 (1990), 3-20. When we compare this integrationist view with the views of others who opine for a different model as a result of the new relationship with indigenous knowledge hitherto categorised as myths or superstitions but now demarcated from science and pseudo-science, then the grounds for the model defended in this thesis begin to come to fore. See more, Bala & George, 'Indigenous knowledge and Western science', 39. For insights on intellectual property rights issues as it relates to local and diverse knowledge systems, see, I. Mgbeoji, *Global biopiracy: patents, plants and indigenous knowledge* (Ithaca, New York: Cornell University Press, 2006); C. Oguamanam, 'Local knowledge as trapped knowledge: intellectual property, culture, power and politics', *Journal of Intellectual Property* 11, 1 (2008), 29-57.

⁵⁸¹ K. Popper, *Conjectures & Refutations*, 384; K. Popper, *Objective Knowledge*, 265. While in *The Myth of the Framework*, 100, Popper describes our knowledge situation as both impressively vast knowledge but also boundless ignorance, the growth of knowledge is partly dependent on the tension and clash between these two, influencing its advancement. An acknowledgement that is a precursor to a well-disposed knowledge tradition.

⁵⁸² A. Aldi, 'African philosophies of education: deconstructing the colonial and reconstructing the indigenous', *Counterpoints*, 379 (Indigenous philosophies and critical education: a reader), (2011), 80-91: 89.

For there would be no philosophical basis of pluralism or pluriversal commitment capable of inclusion once the dialogical model is diminished in the face of the adoption of modernist/universalist or integrative model which excludes and privileges one over the other, as it is the case, just now.⁵⁸³

Among the prerequisites for this model to work, is, first and foremost, is, the imperative of openness on the part of both knowledge traditions to the realities of their epistemic character and status. Intellectual humility follows directly from the commitment to reason, from the realisation that we are not omniscient, we are fallible but we can learn from our mistakes, experiences and that we owe most of our knowledge to others.⁵⁸⁴ To this end, therefore, is the urgency of developing a decolonised and open science, a point that clearly horns the expediency of the decolonial task, Popper's thoughts in this regard cannot be overemphasised. That is, to render an account of science that is open, truly global, decolonised and eclectic both in form and content.

5.3 Popper, Positivist Science and 'Philosophy as Metaphysics'

As shown in chapter three of this thesis, Popper's appropriation of Reichenbard's distinction between the context of discovery and the context of justification underscores his remarkable role to reposition metaphysics as philosophy. This, Popper contended with the Logical Positivist movement and defended the relevance of "philosophy as metaphysics to the project of science".⁵⁸⁵ Here, the understanding is to re-emphasise

⁵⁸³ D. Turnbull, 'Rationality, objectivity, and method', in H. Seline (Ed.), *Encyclopaedia of the History of science, technology, and medicine in non-Western cultures* (Dordrecht/ Boston/London: Kluwer Academic Publishers, 1997), 845-850.

⁵⁸⁴ K. Popper, *Conjectures & refutations*, 356, 363; R. Corvi, *An introduction to the thoughts of Karl Popper*, Trans. by Robert Camiller (New York & London: Routledge, 1997), 146-7.

⁵⁸⁵ This point is well researched and defended by a number of scholars. For instance, an old but relevant book defends the view that philosophy of science is the missing link between science and philosophy. See more, P. Frank, *Philosophy of science: the link between science and philosophy* (Connecticut: Greenwood Press, 1974). Recently, a comprehensive assessment of the nature of metaphysical issues in relation to the workings and practice of science consistent with Popper's outlook against the positivist/linguistic or analytic tradition of conceptualising science is given by, C. Dilworth, *The metaphysics of science: an account of modern science in terms of principles, laws and theories*, 2nd Edition (Dordrecht: Springer, 2007).

again clearly the role and relevance of philosophy in general and metaphysics particularly as respectable intellectual disciplines in their own right both in society and to science. Such disciplinary respectability is at the heart of Haack's assessment of scientism and calls for caution and care to avoid it as much as possible given its rather unconscious pervasiveness in contemporary scholarship.⁵⁸⁶ According to Fuller, positivism developed in ways that it not only provides the platform for the adoption of logic and observation as defining features of reliable and valid knowledge, it became the standard by which every other aspect to be taken seriously is to conform to it. It goes beyond epistemology to other areas; politics, society in general.⁵⁸⁷

According to Popper, the dogmatic attitude is clearly related to the tendency to verify our laws by seeking to apply them and to confirm them, even to the point of neglecting refutations, whereas, the critical attitude is one of, readiness to change them- to test them; to refute them; to falsify them if possible.⁵⁸⁸ Recall, it was this predisposition that led Popper to challenge the scientific claim of the theories of Freudian psychology, Astrology, Marxian theory of history and Adlerian individual psychology. Against this backdrop, worldviews, received ideas are to be consistently questioned, interrogated through deliberate and conscious support of the critical attitude Popper advocates, so as to ensure orthodoxies of various forms (epistemological and political) do not constitute a barrier to the growth and development of the society.⁵⁸⁹ For instance, the place of religious institutions and teachings that do prominently influence affairs in Nigeria is

⁵⁸⁶ S. Haack, 'Six signs of scientism', *Logos & Episteme* 3, 1 (2012), 75-95.

⁵⁸⁷ S. Fuller, 'Science studies through looking glass: intellectual itinerary', Ullica Segerstrale (ed.), *Beyond the science wars: the missing discourse about science and society* (Albany: State University of New York Press, 2000), 185-206: 187.

⁵⁸⁸ Popper, *Conjectures & Refutations*, 50.

⁵⁸⁹ A text that discusses theories of Western rationality manifested through uncontested concepts, theories and assumptions relate to this aspect of the thesis and has important lessons for the thesis but looks specifically at the received scientific convictions of modernity in their ability or otherwise to modern day challenges has important message and insights for a society such as Nigeria that seeks to evaluate all of the society from an excessively religio-metaphysical dimension or emphasis. See more, P. Chabal, *The end of conceit: Western rationality after Postcolonialism* (London: Zed Books, 2012).

illustrative of the kind overwhelming beliefs system. In such a situation, the natural is seldom disaggregated from the supernatural by the kind of attention basic issues and challenges are understood and explained. Even issues of the mundane, social and political or economic type are hardly divorced from the supernatural realm. It forms a fundament by which people in society approach and relate to life. Following Popper such should be consistently engaged and critically challenged. In that way, people and society can be saved from claims or beliefs of a dangerous kind. I try to qualify such an outlook as excessive and warn about it having in mind Popper's attitude to metaphysics. Popper notes that while some metaphysical ideas have obstructed the advance of science there have been others which have aided it.⁵⁹⁰ And even from a psychological point of view, Popper argues, "I am inclined to think that scientific discovery is impossible without faith in ideas which are of a purely speculative kind, and sometimes even quite hazy; a faith which is completely unwarranted from the point of view of science, and which, to that extent, is metaphysical".⁵⁹¹ The connection I draw is by no means a synonymous use of metaphysics and religion.⁵⁹² The role of philosophy in this regard cannot be over emphasised.

The thesis provides a new hermeneutics of Popper relevant to African context of science as well as one that gives breadth to how his philosophy can be better appreciated than has been the case. By this, the story of science development in Africa is well rounded and better positioned within the larger intellectual context of knowledge and power relations, one, which the quest to advance science in Nigeria cannot but pay peculiar attention. And so, transforming science in societies where it is not well advanced makes this project more pressing as this thesis has sought to demonstrate through an African reading of Popper's

⁵⁹⁰ Popper, *Logic of scientific discovery*, 16.

⁵⁹¹ Popper, *Logic of scientific discovery*, 16.

⁵⁹² In chapters four and five, I attempted to provide some insights as to the nature of the two distinct but related important concepts especially as they apply within the African context.

philosophy and how this sheds more light on the overall characterisation of reason and rationality by science within a very broad cultural and intellectual context between the West and Africa.

My view of the possibility of a much more open, decolonised, global, and eclectic science is based on Popper's ideas; for instance, his notion of truth or verisimilitude as it relates to any knowledge tradition or claim possessing the entirety of truth in an exclusive fashion and the extent to which this relates to the dialogical model defended in this thesis; a nuanced explication, continuous with the Dussell's decolonial transmodern vision of knowledge.⁵⁹³ This pluriversal/pluralistic image of science can engender ownership and evince the embrace by people properly enervated to develop science enthusiastically as well as other areas of the society accordingly. Science thus conceived, following Popper remains an ongoing task with the dynamic character of perpetual search for truth. Such an understanding keeps it progressing towards greater appreciation of what reality is. In pursuing this task, science is therefore, challenged to remain perpetually open to possibilities of change and advancement both at the global and local (Nigerian) level. This, in my view, is the way to go, if truly science is genuinely open not only to its epistemic self but to the possibilities of the epistemic other.

A state of affairs Laccarino vividly captures,

In developing countries, science education is based on Western concepts and culture, and it is taught those for whom science is often unrelated to their culture. This leads students to deny the validity and authority of knowledge transmitted to them by their parents and creates tension in several societies.⁵⁹⁴

⁵⁹³ This proposal is consistent with Popper's call for suspicion of those who claim to be in possession of absolute truth and have mandate and authority to teach truth to all others. The unreserved criticism of all forms of dogmatism that can promote and accommodate totalitarian tendencies are replete in most of Popper's political reflections. It is important to remark that even though this is utopian, it is a project worth pursuing which sees as the accomplishment of the unfinished project of decoloniality. That is, a state of affairs in which multiplicity of critical perspectives against and beyond eurocentred modernity, from the various epistemic locations of the colonised people of the world. See more, R. Grosfoguel, 'Towards a decolonial transmodern pluriversalism', *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World* 1, 3 (2012), 97-98.

⁵⁹⁴ M. Laccarino, 'Science and culture', *Embo Reports* 4, 3 (2003), 220-223:222.

What is apparent in such conceptualisation involve deep epistemological, institutional as well as political dimensions. Segal gives a more practical example through his reflection on the state of science and technology in the Muslim world. He argues that,

... these incremental and pragmatic measures must still confront a hostile environment. For science again to flourish in Muslim countries (Nigeria has a huge population of adherents of Islam and in fact, controversially a member of the Organisation of Islamic Countries) requires a recognition that it requires long term continuities, the lessening of authoritarianism, and a serious effort to reconcile faith and reason.⁵⁹⁵

Popper's thoughts properly understood, in the manner advanced in this thesis, seem adequately sufficient in tackling not only the political dimension but the epistemological dimension often ignored in the accounts so identified. In fact, the epistemological dimension of the problem of science underlies the political or other aspects in resolving the challenge of development in Africa.⁵⁹⁶ This view is also reinforced by Fergusson's adumbration of the fundamental role of reason (or idea/institutions/epistemology)⁵⁹⁷ towards the transformation of any society and civilisation. This is subtle but often a pointer to the fundamental role that epistemology can play. Gellner writing on the link Popper observed between the secret of science and the secret of a free society argues that,

The precondition of a free society is successful science. This is so in virtue of a simple argument: without genuine science- no powerful technology, without powerful technology no affluence, economic growth, and without those, no open society. Industrial scientific social organisation is the precondition of freedom. It

⁵⁹⁵ A. Segal, 'Why does Muslim world lag in science?' *The Middle East Quarterly* 3, 2 (1996), 61-70: 69.

⁵⁹⁶ T. Pogge, London School of Economics, 'LSE Africa Summit 2016: Africa within a global context; Challenging Conventions', 22 April, 2016. Available online: <https://m.youtube.com/watch?v=DJe3grMmbR8> [Accessed 20/07/2016]. In his presentation while responding to questions, Pogge makes the poignant assertion that the fundamental problem about the crisis of development and leadership in Africa is the epistemological challenge of knowledge. I agree with the position of Pogge about the epistemological basis of the many challenges in Africa. I think it on this account that Taiwo's 2017 TEDGlobal talk on the title, 'Why Africa must become a center of knowledge again'. In the talk, Taiwo claims Africa does not have food or water crises amongst others as it is often claimed, rather, it is rather the crisis of knowledge, which he calls, 'Africa's knowledge imperative'. O. Taiwo, Why Africa must become a center of knowledge again. TEDGlobal 2017. Source from: https://www.ted.com/talks/oluf_mi_taiwo_why_africa_must_become_a_center_of_knowledge_again [Accessed on 23/02/2018].

⁵⁹⁷ Here, the role of academic societies and academies are immediate examples of institutions that are crucial to knowledge development and advancement.

is certainly not a sufficient condition of freedom, but is unquestionably a necessary condition.⁵⁹⁸

In this formulation, the relationship in Popper's epistemological as well as political intervention is reemphasised.

5.4 On the Politics of Reason: Science and the Enlightenment Campaign

There is no question that one of the presuppositions of colonialism in Africa was the basic characterisation that reason was lacking and therefore the social order was in need of redemptive intervention; hence, the mission to civilise! Interestingly, Trigg in his classic work, "Beyond matter: why science needs metaphysics", provides analysis of the relationship between science and reason. A strong relationship conceptualised to have played an overwhelming role in the early centuries of the enlightenment era and beyond.⁵⁹⁹ No wonder, Maxwell argues, that, the enlightenment programme had a regime of reason that was more of a tyranny than one that accommodated plurality of ways of life, values and ideas.⁶⁰⁰ It thus created a society that was not open and in fact, more of a closed society. However, when we approach Popper, we notice a view of rationality that requires plurality of ideas, values and ways of life. An understanding of rationality that can be relied upon to revisit the intellectual attitude towards a people's capacity to be able to engage in philosophy as well as produce and generate values upon which society can grow and develop. Gyekye makes a fine and basic distinction between "having intellectual capacity" and "the impulse to exercise that capacity on a sustainable basis" to yield appropriate results on the other. The latter according to Gyekye was not often promoted as would have made for advancement and fine tuning of tools and skills in

⁵⁹⁸ E. Gellner, 'Karl Popper: the thinker and the man', *Poznan Studies in the Philosophy of the Sciences and the Humanities*, 49 (1996), 75-85: 79.

⁵⁹⁹ R. Trigg, *Beyond matter; why science needs metaphysics* (West Conshohocken, PA: Templeton Press, 2015).

⁶⁰⁰ N. Maxwell, 'The Enlightenment programme and Karl Popper', I. Jarvie *et al* (Eds.), *Karl Popper: A centenary assessment, Life, Times, and Values in a world of facts*. (London: College Publications, paperback editions, 2015), 177-190: 179.

traditional African setting.⁶⁰¹ To however equate the two or ignore such a distinction is disingenuous as it is egregious. (Probing deeply as emphasised by Gyekye as absent since probing deeply meant that one is likely to see the ghost as curiosity in that context kills the cat instead of inspiring innovation and the likes. Here again, the three evils of supernaturalism, anachronism, and authoritarianism highlighted as notable challenges within the African context by Wiredu and others come to mind. For instance, the lack of encouraging questioning values, the dominance of religious authority in an excessively fashion. So, the obvious lack of the teaching of philosophy and its impact for education and pedagogy are examples of the near absence of the impulse to exercise the intellectual capacity on a sustained and ongoing level).

The assessment of the development of thought in view of showing what is true from what is not in cultures undertaken by Barnes provides some illumination on the value of Gyekye's distinction and it worth pointing out because of its affinity with the understanding of Popper pursued in this thesis. Barnes argues that, truth and error delineation is central to both scientifically minded as well as religiously minded cultures and has a pattern akin to the Piagetan individual psychology child development.⁶⁰² Barnes further states that in every culture there have undoubtedly been many innovators whose ideas and methods of thought galloped far in front of their times. But if the culture does not have the language and social structure publicly to support ideas of a new level of complexity or sophistication, then the thinking of the innovators will likely go unnoticed, be rejected, or revised into simplicity.⁶⁰³ In a related development, Barnes further claims

⁶⁰¹ K. Gyekye, 'Philosophy, Culture and technology in the Postcolonial', Emmanuel C. Eze (Ed.), *Postcolonial African Philosophy: A Critical Reader* (Cambridge, Massachusetts: Blackwell Publishers, 1997), 30.

⁶⁰² M. H. Barnes, *Stages of thought: the co-evolution of religious thought and science* (Oxford: University of Oxford University Press, 2000), 3. The work focused on the question of truth claims within science and religion only. What Piaget did with individual's cognitive developmental stages, Barnes draw a corollary with the cultural sphere.

⁶⁰³ Barnes, *Stages of thought*, 18.

that on the empirical-critical culture which shows the self-reflective reflexive awareness of knowledge is conditional and tentative as all knowledge because it is human must be consistently subjected to constant test and scrutiny. This is highly Popperian in the sense that the fundamental character of the subject of knowledge is not above error. And so this realisation comes with the cautionary exercise of being open to being corrected and the possibilities that the other offers. Also, the fact that there is element of rationality beyond the Western tradition in traditional thought of indigenous peoples and in the intellectual capabilities of the people in their relations among themselves as well as the environment.⁶⁰⁴

With philosophy of Popper, these epistemic presuppositions can be re-engaged fruitfully. For instance, the notion of rationality as used in Popper's philosophy is not one that assumes the absence or lack of capacity to engage the "other" critically in any knowledge situation. In fact, claims of knowledge possession are characteristically optimistic and cautious as far as Popper is concerned. The extent to which the "other" may be right as he or she is not only capable of producing knowledge that is worthwhile but also possesses what it takes to show the limits of one's epistemic claims. This is assured by being perpetually ready to thoroughly criticise and be criticised. That is, mutual criticism, engaging and listening to the other as well. Hence, the authoritarian or dogmatic disposition of any epistemology that lays claim to absolute possible knowledge or in possession of truth exclusively, for Popper, is not only dubious but dangerous and this should be eschewed. As it is in epistemology so it is in politics.⁶⁰⁵

⁶⁰⁴ Barnes, *Stages of thought*, 27, 28.

⁶⁰⁵ The radical changes of the fundamental questions in both epistemology and politics by Popper make obvious this position. For instance, the traditional questions of 'what is the main source of knowledge?', 'who should rule?' to 'how can we avoid error?', and 'how can we so organise political institutions that bad or incompetent rulers can be prevented from doing too much damage?' *The Open Society and its enemies*, Vol. I, 121; *Conjectures & Refutations* (London: Routledge, 4th edition revised, 1978), 25.

Its relevance to the knowledge tradition in Africa is its capacity to promote profound curiosity often not supported by practices of the people. Popper's proviso has the capacity to transform the cliché in the African context that, "curiosity kills the cat", to one, where, "curiosity supports innovation and scientific enterprises".⁶⁰⁶ To fully appreciate the role that the philosophy of Popper can play in revisiting some of the epistemic presuppositions of Western thought, Amato makes the argument which captures the intellectual mood in question and it is worth quoting elaborately. Amato argues,

Classical enlightenment thinkers saw modernism as the denial of their own and others' condition of life and circumstances in the interest of achieving rationality, at a time when reason took on the overtones of sciences that had not even been established or methodologically articulated. Yet, in the hope of achieving a standpoint from which the universal and scientific truth might appear, they cut themselves off from the lifeline of human cultural experience, not recognising that they themselves would thus also be cut off from what had inspired many of them. Because in its attempt to be more scientific and universal, Western thought had only become more incestuous and homogenous, the central tenets of enlightenment were to become dogmas of enlightenment, which associated intellectual progress and human advance with the economic regime and the scientific and political programme of European colonialism and imperialism. As the enduring legacy of this idea of modernism, it has been difficult for scholars educated in the traditions of Western philosophy to easily recognise that cultural productions and forms of thought from beyond its self-imposed boundaries can be legitimately philosophical, rational, or even modern, in an important sense.⁶⁰⁷

The point being made is similar to Falola's view that,

Together, capitalism and coloniality have imposed a knowledge divide. The core represents the centre of power, where universal ideas are generated. The peripheries are colonies where internally generated ideas are categorised as "local". The status of researchers in both worlds is not the same, and the relevance of their research outcomes are equally unequal. The researchers at the core produce methods and theories, and those in the periphery consume and apply them.⁶⁰⁸

It is therefore obvious and goes without saying that the problems of induction and demarcation, central epistemological issues in Popper are directly tied to enlightenment

⁶⁰⁶ Popper uses the term enlightenment following Kant, to challenge all to dare to be courageous and deploy intelligence towards freedom from self-induced tutelage or any other form of captivity. See more, K. Popper, See more, K. Popper, *In search of a better world: lectures and essays from thirty years*, (London & New York: Routledge, 1992), 137.

⁶⁰⁷ Peter Amato, 'African Philosophy and Modernity', E. C. Eze (Ed.), *Postcolonial African Philosophy: A Critical Reader* (Cambridge, Massachusetts: Blackwell Publishers, 1997), 86.

⁶⁰⁸ Falola, *Ritual archives*, 714.

epistemology fundamentally characteristic of the positivistic commitment in history, philosophy, modern science and its logic that underpinned the colonial project in Africa. In fact, as Eze argues, substantial parts of the philosophies of Hume, Kant, Hegel and Marx are understood to have originated against this backdrop generally referred to as the age of Europe, 1492-1945.⁶⁰⁹ These became amongst other things the defining features of civilisation, modernity or enlightenment and therefore partly the *raison d'être* for the colonial programme in Africa.⁶¹⁰

Cunningham and Andrews argue how the idea of Western medicine (as reflective of Western modern science), an epitome of rationality was paradoxically involved in many contexts outside the West. For instance in Africa, we find a classic example of the complicity of reason as science in colonialism. Its obvious lack, or “absence”, and the promise that its embrace or adoption was to guarantee Africans a place on the map of reason/rationality/science/modernity/civilisation clearly was a central preoccupation of the facilitators of the colonial agenda in Africa.⁶¹¹ The standard of such valuation is *a fortiori* taken for granted. The complicity of modernity in the colonial experiment provides the *leit motif* of Mignolo’s voluminous work, “The Darker side of Western Modernity”. In the work, Mignolo not only reiterates his decolonial epistemology but challenges any attempt to decouple modernity and coloniality in the appreciation of Western colonialism and its impact right from the 15th century onwards. For Mignolo,

⁶⁰⁹ E. C. Eze, ‘Introduction: Philosophy and the (Post)colonial’, E. C. Eze (ed.), *Postcolonial African Philosophy: A Critical Reader*, 6.

⁶¹⁰ The thoughts of Hegel and others in this regard unquestionably provided intellectual fertility to the ideas expressed in the colonial experiment in Africa. This was a central theme in the introductory remarks provided by Eze. See more, E. C. Eze, ‘Introduction: Philosophy and the (Post) colonial’, E. C. Eze (ed.), *Postcolonial African Philosophy: A Critical Reader*, 1-21. Quite interestingly, Popper provides strong critique of Marx and more pointedly Hegel as it dominates the entire second volume of *The Open society and its enemies*.

⁶¹¹ A. Cunningham & B. Andrews, (Eds.), *Western science as a contested knowledge* (Manchester & New York: Manchester University Press, 1997). Another work that tends along similar view point is, H. Ebrahimnejad (ed.), *The development of medicine in non-Western countries: historical perspectives* (New York & London: Routledge, 2009); Saul Dubow (ed), *Science and society in southern Africa* (Manchester: University of Manchester University Press, 2000).

these two, that is, coloniality and modernity constitute two sides of the coin. This position is unlike the disentanglement of the two, replete in postcolonial literary interventions.⁶¹² Harding's view that "society and science coproduce each other"⁶¹³ provides an excellent classic formula to sum up the point in the foregoing.

To take Popper more seriously, is, to call into question some of the intellectual biases and presuppositions that inform the historical experiences of colonialism as well as their modern manifestations. As Eze argues,

African philosophy labours under this yet-to-end exploitation and denigration of African humanity. It challenges the long-standing exclusion of Africa or, more accurately, its inclusion as the negative 'other' of reason and of the Western world on the major traditions of modern Western philosophy, (by extension, Western science).⁶¹⁴

Popper's philosophy provides the tools with which some of the underlying presuppositions of modern manifestations enumerated in Eze's position and the works of others can be challenged and revisited in ways that are not only inspiring but capable of unleashing the capacity for production of knowledge rather than the ones that only encourages the regurgitation and only reproduce Western knowledge forms. The quality of these Western forms is even often in contention as some will argue, that, Africans are bad imitators of their oppressors.⁶¹⁵ And, as Segal puts it beautifully, "... results have been more impressive quantitatively than qualitatively".⁶¹⁶ Again, Koertge makes the point that the popularity of Popper's philosophy would have significantly changed the science wars debate, since the issues raised in the debates were already provided for in his philosophy. For instance, the naïve foundationalist account attributed to both scientists

⁶¹² W. Mignolo, *The darker side of Western modernity: global futures, decolonial options* (Durham & London: Duke University Press, 2011). The understanding here suggests the preference for decolonial project in this thesis rather than postcolonial scholarship represented by Bhabha, Spivak and Said for instance.

⁶¹³ S. Harding, *Objectivity and diversity: another logic of scientific research* (Chicago: University of Chicago Press, 2015), 126.

⁶¹⁴ Eze, *Postcolonial African philosophy*, 14.

⁶¹⁵ Abdi, under the sub-heading, 'Re-philosophising African education: the missed link' in his essay, 'African philosophies of education', 86.

⁶¹⁶ Segal, 'Why does the Muslim world lag in science?', 64.

and philosophers of science received immense treatment in Popper, according to her.⁶¹⁷ The work of Spivak, “Can the subaltern can speak”⁶¹⁸ aptly captures such a task before us to which Popper’s ideas can animate within an African context. Gerdes, for instance, through his works, embodies this type of effort to show how the subaltern can and should speak in the context of mathematical science and deepening mathematical knowledge in Africa.⁶¹⁹

Similar thoughts that seem to rely on the extrapolation of Popper’s thought and therefore potentially horn the contention of this thesis is given by Andreotti et al’s argument that,

The proposition of a transitory or provisional “general epistemology of impossibility of a general epistemology” offers a possible way forward that is congruent with key characteristics of some indigenous epistemologies. Different from absolute relativism that relies on conceptualisations of independent and self-sufficient systems of knowledge production, the paradoxical general epistemology proposed is based on recognition of located ignorances that could enable a conceptualisation of knowledge systems as dynamic, interdependent and insufficient. Therefore, the principle of solidarity requires recognition that the production of meaning or knowledge construction is contingent, situated and provisional. The epistemological pluralism required for ecology of knowledges emphasises the provisional, propositional, equivocal and tentative nature of knowledge production, which enables the possibility of the emergence of different forms of dialogue focusing on the value of dissensus.⁶²⁰

The obvious emphasis in the elaborate quotation re-echoes the basic characterisation of knowledge claims or specifically the nature of scientific theories defended by Popper and one of the interesting feature of philosophy which celebrates adversarial discourses. That scientific theories according to Popper are rendered as tentative, hypothetical or provisional means that when knowledge claims are made and held unto to be error proof, is mistaken. The views expressed by Andreotti et al, therefore, hinge significantly on the

⁶¹⁷ F. Stadler & I. A. Kieseppa, Science- A house built on sand? A conversation with Noretta Koertge in Minneapolis on November 21, 1998 in D. Greenberger, W. L. Reiter & A. Zeilinger (Eds.), *Epistemological and experimental perspectives on quantum physics* (Dordrecht: Kluwer Academic Publishers, 1999), 279-301.

⁶¹⁸ G. C. Spivak, ‘Can the subaltern speak?’, C. Nelson & L. Grossberg (Eds.), *Marxism and the interpretation of culture* (Basingstoke: Macmillan Education, 1988), 271-313.

⁶¹⁹ P. Gerdes, “Ethnomathematics, geometry and educational experiences in Africa”, Devisch & Nyamnjoh (eds.), *The Postcolonial Turn: Re-imagining Anthropology and Africa*, 317.

⁶²⁰ Andreotti *et al*, 44. Here the authors rely on the theories of Boaventura de Souza de Santos to defend a plural form of epistemology.

philosophical shoulders of Popper. It is interesting to note that there are others, who share similar convictions as well. Turnbull, for example, argues for a new conceptualisation of how the local relates with the global against the backdrop of contesting the notions of rationality, objectivity and scientific method.⁶²¹ Therefore, the contestation of the concept of rationality has remained a valuable part of the problem of science in non-Western societies,⁶²² African context, Nigeria to be precise.

The positivistic inclination and emphasis of the debate remains central for as long as the potentials of the knowledge heritage of these societies are relegated and considered “nonsense” in the light of the standards of Western modern science and philosophy.⁶²³

Popper’s interest in pursuing the demarcation problem along with how the idea and method of induction played a significant role in providing the verificationist standard, upon which, all non-conforming epistemic values are termed, nonsensical and to be done away with. Popper’s task was to locate the distinctive feature by which science can be demarcated from pseudo-non science. Within such a programmatic frame, metaphysics is not endangered as it is in fact fundamental to both philosophy and science, unlike the Logical Positivists or their empiricist forebears whose impact goes beyond science as various social and professional practices as education.

Unlike the positivists, what Popper hopes to achieve with the demarcation proposal is also healthy for both science and philosophy at the same time. According to Popper,

... I hope that my proposals may be acceptable to those who value not only logical rigour but also freedom from dogmatism; who seek practical applicability but are even attracted by the adventure of science, and by discoveries which again and

⁶²¹ D. Turnbull, ‘Rationality and the disunity of the sciences’, U. D’Ambrosio & H. Selin (eds.), *Mathematics across cultures: the history of non-Western mathematics* (Dordrecht: Kluwer Academic Publishers, 2000), 23-36. In fact, this notion of decentring universalist/modernist science is a recurring theme in Turnbull’s intellectual contributions. However, his relativistic convictions are rather extreme in my view and employ his criticism of these issues with caution, for I do not enjoy the intellectual wherewithal as Turnbull to defend relativism he so vehemently defends. See more, D. Turnbull, ‘Reframing science and other local knowledge traditions’, *Futures* 29, 6 (1997), 551-562.

⁶²² Corvi, *An Introduction to the thought of Karl Popper*, 25.

⁶²³ Falola insists that part of the project of taking seriously the project of taking serious ritual archives is cast in this light. See more, Falola, *Ritual archives*.

again confront us with new and unexpected questions, challenging us to try out new and hitherto undreamed-of answers.⁶²⁴

In the body of philosophy and of science then, these claims are considered and allowed but with the proviso that they are articulated in clear language and are to be open to the possibility of establishing their disconfirming formulation. By this, they are disposed to be tested, evaluated by criticism, an attitude that defines rationality or scientific mentality.⁶²⁵ In other words, any theory to be considered as scientific must be clearly formulated and ready to be exposed to the severest of tests or criticisms. Hence, Corvi states,

Popper proceeds to deal with the two basic problems of the theory of knowledge. Turning them inside out both theoretically and historically, he gradually offers a series of pointers towards a composite image of science that is very different from the ones presented by nineteenth century positivism or twentieth century Logical Positivism, and yet is still closely bound up with the epistemological tradition of the West.⁶²⁶

In Popper, therefore, we see a commitment to a new conception of rationality, a more promising model, by which, the attitude to science can be turned in Nigeria for good as well as in other African contexts. In other words, when rationality is reconceptualised and understood as the readiness or disposition to severely criticise and listen to critical arguments. Through the dynamics of rational criticism then, we are able to learn from our experiences. As such, there is faith in reason, even in the reason of others, which implies, impartiality, tolerance, and rejection of any authoritarian claims.⁶²⁷ Such, is the nuanced conceptualisation of these terms in Popper's philosophy that are indispensable and salient for the project of revising the epistemic character of Western modern science outside the West as it pertains to the science situation in Nigeria.

⁶²⁴ Popper, *Logic of scientific discovery*, 15.

⁶²⁵ Popper, *Objective knowledge*, 347-348; *Realism and the aim of science*, 7.

⁶²⁶ Corvi, *An Introduction to the thought of Karl Popper*, 23.

⁶²⁷ H. Marcuse & K. Popper, *Revolution or reform? A Confrontation*, edited by A. T. Ferguson (Chicago, Illinois: New University Press, 1985), 39.

On the tendency to always see as mysterious what the people are not able to understand and deal with immediately, as a result of which, there is, a heightened tendency towards establishing essences within an African context, Popper's thoughts can be both illuminating as well as liberating. The moment any challenge is considered as a mystery, we invariably turn it into an essence; meaning, something to be revered, instead of, a problem to be solved. And this is problematic. For as, Popper in *Conjectures and Refutations* is prepared to admit that much is hidden from us, and that much of what is hidden may be discovered but thinks that to assume the existence of "essences" is of no help to scientists, sometimes indeed a hindrance, because it may make them happy with supposed description of the essential nature of the object and discourage them from further investigation.⁶²⁸ This type of attitude is a common feature of a typical African mode of life.

Furthermore, what is particularly worth noting here, is, inductive thinking which seems to be the basis for the logical move whereby Western experience of reality is projected as the universal experience. In virtue of this, the notion of universal truth, universal epistemology and related issues tend to operate on a logic of linearity. Popper partly took issues with Plato, Hegel and Marx on the account of the assumption of their convictions to locate the inexorable systems or laws by which history operates as instance of social systems under the guise of adopting a scientific rule. Once the uncertainty element is taken out, it stands in opposition to the scientific attitude according to Popper. No wonder then, he considers his work, "The Open Universe: an argument for indeterminism", as a critical introduction to his commitment to liberalism, human creativity, rationality and agency.⁶²⁹ The underlying linear logic which Popper tackles is argued to characterise

⁶²⁸ Popper, *Conjectures & Refutations*, 105; Corvi, *An Introduction to the thought of Karl Popper*, 55.

⁶²⁹ K. Popper, *The Open universe: an argument for indeterminism* (London & New York: Routledge: 1982).

“abysmal thinking and the resulting epistemic blindness that renders the production of knowledge outside its scheme or framework impossible”, according to Andreotti et al.⁶³⁰

This logic of linearity which underpins abysmal thinking can however be countered by the principle of solidarity. This principle of solidarity conceptualised and defended by Andreotti et al seems a bold reiteration of epistemic virtues in the nature of cautious optimism about knowledge, the need for cooperation, and accommodation. These values are central to Popper’s epistemology. These epistemic values are well encapsulated in his classic epistemic principle, “I might be wrong, you may be right, but together we can get nearer the truth”.⁶³¹

The goal then, consistent with the dialogic model of this thesis, is, to arrive at what Grosfoguel refers to as, a diversity or plurality of views; that is, a world which is no longer one but one where many worlds are possible.⁶³² The implication of this, on both practical and pedagogical levels, is underscored by Eglash’s remarks that,

As multiculturalism is felt in the humanities, its comparative absence in science curricula is likely to send wrong message to students, implying that mathematics, science, and technology are restricted to the European cultural heritage. If there is to be a successful multicultural curriculum in the sciences, it will depend on disciplinary diversity.⁶³³

As we think and take on this challenge, care must be taken in delineating the notion of truth, among others, in this regard so that it is not construed as an endorsement of relativism, tacitly or otherwise. In fact, with the regulative role of truth in Popper’s philosophy one can immediately to deal with the charge of relativism, without much trouble. The point will be made clearer shortly under a subsection that focuses particularly

⁶³⁰ V. Andreotti et al, *Epistemological pluralism*, 44.

⁶³¹ K. Popper, *Open Society and its enemies*, vol. II, (1945), 249.

⁶³² R. Grosfoguel, An evening with Ramon Grosfoguel: *Postcolonial or Decolonial*, 16th December, 2014 organised by the British Islamic Human Rights Commission. Also, P. Mungwini, ‘African modernities and the critical reappropriation of indigenous knowledges: towards a polycentric global epistemology’, *International Journal of Renaissance Studies* 8, 1 (2013), 78-93.

⁶³³ R. Eglash, ‘When mathematics world collide: intentions and inventions in ethno mathematics’, *Science, Technology, & Human Values*, 22, 1 (1997), 94. Here, I assume and it is taken for granted that multicultural perspective does suggest how I deploy plurality/pluralism in this thesis.

on truth as a regulative principle. The subsection discusses truth and its place among competing epistemic claims in view of how it makes workable the dialogue model of epistemology of science advocated in this thesis.

As it is obvious, the thesis did not set out to pursue the problem of knowledge within Foucault's dynamics power structure. Within such a context, knowledge is seen more as a political issue than it is epistemological. For in Foucault, power is knowledge, the obverse conceptualisation of Bacon's vision of science. However, in Popper, the two issues are distinct, albeit, related. Even though, Popper engaged Bacon's inductivistic account of science where knowledge is power and epistemology is prior to political theory, one is not reduced to the other.⁶³⁴ On their relationship, Agassi reports his 1976 interview of Popper, who states, "my theory of knowledge, my philosophy of science and my political philosophy are original only in their interdependence".⁶³⁵

The views of postcolonial scholars who followed Foucault; Edward Said's account, for instance, for all its intrinsic interest remain peripheral to the objective of my discussion; whereas, both Popper's ideas and decolonial convictions as expressed by many thinkers as more appropriate for my task in this thesis. For instance, as Notturmo argues that once criticism becomes the hallmark in place of justification or description, truth therefore replaces power as the key element. The primacy of truth over power in a non-justificatory type of epistemology where authoritarianism and uncritical deference to it exalts power; whereas the regulative role of truth is indispensable in Popper.⁶³⁶

More so, the overall philosophical implications of Popper's thought which supports the dialogical atmosphere for the different traditions of knowledge make it a much more

⁶³⁴ J. C. Chester, 'Popper's epistemology versus Popper's political politics: a libertarian viewpoint', *Journal of Social Evolutionary Systems*, 18, 1 (1995), 87-93.

⁶³⁵ J. Agassi, *Karl Raimund Popper (1902-1994)*, 2010, 1. Available online: <http://www.tau.ac.il/~agass/joseph-papers/Popperiep.pdf> [Accessed 11/08/ 2016].

⁶³⁶ M. A. Notturmo, *Science and the open society: the future of Karl Popper's Philosophy* (Budapest: Central University Press, 2000), 238.

encompassing philosophical framework than has generally been held about Popper. The fact that, fallibilism can show us that the role of thought is to carry out revolutions by means of critical debates, rather than, by means of violence or warfare or by some epistemic fiat points to its potentials. The type of revolution here, is one which, not only has a political side, but it is to be founded on a new epistemology that enriches and strengthens the entrenchment of science culture in the African context, Nigeria. After all, the political needs more of the epistemological to succeed as shown in my assessment because the inattention to this fact seems to me to be partly responsible for some of the failures recorded in the early days of independence (and somewhat even now!) in sub-Saharan Africa. This view also takes a clue from Alcoff's argument that the possibility of realising radical liberation is not only political but much more importantly, epistemological in nature. By this, there is a constant query on the relation between identity and knowledge targeted at diversity and revitalisation of the decolonial or liberatory task at both disciplinary and institutional levels while recognising the dangers of postmodern discourses.⁶³⁷

5.5 Pluriversal or Planetary Vision of a 'decolonised' Science

Reflecting on the dominance of modernity, Taylor characterises it as the triumph of reason epitomised by Western science and technical rationality increases while myths, false superstitions and false metaphysics give way in manners that draw the conclusion to the effect that empirical approach is the only valid and viable means of gaining/acquiring knowledge. There is, however, a danger inherent in such a view as there is a growing need to understand the full gamut of alternative modernities in the making in different parts of the world. This is because it has the tendency to lock us into an ethnocentric prism, condemned to project our own forms unto everyone else and

⁶³⁷ L. M. Alcoff, 'An epistemology for the next revolution', *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World* 1, 2 (2011), 67-68, 77.

blissfully unaware of what we are doing.⁶³⁸ In a much more integrated contemporary society the facts of difference and plurality have to be properly situated and understood so as to eschew all sorts of exclusion or violence that may arise as a result of failure to accommodate the other. This can occur in a number of ways in the different segments of societal life.

Taylor's reflection shows the positivistic character and features of Western modern science and the problematic nature of its claims of universality, objectivity, neutrality and rationality it purportedly epitomises. Within such a frame, worldview, and intellectual attitude, the possibility of dialogue seems largely excluded, as only one model of knowing is claimed to be possible, valid, viable and reliable. And so, its tools, methods and standards are to be adopted if one is to be taken seriously. This, therefore, embodies the very problem that is the bane of science advancement in Nigeria, as it creates tension with the underlying knowledge tradition of the people. This happens first and foremost by the very fact of non-recognition of identity and presence of difference making unique emphasis. Taylor describes Eurocentric habit of naming the others in terms of the misrecognition of others that;

our identity is partly shaped by recognition or its absence, often misrecognition of others and so a person or a group of people suffer real damage, real distortion, if the people or society around them mirror back a confining or demeaning or contemptible picture of themselves. Non recognition and misrecognition can inflict harm, can be a form of oppression imprisoning someone in a false, distorted and reduced mode of being.⁶³⁹

To counter this attitude, Ryan argues for the need to always recognise the ontological framework within which we work so as to make for a deeper understanding and enrich the horizon of knowledge in relation to the complexities of the world.⁶⁴⁰ The proposal of

⁶³⁸ C. Taylor, 'Two theories of modernity', *The International Scope Review* 3, 5 (2001), 5, 9.

⁶³⁹ C. Taylor, *Philosophical Arguments* (Cambridge, Massachusetts: Harvard University Press, 1997), 225.

⁶⁴⁰ A. Ryan, 'Indigenous knowledge in the science curriculum: avoiding neo-colonialism', *Cultural Studies of Science Education*, 3 (2008), 663-702: 682.

a model of dialogue emphasised in this thesis, therefore, calls for the epistemic self-reassessment of its status towards an urgent need to recognising its limitation as well as possibilities that are external to its frame. In this way, the underlying hegemony is brought into question and reconstructed to facilitate a new basis for relation between epistemic modes that are possible. In this context, power factor and advantage accruing from the long history and popularity of (Western) modern science is revisited, in view of diminishing its excesses to be the only standard not only for knowledge, but for value and meaning. Thus, its identity reconfigured can make for a novel mode of relations.⁶⁴¹

No wonder, Popper argues that, the nature of scientific objectivity shows it is not synonymous with the impartiality of an individual scientist, rather it is a product of social or public character of scientific method; and the impartiality of the scientist is not the source but result of this socially or institutionally organised objectivity of science.⁶⁴²

Cottingham gives a more vivid picture of the scientific way as one which “involves a deliberate decision and attempt to filter out or abstract the interpreted world of meaning and values in favour of certain structural and quantitative description that are suitable for explanation and predictions”.⁶⁴³ Understood in this light, scientific or technical rationality or instrumental technique will not be confused with what it represents. Here, thought and ontology are distinguished. It is this type of recognition of the distinction that prepares

⁶⁴¹ J. Cottingham, ‘Detachment, Rationality and evidence; towards a more humane religious epistemology’, Conference paper on the theme: *Religious epistemology Conference*, Heythrop College, Kensington London, 19th June, 2015. Available online: https://www.youtube.com/watch?v=TLUOpwaKjOg&list=PLqK-cZS_wviDbx7kn8kXG_02gk41wq-Rq&index=2 [Accessed 18/08/2016]. Cottingham highlighted modern science in his presentation. The argument however serves the manner in which in this thesis understands Western modern science as reflecting of the nature of science characterised in Cottingham’s presentation.

⁶⁴² K. Popper, *Open society and its enemies*, vol. II, 208.

⁶⁴³ Cottingham, *Detachment, Rationality and evidence*.

grounds for the possibility and realisation of Haraway's notion of "solidarity in politics" or "shared conversations in epistemology".⁶⁴⁴

Thus, it is interesting to observe, as Popper argues that, rationalism is "an attitude of readiness to listen to critical arguments and to learn from experience".⁶⁴⁵ And that the search for truth is a cooperative affair. Everybody with whom we communicate is a potential source of argument and of reasonable information. It thus establishes what may be described as the rational unity of mankind. How this is done according to Popper, is, the critique of tradition (interpersonal notion of social reason), planning of the growth of reason, and through development of institutions to guide and safe guide the freedom of this criticism.⁶⁴⁶

With the thesis' contention that commitment to universal, neutral and objective claims of knowledge championed by Western modern science is problematic and inherently colonised, there is, therefore, no gainsaying that, there is the urgent need to decolonise modern science and its related values, terms, framework. On the face value of it, the issues are not as innocuous as they seem, and so, these terms embody the very values that have kept the realisation of the advancement of science in Nigeria particularly daunting. As Harding argues,

... the hegemonic Eurocentric discourses block easy exit from their conceptual frameworks. Modern science reinscribes the Eurocentric dichotomy between the dynamic, progressive sciences of the North and the static, historically unchanging traditional knowledge of other cultures. Only the North carries forward the trajectory of human history, for the cultures of the South have only static, unchanging tradition, this contrast implies.⁶⁴⁷

⁶⁴⁴ D. Haraway, 'Situated knowledges: the science question in feminism and the privilege of partial perspective', *Feminist Studies* 14, 3 (1988), 584. This notion is distinct from the two extremes of relativism and totalisation viewpoint.

⁶⁴⁵ Popper, *Open society and its enemies*, 213.

⁶⁴⁶ Popper, *Open society and its enemies*, 214.

⁶⁴⁷ S. Harding, 'Is modern science an ethnoscience? Rethinking the epistemological assumptions', E. C. Eze (Ed.), *Postcolonial African philosophy: a critical reader* (Cambridge, Massachusetts: Blackwell Publishers, 1997), 49.

Once, the basis of the challenge is here understood accordingly, the regime of truth and knowledge claims are not to be guided by the principles of a postmodern intellectual critique that relativises truth. It is rather envisaged, that the regime, will be one inspired by Popper's regulative understanding of truth as well as the import of his attempt to provide, the criterion for the rationality of theory choice, the growth and progress of science, which celebrates being open to criticism. In this regard, the relations between different knowledge traditions can reinforce each other as conversation between them is taken for granted within this Popper's frame of truth. Here, the notion of truth transcends any knowledge tradition and serves as the ideal towards which all looks up to, in a kind of "transmodern" vision, to borrow from Dussell.⁶⁴⁸

It is important to recall that Popper's falsifiability principle as the basis of demarcation did not put an end to the problem, as has been argued by numerous philosophers.⁶⁴⁹ In fact, to focus on the criterion of demarcation and the avalanche of criticisms, it has received, debunking its claims, can take more than a chapter to exhaustively engage, suffice it, to note that, the point of highlighting it here, is, to show, that, the problem of demarcation despite the fine effort of Popper and others remains quite intractable with far reaching implications for other non-epistemic values. For as Laudan rightly argues,

the value-loaded character of the term 'science' and its cognates in our culture should make us realise that the labelling of a certain activity as 'scientific' has social and political ramifications which go well beyond the taxonomic task of sorting beliefs into two piles.⁶⁵⁰

⁶⁴⁸ E. Dussel, 'Transmodernity and interculturality: an interpretation from the perspective of philosophy of liberation', *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World*, 3 (2012).

⁶⁴⁹ R. Coletto, 'Science and non-science: the search for a demarcation criterion in the 20th century', *Tydskrit vir Christelike Wetenskap*, 1 (2011), 63-79.

⁶⁵⁰ L. Laudan, The demise of the demarcation problem, R. S. Cohen & L. Laudan (eds.), *Physics, philosophy and Psychoanalysis*, (Springer, 1983), 120.

A practical example can be seen in the extensive boundary dispute in courts between creationism supporters and non-creationism proponents; that is, evolutionary biology.⁶⁵¹ Laudan concludes that, the problem of demarcation remains uninteresting and quite intractable, as the terms we employ only serve emotive ends. In his view, we should do away with such terms, if, we must be counted on the side of reason. Fruitful and more interesting is, to concern ourselves with what makes a belief well rounded or heuristically fertile than with one, that asks, what confers scientificity, the uninteresting.⁶⁵² It seems though, characteristic of some problems in philosophy, to remain as such; that is, remain intractable. In this regard therefore, even though, Popper and others, may not have successfully located the criterion with which to draw the line between science and non-science, some of the fundamental characteristics of the demarcation project influenced how many other theories of knowledge were calibrated and defined. Against this backdrop, Bhaskar's account of the inconsistency of positivism becomes obvious. According to him, in theory, positivism denies ontology. But in practice, it generates an implicit ontology.⁶⁵³ For example, we can look to the tension and politics of knowledge within the global capitalist system of agriculture where there is the persistent categorisation of farmers in less developed countries as primitives with outdated farming practices and poor yielding seeds. Such calibration is underpinned by the drive to ultimately replace these so-called local, poor farming values with modern industrial agriculture, including genetically engineered crop varieties, incorporating farmers into the global system dominated by private companies.⁶⁵⁴

⁶⁵¹ P. J. Wendel, Falsifiability as a science/non-science demarcation criterion in the battle against creationism, paper presented at the 9th International History, Philosophy and Science Teaching Conference, University of Calgary, Alberta, held from June 25-28, 2007.

⁶⁵² Laudan, *The demise of the demarcation problem*, 125.

⁶⁵³ R. Bhaskar, *A realist theory of science* (London & New York: Routledge, 2008), xiv.

⁶⁵⁴ D. A. Cleverland & D. Soleri, 'Farmer knowledge and scientist knowledge in sustainable agricultural development: ontology, epistemology and praxis', P. Sillitoe (ed.), *Local science vs Global science: approaches to indigenous knowledge in international development* (New York & Oxford: Berghahn Books, 2009), 209-229: 216.

In the face of the collapse of any single criterion, the basis for the exclusion and non-recognition of indigenous knowledge claims as valuable and of any epistemic value, can then be contested. Harding seems to have envisaged this type of aspiration, when she argues that, there can be desirable epistemological standards after the demise of Eurocentric, internalist epistemologies by suggesting the locality or cultural situatedness of knowledge claims, even of Western modern science too seen in this light.⁶⁵⁵ For Amato, “from the Western philosophical point of view, understanding African philosophy will require the renunciation of the relationship that the West has held toward Africa for centuries, a relation which has been encoded into its philosophical and scientific assumptions”.⁶⁵⁶

Again, to account for the challenge of development in Africa, Sabelo suggests that there is need to revisit the colonial matrix of power and other revolutionary critiques of modernity or global systems, dominated by the West to unpack the issues and contradictions of the decolonisation project in Africa. For it is only through such theoretical efforts that the unfinished project will be taken to its logical end. That is, enunciating a new locus to engage modernity to which much of the African challenge is connected. Small wonder then, Sillitoe contends that the quantification and measurement fallacies do contribute to the unsustainability in development planning even when they are laced up with participatory rhetoric. For him, “the belief in counting, measuring and monitoring outputs and uptake to evaluate success of development projects is inhibiting the practice of process planning and implementation where people actually meaningfully contribute to and influence the objectives and directions of projects”.⁶⁵⁷ Towards this end

⁶⁵⁵ Harding, *Is modern science an ethnoscience*, 47. (Advocates emphasise the cultural situatedness of modern sciences, but take them to provide good reasons to reject the internalist features (rationality, objectivity, universality) of the epistemological notions, not the notions themselves)

⁶⁵⁶ Amato, *African philosophy and modernity*, 92.

⁶⁵⁷ P. Sillitoe, ‘Counting on local knowledge’, in P. Sillitoe (ed.), *Local science vs global science*, 257-278: 273.

then, some positive values of indigenous African roots are sought to close ranks towards true, authentic emancipation of Africa.⁶⁵⁸ Dussell has also suggested some examples of the epistemic value that can be gleaned from without the popular Western modern science paradigm with his the notion of nature, more ecologically balanced held by those referred to as primitives by the modernist capitalist developmental paradigm that exploits nature and has led us to where we are now as regards issues of climate change and sustainable development.⁶⁵⁹

Similarly, Okere argues that the colonial burden is partly responsible for the failure of science and development in many African countries.⁶⁶⁰ What is particularly fascinating about the position of Okere, is not just the provocative analysis and contention with the ideological character of Western science but the boldness with which the work calls for a pluralistic epistemology of science. Such a view is very much in tandem with the position that, this thesis not only reiterates but takes further with the support of philosophical proviso of Popper with an African touch. It comes with some challenges no doubt as enumerated and considered through the exploration of decolonial and sociological thoughts of Boaventura de Souza Santos by Andreotti *et al* cited earlier exploring epistemological pluralism.⁶⁶¹

Being fixated on demarcation between what passes for science, reason, rationality as has characterised the historical discourse of Africa relative to the West, exemplified by the

⁶⁵⁸ S. A. Ndlovu-Gaysheni, *Coloniality of power in postcolonial Africa: myths of decolonisation* (Oxford: African Book Collective, 2013), 257 edited by Chambati, Walter. Theorising about the African predicament as a form of production of knowledge by African intellectuals for use by Africans in Africa. Theory is a light that assists in avoiding ill-focused, positivistic, shallow and prescriptive narratives divorced from complex historical, discursive and epistemological terrains that reproduce political and economic crises and problems that bedevil Africans and Africa today.

⁶⁵⁹ Dussel, *Transmodernity and interculturality*, 50.

⁶⁶⁰ T. Okere, 'Is there one science, Western science?' R. Devisch & F. B. Nyamnjoh (Eds.), *Postcolonial turn: re-imagining anthropology and Africa* (Bemenda: Langaa RPCIG, 2011), 310.

⁶⁶¹ V. Andreotti, C. Ahenakew, G. Cooper, 'Epistemological pluralism: ethical and pedagogical challenges in higher education', *Alternative: an International Journal of Indigenous Peoples* 7, 1 (2011), 40-50.

historical movement of the *Geist* in Hegel's system, typifies disciplinary decadence, according to Gordon.⁶⁶² He argues further that,

Colonisation involves the elimination of discursive opposition between the dominant group and the subordinated group. A consequence of this is the elimination of speech a fundamental activity of political life with a trail of concomitant conditions for its possibility. It is not that colonised groups fail to speak. It is that their speaking lacks appearance; it is not transformed into speech. The erasure of speech calls for the elimination of such conditions of its appearance such as gestural sites and the constellation of muscles that facilitates speech—namely, the face. As faceless, problem people are derailed from dialectics of recognition, of self and other, with a consequence of neither self nor other.⁶⁶³

Such a picture contends the view or position that perceives the original interest and initial quest to adopt Western scientific culture to be a smooth and peaceful persuasion, which arose from the realisation of the inadequacies of the prevailing cultural or traditional knowledge forms in such societies.⁶⁶⁴ Hence, scholars like Selin, Grosfoguel, and others argue that what happened in most colonial contexts was not only violent but a deliberate and conscious genocide of local knowledge forms and values, otherwise termed, “epistemicide” and “ethicide” respectively.⁶⁶⁵ What underpins these experiences so described can be stretched to the idea of “epistemic injustice”, in Fricker's conceptualisation.⁶⁶⁶ Such a knowledge situation where in, the ‘other’ is assumed or taken to lack the capacity for producing valuable knowledge, that is different and can call to question the very standard by which its status and identity are undermined. Through

⁶⁶² L. Gordon, ‘Shifting the geography of reason in an age of disciplinary decadence’, *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic world*, 1, 2 (2011), 98. Same piece is also published under different title as ‘disciplinary decadence and the decolonisation of knowledge’, *African Development*, XXXIX, 1 (2014), 81-92.

⁶⁶³ L. Gordon, *Shifting the geography of reason*, 99-100.

⁶⁶⁴ T. Schott, ‘World science: globalisation of institutions and participation’, *Science, Technology, & Values*, 18, 2 (1993), 198.

⁶⁶⁵ H. Selin (ed.), *Mathematics across cultures: the history of non-Western mathematics* (Dordrecht: Kluwer Academic Publishers, 2000), xvii; R. Grosfoguel, ‘The structure of Westernised universities: epistemic racism/sexism and the four genocides/epistemicides of the Long 16th century’, *Human Architecture: Journal of the Social of Self-Knowledge* 11, 1 (2013), 73-90.

⁶⁶⁶ M. Fricker, *Epistemic injustice: power and the ethics of knowing* (Oxford: Oxford University Press, 2007). Basically, it addresses the problem of the wrong done to the other in their capacity as knowers. For Fricker, it takes two forms; testimonial and hermeneutical forms. The former occurs when bias impacts on the epistemic credibility of a knowing subject, that latter is more apriori in the sense that it denies the collective capacity for the appreciation of hermeneutical resources, thus, there is a structurally prejudicial in both style and content.

deploying the philosophical intervention of Popper we can undercut and revisit some of these critical issues. It is with this conviction that we will assess the more positive epistemic outlook that can facilitate and enhance the flourishing of science in the context under review.

5.6 Global Science: Pluralism and its Implications for Development

The agenda and programmes for science and technology components of development are more often than not set by the powerful forces within the global arrangement as presently obtained. This idea is described as “extraversion” by Hountondji.⁶⁶⁷ Along this line, Harding was very explicit in her views that,

the world can be safely seen and considered as the laboratory of Europe through European expansion and continue to so function today through the science and technology components of development. The point is that areas and topics funds are readily made available and sponsored are only those conceptualised by those in the North who get to participate in making development policy and their allies elsewhere.⁶⁶⁸

Harding further adds that, the picture of nature produced by solving the expansionist North’s problems ignores or hides those aspects of nature, that are assumed to be irrelevant to success at expansion. Thus culturally distinctive patterns of both systematic knowledge and systematic ignorance are easily detected from the perspective of cultures with different purposes.⁶⁶⁹ Some credence is given to Harding’s position when one reviews activities of multilateral bodies and agencies that directly influence the design, development of policies priorities and strategies for science and technology advancement in many countries across Africa. For example, Schott lists; UNESCO (United Nations

⁶⁶⁷ P. Hountondji, ‘Knowledge of Africa, knowledge by Africans: two perspectives on African studies’, *RCCS Annual Review*, 1 (2009), 1; Hountondji, ‘Scientific dependence in Africa today’, *Research in African Literatures*, 21, 3 (1990), 5-15.

⁶⁶⁸ S. Harding, Is western science ethnoscience? Rethinking the epistemological assumptions, E. C. Eze (ed.), *Postcolonial African philosophy: a critical reader*, 45-70: 54. While in H. Tilley’s work, *Africa as a living laboratory: empire, development, and the problem of scientific knowledge, 1870-1950* (Chicago: University of Chicago Press, 2011), we have a demonstration of historical and anthropological accounts as well as various scientific disciplinary accounts (particularly ethno sciences and the field sciences) of the claims of Harding.

⁶⁶⁹ Harding, *Is Western science ethnoscience*, 54.

Educational, Scientific and Cultural Organisation), OECD (Organisation for Economic Cooperation and Development), The Rockefeller Foundation and the World Bank, as some of these organisations that play significant roles in the setting of priorities and agenda for science investment, education and developmental focus in the developing countries of Africa and others.⁶⁷⁰ The huge role of UNESCO in the development of the new science policy in Nigeria, 2005 is a clear demonstration of Scott's claim. Nigeria's science policy document was updated into the latest version in 2012.⁶⁷¹ In addition to these agencies or bodies, the Bill Gate Foundation, also helps to determine the science research priority areas and programmes within Africa as well. In Nigeria particularly, the foundation's role has been quite pronounced. From health and disease issues, to poverty, food and agricultural sectors to education; these multilateral bodies dominate in how policies of priority areas are set with promises of assistance and aid supports as well in Nigeria. For instance, the Gates Foundation has been in the news media, as the organisation which promotes or champions the introduction of Genetically Modified Organisms (GMO), as a model for improved high yields of crops, so as to meet the food needs of Nigeria's huge population.⁶⁷²

Lately, the growing presence of China in Africa too takes the centre stage of debate in international relations, as regards science and technology with related developmental issues.⁶⁷³ One cannot be under the illusion about the benevolence of these various external

⁶⁷⁰ T. Schott, 'World science: globalisation of institutions and participation', *Science, Technology, & Human Values*, 18, 2 (1993), 196-208: 198.

⁶⁷¹ The Federal Republic of Nigeria's Science, Technology and Innovation Policy, 2012. Available online: http://www.scienceandtech.gov.ng/docs/STI_POLICY.pdf [Accessed 09 August 2016]

⁶⁷² J. Ibrahim, 'Mosanto's plot to take over Nigeria's Agriculture and our policy response', *Premium Times*, July 25 2016. The many questions are raised in Nigeria on the National Biosafety Management Act of 2015. At a conference held from 23-25 May, 2016 in Abuja, Nigeria on the theme: The Nigerian Biosafety Law, GMOs, and The Implications for Nigeria and Africa. The conference was at the instance of the Health of Mother Earth Foundation and the Earth Foundation and Environmental Rights Action. *Eco-Instigator, A Publication of Health of Mother Earth Foundation*, Issue 12, June 2016 documents the entire proceeding of the various interventions on the matters arising from the introduction of GMOs and the politics of the enactment of the Biosafety Act of 2015 and the implications of all of these for the country.

⁶⁷³ K. King, *China's aid and soft power in Africa: the case of education and training* (New York: Boydell & Brewer, 2013).

interventions and so, one agrees with the argument of Juma to the effect that, there should be an urgency of pragmatism, deepening of partnership and undertaking radical institutional reforms within African countries, to be able to maximise the benefits of such interventions for the good of African countries and peoples.⁶⁷⁴ Thus, the burden rests solely and squarely with these African countries, as they enter into partnerships since partnership and collaboration should be for mutual benefits. With historical hindsight, however, the earlier we in Africa realise this fact, the better for Africa. As concrete strategies and actions plans must be in place to tap into whatever gains there are and maximise benefits thereof. This can be done through the provision of the right environment and necessary incentives, which can maximise every effort to develop and advance science in the home front in a way and manner that is empowering and truly democratic. For instance, the human resource dimension, in the nature of the South to North brain drain phenomenon is a case in point that deserves serious and profound exploration on how best to make it work in the best interest of and for Africa.⁶⁷⁵ The emphasis here again is that, this is an area that must be deeply examined to ascertain the extent to which this phenomenon impacts on the drive of many African countries towards advancing science and technology within a global context.

The contributions and learning opportunities of how other countries have been able to advance in all facets of development through the assistance of foreign countries and agencies do have important lessons that can help Africa's inward assessment towards developing pragmatic reforms capable of helping to make the best out of the opportunities of partnership. Needless, to remind us that to be able to ascertain what constitutes the best or the most in such opportunities is largely a question of knowledge, an epistemological

⁶⁷⁴ C. Juma, 'the China-Africa Bond; science, technology and engineering diplomacy', *CAIJING Annual edition: Forecasts and strategies*, (2012), 170-172.

⁶⁷⁵ L. Nordling, 'Science in Africa: enter the dragon, China is pumping money into African science. But what do both sides stand to gain – and lose?' *Nature*, 474 (2011), 560-562: 561.

angle to the political centre of power in such countries. From externally determined priorities of areas of focus, to micromanaging the prospect of such research, through funding and employment of external consultants and experts, ensure that the much sought after knowledge and skills keep eluding Africans. Obviously, these are challenges which demands contextual and pragmatic solutions.

Against this backdrop, Kitcher's analysis of the challenges that face contemporary research agenda, in view of the common good provide important lessons in the context of engaging the public through democratic deliberations as germane for Africa's science and technology aspirations supported by external agencies or countries.⁶⁷⁶ In getting these partnerships to work for the good of African countries, one area to keenly watch includes, the challenge of the efficient and effective management of resources. The aim is to ensure that objectives can be delivered accordingly. For instance, in their assessment of external interventions in many countries in Africa, the idea of "travelling technocratic rationality", according to Xu et al, ushers in an interesting twist to the nature of relations there is for knowledge, politics, aid, technology transfer, business, and development. For these scholars, the Chinese model embodies the notion of travelling technocratic rationality and it blurs business, aid in the context of development, which is very problematic. This is somewhat more complex relative to the Western bilateral aid programmes in Africa.⁶⁷⁷ More than that, the paternalistic epistemology which underlies foreign aid/assistance and the paradoxes of foreign or technology transfer in Africa with the abysmal failure of the developmental experiments in many countries in Africa leaves much to be desired.⁶⁷⁸ And so, whichever model in place, should be one that is adaptive and accommodative of the epistemic tradition in which it is to be implemented or executed. In my view, therefore,

⁶⁷⁶ P. Kitcher, *Science, Truth and democracy* (Oxford: Oxford University Press, 2001), 129-132.

⁶⁷⁷ X. Xu, *et al.*, 'Science, Technology, and the politics of knowledge: the case of China's demonstration centres in Africa', *World Development*, 81 (2016), 82-91: 89.

⁶⁷⁸ D. Moyo, *Dead aid: why aid is not working and how there is another way for Africa* (London: Penguin Books, 2009).

there are challenges that require deep knowledge and political sagacity to be able to make such arrangements mutually beneficial and thoroughly accountable in a responsible fashion (from the African perspective).

5.7 Truth as a Regulative Principle and its import for a Model of Epistemic Dialogue

It is important to be reminded that the appeal to the idea of verisimilitude in Popper does not necessarily raise the question about truth. And so, to engage in the contestations about truth and the various theories that traditionally seek to detail what constitutes truth may not be immediately relevant to our concern and purpose in this thesis. For the purpose of information, Popper prefers Tarski's correspondence theory of truth. For the present concern, his notion of verisimilitude is apropos and so, will be explored to serve the interest. The concept of truth features prominently in the thought of Popper. More precisely, the fundamental aim of science in Popper is the detection of error and its elimination. In fact, his notion of truth-likeness, degrees of truth or verisimilitude as a more plausible and rational standard than the justificatory/foundationalist truth claims is highly well developed in the body of Popper's philosophy.

The intractable problem at the root of inductive reasoning finds some leeway provided by such an understanding of truth as found in Popper. According to Healy, this is fundamental because of his view of theories as conjectures and the general view of scientific activity as predominantly problem solving activity, by which we can learn and grow as we test our theories and learn from our mistakes.⁶⁷⁹ For instance, the asymmetry between verification and falsification shows the validity of the logic upon which Popper's notion of falsifiability operates, even though it does not establish the truth by logic, it

⁶⁷⁹ P. Healy, 'Popper on truth', *Auslegung* XII, 2 (1986), 134-145: 135.

reveals the false aspect of the theory. Popper states, “we do not verify the truth of theories in the most certain ways but certainly can tell the degree to which it may be false, through severe critical testing”.⁶⁸⁰ The inductive basis of the assumptions that foreground scientific laws is supported to stand once we begin to appreciate the fact that these assumptions and whatever is founded upon them do not yield sacrosanct truths. On this basis, Popper founded his fallibilist theory of rationality and logic. As earlier noted, the idea of fallibilism Popper borrows from Peirce but uses it in the positive sense.⁶⁸¹ This is the case because of the possibility of correcting our mistakes, learning from them as such. This happens because of the idea of objective truth, notion of truth that helps one to avoid falling into a position of arrogance/hubris, as it recognises that one’s view may not be in total possession of truth, which always transcends and thus, serves the role of a regulative principle.⁶⁸²

Writing on this, Agassi argues,

Acknowledging the influence of Hume, Einstein reported that in part he owed his intellectual ability to the conviction that science is fallible. This became the corner stone of Popper’s philosophy; his contribution was of immense significance just because it was a fallibilist theory of rationality as critical-mindedness and of progress as the elimination of errors that he presented as an alternative to Plato’s theory of rationality as demonstrated truth. Popper viewed reason as a means of hopefully approaching the truth.⁶⁸³

For instance, the assumption that there is uniformity of nature has a metaphysical dimension that is yet to be proved through experience. That we do not live in the future and have not yet experienced the future is a pointer to the possibility of the future not looking like the past which we have experienced and observed. Hence, the basis of scientific laws or thinking, sometimes, cannot be absolutely secured or founded on an

⁶⁸⁰ Popper, *Conjectures & Refutations*, 115.

⁶⁸¹ Corvi, *An introduction to the thought of Karl Popper*, 135.

⁶⁸² Popper, *Conjectures & refutations*, 16.

⁶⁸³ J. Agassi, *Karl Raimund Popper*, 7.

indubitable truth in the nature of certainty of the Cartesian ego. This of course is central to the problem of induction/positivism and of causative reasoning generally.

The standard of truth and knowledge we have come to identify with Western philosophy and modern science have been in contention championed by decolonial scholars and others. The contention is not so much in the sense of attacking the truth content but more pointedly, at the complicated history and complicity with which these epistemic claims purportedly sets the limits of logic, describe ontology and determine epistemology. For instance, Grosfoguel argues that such convictions typify the myth that Western philosophy and science cannot be said to reflect a point of view, presenting itself as the standard truthful universal knowledge. In fact, Grosfoguel goes further to give a brilliant decolonial account of, how this epistemic conviction became the intellectual fad through history, science and philosophy. For him, this became possible by social, political, social conditions of power relations, which roughly hierarchises, a dominant, privileged, powerful North over a subaltern, oppressed, relegated Southern group.⁶⁸⁴ In doing this, these scholars are of the view that the identity of who speaks (epistemic enunciation) is concealed, given that, it presents itself as a disembodied and unlocated neutrality and objectivity of the ego politics of knowledge.⁶⁸⁵ This reading and understanding puts us in a rather difficult position since we have punctured the hitherto viewpoint that self-describe itself as a presuppositionless viewpoint to be contextless.

⁶⁸⁴ Grosfoguel, 'The structure of Westernised universities: epistemic racism/sexism and the four genocides/epistemicides of the Long 16th century', *Human Architecture: Journal of the Social of Self – Knowledge* 11, 1 (2013), 73-90: 83.

⁶⁸⁵ Grosfoguel draws inspiration from a number of decolonial scholars and represents these views in many of his essays, where he traces the philosophical cum historical discourses on the intellectual foundation for the epistemological and demarcatory politics between societies, cultures and peoples of the west in relation to non-western societies where there were historical exchanges of complex ones. See more; Decolonising Western uni-versalisms: decolonial pluri-versalism from Aime Cesaire to the Zapatistas', *Transmodernity: Journal of the Peripheral and Luso-Hispanic World* 1, 3 (2012), 88-104; A decolonial approach to political economy: Transmodernity, border thinking and global coloniality, 10-, *Kult- Special Issue 6: Epistemologies of Transformations, Latin American Decolonial Option and its ramifications*, 2009.

The question to then ask is, which or what is the way out of this lock jam? It is definitely safe to suggest that the picture of truth taken from Popper is uniquely insightful in resolving this crisis situation. It must however be noted that this notion of truth flows seamlessly into Dussel's notion of transmodernity. Again, it reemphasises coextensive link between Popper and the epistemological task of the decolonial project of philosophy, a position advanced in this thesis. Transmodernity as a utopian vision and view comes handy as a better frame to accomplish a liberatory task that has become urgent for the abstract universalism of Eurocentric position epitomised by Western philosophy and modern science. This is, however, not an endorsement of relativism, for as Grosfoguel argues, defended by Dussel and many others to project an epistemic practice whereby no position is said to dominate the others in terms of setting the standards of truth. The notion of truth as defended by Popper is, therefore, apt and appropriate in providing the leeway for the practice and praxis of the possibility of a rather utopian idea of transmodernity but worth pursuing none the less. The value of this transmodern idea, is, according to Alcoff, is that, "it displaces the linear and geographically enclosed timeline of Europe's myths of autogenesis with a planetary spatialisation that includes principal players from all parts of the globe".⁶⁸⁶ In this way, it can be seen to be able to meet the growing calls for new metaphysical and epistemological presuppositions that can change the otherwise excessively materialistic, exploitative, destructive course, where, science and its technological activities and applications are tended/ directed.⁶⁸⁷

5.8 Dialogic/Inclusive Global Science in Science Education Context:

Praxis for an African Philosophy of Science

⁶⁸⁶ L. Alcoff, 'Enrique Dussel's transmodernity', *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World*, 1, 3 (2012), 60-68: 63.

⁶⁸⁷ N. Maxwell, *From knowledge to wisdom: a revolution for science and the humanities* (London: Pentire Press, 2nd edition, 2007).

At the heart of science education in so-called postcolonial societies is a reproduction of an epistemology of science that is still colonised. This is particularly evident in the epistemic outlook of Western modern science's pretensions on universality, objectivity, rationality that hardly creates opportunity for constant interrogation of itself and at the same time continues to repress and oppress the knowledge tradition of the people, where contextual efforts are directed at its embrace and advancement. This has been the bane of science advancement of science education in postcolonial African societies.

Educational experts in these contexts observe consistently the intellectual challenge in science classrooms, by students in these contexts. Science education can then be said to be caught up within the matrix of coloniality, especially when, it is presented or represented as a monolithic epistemic authority, based on,

Claims of universality ... where there is an assumption of authority of Western 'truths' over other cultural ways of knowing and understanding. This leads to censoring of any form of knowledge understating the Western worldview. We fall into the myth that science is discovered and not negotiated, a myth perpetrated at all levels of Western science and science education.⁶⁸⁸

Against this backdrop, there has been call and efforts towards introducing some elements of indigenous knowledge into the science curriculum in a number of African countries, both context and content wise. South Africa is at the forefront in this direction though not without its own challenges because of its peculiar historical experiences.⁶⁸⁹ Along this line of argument, Ryan acquiesces with Harding's call on the need to reveal the hidden assumptions behind science as even these constitute a hidden curriculum of science

⁶⁸⁸ Christie 1991, cited in Ryan, 'Indigenous knowledge in the science curriculum', 674.

⁶⁸⁹ I recall a video clip that went viral in the new media in late 2016, "Science must fall", following the "Rhodes must fall" movement. The entire clip taken out of context is capable of sending dangerous signals, perhaps the manner in which underlying issues and challenges (for instance, science does not happen in a vacuum, research priority areas or themes with related ethical issues and funding issues, means that science is to be taught in a historical context) that students face science classroom was poorly represented by the student whose remarks in the video became subject of concern. Available online: <https://www.youtube.com/watch?v=C9SiRNibD14> [Accessed on 12/12/2016]. Some of these underlying issues properly understood seems be at the root of growing calls for the decolonisation of curriculum activities in a number of universities.

education.⁶⁹⁰ No wonder then, Swann champions the growing call for rethinking how all stakeholders in the business of education should have a say in the content and context of educational curriculum. And what is particularly interesting about Swann's approach is that Popper's evolutionary epistemology influences and inspires the kind of philosophy of education and the learning activities he advocates.⁶⁹¹

A more detailed account of this state of affairs is evident in Amato's argument that,

When it becomes clear that modern/traditional dichotomy has played a negative rhetorical role in Western self and other designations, as I believe it has, the myth of a universal horizon for humanity can be retold in a fundamentally different and I believe, positive way. Rather than a rhetorical device that allows one cultural tradition to subsume the individuality of all others in a homogenous and self-serving narrative of supposed intellectual and material progress, the idea of a universal human horizon may become simply the generalised location for the overlapping conceptualisations of human nature that our different intellectual cultures may produce through real dialogue. The focus will need to shift from a putative universal horizon, to the many actual and differentiated horizons of different cultures and different writers. Rather than being assumed at the outset, convergences would need to be seen as the hoped for result of a pluralistic dialogue that could not be guaranteed (or imposed) beforehand. Part of the problem here is that the scientific perspective that has dominated Western intellectual culture over the last few centuries has been rather unscientific in seeing its own expectations through. If some convergences were to result from close encounters between free peoples seeking mutual understanding, this would be both predictable and a beneficial result. But encounters between Europe and Africa have been anything but free and mutual.⁶⁹²

The view of dialogic or inclusive knowledge speaks to the heart of democratisation of science—not in the sense as popularised by researches common in many academic journals, on the place of non-experts in the decision making processes of science project.⁶⁹³ This is different because it calls for the re-examination of science itself, in

⁶⁹⁰ Ryan, *Indigenous knowledge*, 679.

⁶⁹¹ J. Swann, Popperian selectionism and its implications for education, or 'what to do about the myth of learning by instructions from without', in P. Zuzana & R. S. Cohen (Eds.), *Rethinking Popper* (Dordrecht: Springer, 2009), 379-388; J. Swann, How to avoid giving unwanted answers to unasked questions: realising Karl Popper's educational dreams', in I. Jarvie, K. Milford, D. Miller (Eds.), *Karl Popper: A centenary assessment* – Vol. Science (Milton Keynes: Ashgate, 2006), 261-272.

⁶⁹² Amato, *African philosophy and modernity*, 75.

⁶⁹³ E. Lovbrand, R. Pielker, Jr., S. Beck, 'A democracy paradox studies of science and technology', *Science, Technology & Values*, 000, 00 (2010), 1-23; M. S. Carolan, 'Science, expertise, and the democratisation of the decision making process', *Science, Technology, & Human Values*, 18, 2 (1993), 196-208; S. Fuller, 'Can science survive its democratisation?', *Logos and Episteme*, II, 1 (2011), 21-32.

terms of its epistemic self-image with a view to opening it up, de-globalise knowledge and create poles and active partners who can on equal footing become co-participants in the business of science, tackling challenges of various societies.⁶⁹⁴ Already, we have in place policies and programmes of science, yet not much will be achieved if the point canvassed in this thesis is not well taken and adequately addressed.⁶⁹⁵

Here, even the attempt to remake the disciplines in humanities into the image of science can be reengaged, so that, each remains intact in its own right or terms, making its contribution as such.⁶⁹⁶ In setting the agenda and priorities for science and technology, the space and place of the societies to be assisted cannot continue to be one of invisibility, where, the “other” is considered not to be capable. Except there are other considerations: this could possibly explain partly the basis for the failure of template transfer model of development in many African countries. My argument does acknowledge that there is a growing body of literature promoting learning in the cultural knowledge contexts of learners.⁶⁹⁷ The benefits of this approach accrue to both learners and teachers, to both the development of science in African and to Western science itself: that is, it not only helps the learners to meet one of the major barriers to learning science, but it also helps the teachers and promoters of Western science to appreciate the epistemic limitation within which modern Western science continues to operate.⁶⁹⁸

⁶⁹⁴ S. Harding, ‘Introduction, Beyond postcolonial theory: two under theorised perspectives on science and technology’, in S. Harding (Ed.), *The Postcolonial science and technology studies reader* (Durham & London: Duke University Press, 2011), 10. Integration should be resisted as it did with colonialism and imperialism, suppression of diversity. Also, C. A. Odora Hoppers, ‘Towards the integration of knowledge systems: thought and practice’, in the same volume edited by S. Harding, 388-402.

⁶⁹⁵ P. Houndtndji, ‘Global knowledge: imbalances and current tasks’, G. Neave (ed.), *Knowledge, power and dissent: critical perspectives on higher education and research in knowledge society* (Paris: UNESCO publishing, 2006), 41-60.

⁶⁹⁶ Haack, ‘Six signs of scientism’, 84.

⁶⁹⁷ L. Le Grange, ‘Integrating Western and indigenous knowledge systems: the basis for effective science education in South Africa? *International review of Education* 53, 5/6 (2007), 577-591.

⁶⁹⁸ M. G. Hewson, *Embracing indigenous knowledge in science and medical teaching* (London: Springer, 2015).

Overall, there is no better way to bring the discourse in this chapter to a close than Kitcher's remarks, arguably Popperian, which sum up the foregoing contestations rather auspiciously. As will be noticed, the following intriguing and long quotation of Kitcher's arguments, also provide a practical example of how the model of dialogue I advocate in this thesis can work effectively and seamlessly. Kitcher argues that to claim the truth of a statement is not to declare the certainty of our knowledge. Whatever hopes our predecessors may have had, contemporary views about human knowledge are saturated by the conviction that our beliefs about nature are fallible and that an absolute certainty is not an option for us. When someone maintains the truth of the thesis about the composition of the atmosphere, for example, he or she can consistently acknowledge the possibility that further inquiry may reveal it to be false. Indeed, we spend our lives proclaiming true and acting upon beliefs we recognise as vulnerable to the course of future experience. There is no snapping shut our minds, no insulation against critical scrutiny, when we move from saying what we believe to declaring its truth.

In many instances, however, scientific realism makes judgments, and the judgments are castigated by opponents as chauvinistic, imperialistic, and insensitive. Who are we to assert the superiority of Western science over systems of thought that prevail in other regions of the world? That question should not be rhetorical. Consider the suggestion that Western beliefs about the mechanisms of hereditary are closer to the truth than those current among some culturally distinct group. A defence of the suggestion need not deny the "natural rationality" of members of this group. Instead, champions of genetics should point out that Western scientists and their societies have had a greater interest in this topic and that our range of experience of hereditary systems is much broader, that we stand in a tradition in which substantial effort has been expended in building on the achievements of previous investigators, and so forth. Furthermore, we rightly appraise the tradition critically, and part of the critical attitude should lead us to inquire if the rival views, based

on different experiences, provide grounds for revising or enriching our beliefs.⁶⁹⁹ So, in keeping with the Popperian spirit therefore, the appropriate intellectual attitude that should inform interaction with positions which may appear different, Gillies advocates that the critical attitude and open-minded disposition is imperative.⁷⁰⁰ While reflecting on a similar example Bodeker argues,

Of central importance in any programme of scientific evaluation of traditional herbal medicines is an open minded and respectful dialogue between modern medical scientists and the custodians of traditional medical knowledge. Such dialogue offers the potential to recognise within traditional explanatory frameworks new pathways and modes of action, potential interactive effects of the multiple ingredients in traditional complex herbal mixtures, and methods for capturing these effects in appropriately and sensitively designed research.⁷⁰¹

5.9 General Evaluation and Conclusion

This thesis has examined the place of science in society and culture as more of a philosophical concern than one that is historical or sociological, even though these aspects are all related and crucial as well. Hence, the deliberate choice of Popper serves this purpose, amongst other things. In his work, *Science, Technology and Culture*, Bell argues that characteristic of modernity is the penchant for boundaries. There is a focus on the Western state of affairs with the question of demarcation and how central it has become in the society as well as for the science community.⁷⁰² The role of positivistic science as the capstone of reason and rationality cannot be overemphasised. As a direct consequence, a body of knowledge tradition is calibrated and challenged to be or not to be. The extent to which in these societies the supposedly standard model of rationality has fared is examined.

⁶⁹⁹ Kitcher, *Science, truth, and democracy*, 13.

⁷⁰⁰ D. Gillies, 'The demarcation problem and alternative medicine', conference presentation on the theme: Karl R. Popper: Revision of his legacy, held at La Coruna, Spain, 2003. Available online: <http://www.discovery.ucl.ac.uk/17002/1/17002.pdf> [Accessed 14/12/2016]

⁷⁰¹ G. Bodeker, 'Traditional medical knowledge and the twenty first century healthcare; the interface between indigenous and modern medicine', in P. Sillitoe (ed.), *Local science vs global science*, 23-39: 34.

⁷⁰² Bell, *Science, technology and culture*, 102-103.

Against this backdrop, therefore, this thesis has basically assessed science and philosophy in the African context, through assessing the ideological underpinning of the demarcatory project, wherein what passes for science, reason, and rationality on the one hand, and what does not pass for science, reason and rationality on the other hand, are contested. One whose philosophical framework is strategically positioned to examine the nuanced relations/interesting twist and turns of these issues and related matters is none other than Karl Popper. This may seem surprising, given that the demarcatory project was a central motivating quest for falsificationism. And yet, or so I have argued, focussing exclusively on this obscures other key features of Popper's thought and it is by shifting our focus to these that we can see that his thought provides a framework for dialogue and so makes a positive contribution to the question of science advancement in an African setting (Nigeria).

The thesis contends that the standard or yardstick of reason and rationality has come to be defined by the successes of Western modern science. The long complicated historical relationship with the intellectual culture of the West in relation to Africa was highlighted to be centrally implicated in any effort to advance and promote the culture of Western modern science in the African context, such as Nigeria. Hence, Popper's thoughts were situated as continuous with the decolonial project of philosophy to render an account that argues for a new model or approach to philosophy of science appropriate to the African setting: that is, a model that provides an alternative or the dialogical model to the integrationist's or the dismissive model that seems prevalent. By deploying Popper's ethical principles and epistemic values of his epistemology of science directly connected with his political thought, two aspects that we must never lose sight of in tackling science and technological advancement in Africa are brought into sharper focus for, as Tilley argues, "... researchers increasingly had to confront reductive tendencies in laboratory

methods and scientific reasoning, which privileged parts over wholes and drew conclusions about organisms in the absence of an analysis of wider interactions”.⁷⁰³

Interestingly, the two fundamental problems of epistemology Popper tackled in his philosophy of science flow into each other with both at the centre of the problematic at the heart of this thesis. I have shown how inductive rationality underpinned the positivistic methodology of science (justificationist epistemology) and by which it considers only confirmatory or verificatory evidences as the basis of scientificity, and therefore, assumed the competence of drawing conclusions about what is and what is not science. To a large extent, this demarcatory programme within science played important role even beyond science as it had corollaries too in the context of philosophy (metaphysics), culture and social realms of the enlightenment understanding of reason and rationality. How Popper interacted with this trend while projecting a non-justificatory option has been well noted in this thesis, especially, reiterating the importance of philosophy as metaphysics and the open-ended nature of such a standard for the epistemic or scientific status of the disciplines of Adler’s individual psychology, Marxism, Freud’s psychoanalysis and others.

More importantly, Popper’s contributions on these matters bring with it unique insights in many ways. The thesis avers that the ideological connotation of the demarcation project is problematic for science in society, because of the authoritarian or totalitarian underpinning of such claims. When the model of modern Western science is claimed to exhaust all possibilities of valid, credible and reliable means of accessing truth and arriving at certain knowledge, “a kind of Hegelian understanding that one spirit does animate all begins to emerge”- to borrow from Wieseltier.⁷⁰⁴ Interestingly, scholars

⁷⁰³ Tilley, *Africa as a living laboratory*, 317.

⁷⁰⁴ L. Wieseltier, ‘Crime against humanities: now science wants to invade the liberal arts, don’t let it happen’, *The New Republic*, September 4, 2013.

acknowledge the value ladenness of any attempt at boundary delimitation, and its potential to undermine even the project of science cannot therefore be denied. Much of the craze and fad to “scientise” various disciplinary endeavours as a way of securing legitimacy, earn some modicum of respect and thus have legitimate space within society, is injurious rather than supportive as science’s self-image or epistemic status is hardly called to question. This is attested to by what Gieryn calls, “the ambiguities of boundary-work”.⁷⁰⁵

There is something quite profound and far reaching here. For instance, in a 2012 interview titled, “In Conversation with History”, Leon Wieseltier draws our attention to something salient, that there is a great deal of wisdom more rewarding than the pragmatic or economic mind-set, “to game everything”. He makes the point that there is a subtle distinction between perfection on the one hand and perfectibility on the other hand; that is, the aspiration towards perfection, citing a 16th century Jewish thinker who wrote an essay on frivolities. Any epistemic position or person who believes he/she or such a position is perfect will be less likely to achieve extraordinary things than people who aspire towards perfection (perfectibility, a feature where the state of perfection itself is considered as a flaw). The latter is much better placed to achieve extraordinary feats. This is always the case because the aspiration towards perfection is able to bring both the ideal and the critical frame of mind together and one does not fall away from the other, which is the key, thus, guaranteeing greater accomplishments.⁷⁰⁶ This idea simply underscores the fundamental contribution of this thesis in its call for a change of disposition and attitude on the part of science—one which is accommodative of the epistemic possibilities of the other forms of knowledge traditions or approaches. This can indeed be the key in

⁷⁰⁵ T. Gieryn, ‘Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists’, *American Sociological Review* 48, 6 (1983), 781-795.

⁷⁰⁶ L. Wieseltier, ‘*In Conversations with history*’, organised by The Institute of International Studies, University of California, Berkeley, October 12, 2012. Hosted by H. Kreisler. Available online: <https://www.youtube.com/watch?v=uMH5kRBe-Y> [Accessed 12 July, 2016].

expanding the frontiers of scientific development and its advancement in Africa generally and enriching science specifically. As Mazzocchi argues, Western science and traditional knowledge, despite their variations and different forms of knowledge, can learn from each other. The real world is too complex to be compressed into static conceptualisations. Dealing with this complexity requires approaches and strategies that maintain a continuous openness and willingness to discover and learn.⁷⁰⁷

To this extent, the support that philosophy along with other disciplines lends to the programme of science is not only threatened but undermined on a consistent basis when it is not regarded as what it is in its own right.⁷⁰⁸ Here, the emphasis of Popper on the relevance of metaphysics as philosophy comes to the fore once again. Sarkar observes that science and rationality are shown to be intertwined, though not without problems. While reviewing Popper on rationality vis-à-vis the responses to Popper by other thinkers, including Feyerabend, Kuhn and others, Sarkar says of Popper's thought that "... elements of chance and uncertainty were allowed in the arena of science via indispensability of lucky guess conjecture and happy hits (potential falsifiers resilient theories)".⁷⁰⁹ As demonstrated in Chapter Five, the role of history and philosophy of science in science and its culture was underscored and the indispensability of philosophy to science and society was shown. Therefore, the lack of appreciation of the culture of philosophy, as well as the thinking that in the age of science, and that there should not be serious space for philosophic speculation, is not only mistaken but misplaced in the context of Nigeria. For there is more to reality than is exhaustible by science and its related mode of proceeding/enquiries. Any appreciation of the fact that the truth of reality

⁷⁰⁷ F. Mazzocchi, 'Western science and traditional knowledge', *Embo Reports* 7, 5 (2006), 463-466: 465.

⁷⁰⁸ L. Wieseltier, 'Crimes against humanities: now science wants to invade the liberal arts, don't let it happen', *The New Republic*, September 4, 2013. Available online: <https://newrepublic.com/article/114548/leon-wieseltier-responds-steven-pinkers-scientism>. [Accessed 12 August, 2016].

⁷⁰⁹ T. K. Sarkar, 'The changing concept of Rationality in science', D. Andler *et al* (Eds.), *Facets of Rationality* (New Delhi/Thousand Oaks/London: Sage Publications, 1995), 212-226: 214.

extends beyond the remit of science and its competence as the only viable and reliable yardstick or standard to evaluate the truth status of all other knowledge claims will amount to the arrogation of an all knowing model of epistemology to science and science alone/only. Science as emphasised and popularised by Western epistemological presuppositions does not seem to be able to answer all the questions of life. Molefi makes much the same point thus; “Western science, with its notion of knowledge of phenomena for the sake of knowledge and its emphasis on technique and efficiency is not deep enough for our humanistic and spiritual viewpoint”.⁷¹⁰

The assumption upon which modern Western science and philosophy operate relative to the knowledge traditions in Africa, inherent in the declarative conclusions about the rationality or otherwise of these other knowledge systems, was indicative of a coloniality of reason and science. The evidence of this has a long and complex history highlighted in the discourse of coloniality and modernity as two sides of the same coin in historical exchanges and the contemporary relation between the West and Africa. Therefore, to deal with the problem of science advancement in an African setting, a revisit of these issues is a necessary precursor to developing a comprehensive account of the issues at stake. The compelling reason for this is the challenge of meaningful progress and change in many parts of Africa despite profound investments based on the model informed by the dominant model of development predicated on an epistemology of Western paradigm of rationality. Though the arguments for lack of significant progress concomitant with the investments are however contested, some internal, others external or the internal-external linkage, in this regard both the dimension of the internal as well as the external can be seen as socio-political. I argue that the tension between the internal-external epistemic relationships is central to resolving the problem of science advancement in Nigeria.

⁷¹⁰ A. Molefi, *Afrocentricity: the theory of social change* (Trenton: African World Press, 1988), 80.

While I do not ignore the obvious challenges from within in terms of capacity and commitment at all levels of leadership in Nigeria, I would argue strongly that more fundamental dimension of even socio-political challenges seem to be epistemological in nature. To this extent, accounts of the challenge of science advancement in Nigeria have been diverse and many. We can, however, easily characterise and denominate these various accounts into two popular models. Firstly, one that perceives as problematic the Western model of development and hence as something to be replaced by an indigenous model of development. This account can be said to operate on the philosophical reflection of the thoughts of Kuhn and Feyerabend, with the thinking that all knowledge systems are as equally viable, valid, and reliable. The second account is one that locates the problem with the socio-political factors as inimical values to the full actualisation or execution of a Western model of development, which has worked successfully in many other places. I have considered and found problematic each of these accounts. Instead, I have suggested a much more comprehensive account, with Popper's philosophy as guide, especially with respect to its dialogic potentials with the immense benefits this brings. In achieving this, the thesis highlights both epistemological as well as political aspects of the debate in more nuanced ways than has been done so far.

Amongst its contributions to the body of knowledge, the thesis attends to one important challenge thrown to those interested in the nature and state of science in non-Western societies, especially African contexts of science. The challenge and gap in research in this area is echoed in a review by Musselman in which he says,

I do hope to see more work in the future on roads even less travelled, such as non-applied sciences, earlier periods, more regions in southern Africa beyond South Africa itself, and the awkward interplay between African and European conceptions of the natural world. Dubow says offhandedly in his introduction that he suspects the theoretical and natural sciences will prove less susceptible than the human and social sciences to their social environments. Such a remark can at best be considered highly speculative, since we have so little information about the theoretical and natural sciences in the southern African context and since

studies of these sciences in other settings have shown they are hardly immune to social context.⁷¹¹

The thesis, in the course of responding to the foregoing challenge, recalled the classic question of Needham, which clearly situates the problematic nature of positivistic science within a larger intellectual and socio-cultural context. This was done by reconceptualising the question to capture the problem of science advancement in an African context, Nigeria.

To provide such an account of science within an African context, the focus was on the state of affairs of science advancement in Nigeria. While there was an acknowledgment of efforts in the literatures to deal with this problem, I am of the view that previous accounts lack the profundity and robustness to address the problem of science advancement in Nigeria. This is because, very often, these accounts itemise social, political, and economic factors as wanting in the implementation or execution of any developmental programme in Nigeria. Thus, for science advancement then, it is almost natural to locate the challenge solely as a political one. In the view of this, I argue in this thesis therefore, that such conclusions are rather superficial and less compelling since, even when these factors or related problems are resolved, very little is likely to change as regards the story of science advancement in Nigeria because solutions arising from such diagnosis will not be deep enough even though I do not discountenance the political factor to be necessary condition. The example of political independence experience and the challenge of development in many countries in Africa illustrates this claim. Also, sympathetic but not entirely convinced about the extent to which the reactionary position that considers cultural or traditional knowledge systems to be equally valid and viable epistemically comparatively with Western modern science. Such viewpoint predicated on the philosophical arguments of renowned philosophers of science such as Thomas Kuhn

⁷¹¹ E. G. Musselman, 'Book Review: Saul Dubow (ed.), *Science and society in southern Africa*', *Journal of South African Studies*, 28, 4 (2002), 848.

and Paul Feyerabend with relativistic conclusions are not helpful as such and so I exercised constraint in taking such route in my intervention.

I have through this thesis attempted a nuanced philosophical intervention in the discourse of science studies by advancing a hermeneutics of Popper's thought, whose position avoids the relativism associated with the thoughts of Kuhn and Feyerabend as richly balanced and robustly poised to addressing the problem of science advancement earlier accounts fail to comprehensively deal with in an African context. Thus, the thesis retells the story of science in Nigeria with Popper, arguing that both the political dimension often emphasised as primarily fundamental to resolving the problem of development in an African context has an epistemological aspect, something often ignored or which escapes the attention of those who reflect on the problem of science in Nigeria. Both are therefore tackled seamlessly together within the framework of Popper's philosophy, which shows very strong connection between the epistemology of science and his political thought. In achieving this feat, the thesis located the two fundamental problems of epistemology (the problem of demarcation and the problem of induction) to be intrinsically connected to the quest to advance science in an African context because of the historical complicity of the emergence of what defines rationality, knowledge, truth, science and versus what is non-rational, pseudo-science and lacking truth.

Significantly, the manner in which Western philosophical tradition and modern science operate in relation to the African context underscores epistemic values of reason or rationality, an area which touches on other significant aspects of the being of the African. From language, anthropology, sociology, ethics, epistemology, logic, metaphysics, through to education, art, and religion, these and many more aspects of people's being are defined, categorised, calibrated, relegated or ignored as such depending on where it appears on the scale or standard of truth assumed to be exhaustive in the model of knowledge that incarnates rationality, that is, Western philosophy and modern positivistic

science. This feature of the model of rationality and truth, for instance, goes beyond characterising the people and culture to set standards of values for various disciplines, to remake all in its image and likeness given its enormous successes. To the extent that it lays claim to universality, objectivity, and neutrality, it assumes an all-knowing, transcendent context, a God's eye view, *sub specie aeternitatis*. However, the attempt to propagate and popularise its culture in non-Western societies has not yielded the much desired results. More than that, there is an obvious conflict and tension of epistemological traditions which impacts on the prospects of promoting science and its culture in these societies.⁷¹²

The thesis strongly argues that the philosophy of Karl Popper provides a much more comprehensive framework for understanding and resolving the problem of science advancement in Nigeria. For, as Popper notes, the central concern of epistemology is the challenge of the growth of knowledge, which is fundamentally to examine scientific knowledge as it exemplifies the best model of the growth of knowledge possible. The focus of what can be known is all about cosmology, science and philosophy are directed to understanding it, a concern that legitimises both, using any method but must be clear and ready to criticise it thoroughly.⁷¹³ As Haack acknowledges, “science is fallible, limited and human but remarkably a successful human enterprise”.⁷¹⁴

More importantly, the basic emphasis of Popper that re-echoes the Socratic or dialectic model in how knowledge claims are to be made and defended provides a philosophical basis for the model of dialogue upon which various traditions of knowledge can better engage and exchange, while changes happen between and among them. The implication

⁷¹² G. S. Aikenhead, ‘Removing epistemic blinkers and biases; a much needed conversation’, *Studies in Science Education*, (2015), 1-9.

⁷¹³ Popper, *Logic of Scientific Discovery*, 28.

⁷¹⁴ S. Haack, *Defending science within reason: between scientism and cynicism* (New York: Prometheus Books, 2007), 17-19.

of this for the model of Western modern science in the context of science education in non-Western societies cannot be over emphasised.

Beyond the urgency to attend to the problem of science advancement in Nigeria, the call for global sustainable development and growing debates on indigenous knowledges in view of sustainable use of earth's resources and development, the task of the thesis can be seen to have not only local but global relevance. In fact, indigenous knowledge and sustainable development are natural allies.⁷¹⁵ The question of development is no less serious as it is globally than it is within the African context. The contribution of philosophy to this question and how it relates to the African situation is important to be answered for as Hountondji claims, the development in Africa is strongly hinged on the advancement of the scientific knowledge. This can only be achieved with some attention given the indigenous knowledge system which is to be consistently subjected to critical scrutiny.⁷¹⁶

In a sense the project is a modest contribution to the task of epistemic inclusivity/inclusiveness in view of improving the platform of science within a global context, from an African perspective which has consistently failed as a result of the neglect and exclusion of the epistemic worth of the knowledge tradition of the people. In some way then, the problematic challenge for Africa expressed in Ferguson's presentation receives adequate attention in this thesis, by the exploration of ideas and institutions of science and technology. It examined how Western modern science is implicated within the matrix of coloniality of power. Popper's critical philosophy provides the basis to defuse the epistemic arrogance that underpins integrative model, instead advances a dialogic model. Part of the task, therefore, of the thesis in reposing the Needham's

⁷¹⁵ F. E. Neluvhalani, 'Enabling a global imperative of sustainable development through indigenous (local) ways of knowing: a case of South Africa', *Tribes and Tribals*, 1 (2007), 157-165: 164.

⁷¹⁶ D. A. Masolo, 'Review: from myth to reality: African philosophy at century-end', *Research in African Literatures*, 31, 1 (2000), 157.

question in the Nigerian context becomes apparent and, therefore, partly answerable. What is worth emphasising here is the thesis' ability to generate the needed debate on the problem of science and how Popper's philosophy is able to assuage the tension which has been the bane of science advancement in Nigeria. It does this by guaranteeing the needed dialogue of traditions of knowledge that is hitherto lacking, given the epistemic disposition of Western modern science to be an exhaustive approach to all knowledge possible. Popper's philosophy deflates this epistemic self-recognition and self-congratulatory outlook and so, makes room for the possibility of a truly global, decolonised and open vision of science. This indirectly works towards making the global vision of science a possibility in terms that empowers the various components of the world to be able to make contribution to the common pot of science in view of the good of humanity. For it only by this that there can some ownership of the project of science in the Nigerian context. For until this becomes the case, the problem of science advancement may remain a tall order.

In conclusion, and true to Popperian spirit, Popper's philosophical intervention, as explored and illustrated in this thesis, is in no way proposed to be complete or the only way to attend to the all-important question of science advancement in Africa (Nigeria) but rather strives to generate/provoke critical discourse in the field of African epistemology of science and related disciplines; for instance, to raise the question about how Western science gained its authority and prestige by disqualifying indigenous science in colonial contexts. To this challenge there is no static or standard model by which the various tensions across societies can be said to be the same and so any intellectual engagement along this line can be worthwhile for the overall benefit of the (philosophy and) history of science.⁷¹⁷ Development in contemporary times seems

⁷¹⁷ B. Bensuade-Vincent, 'A historical perspective on science and its 'others'', *Isis* 1, 2 (2009), 368.

informed by a kind of absolutist certainty epistemology of science that the method and apparatus of measuring relevance is threatening to unsettle and unseat philosophy and humanities in general. The consequences of this overbearing epistemology of science is challenged and should be replaced with a gradualist epistemology of science predicated on Popper's critique of Baconian inductivist science. With this, science and all its successes will recognise the need for others, especially in this case, philosophy as it seeks to deepen human's self-understanding in the world and its place in it to play its role. The situation in Africa provides new opportunities.

More than anything else, what this thesis has been able to demonstrate an appreciation of the philosophy of Karl Popper through establishing its relevance for the history and philosophy of science in an African context, and the science experience in Nigeria. The thesis thus makes an African case for a greater and better appreciation of the philosophy of Karl Popper. Therefore, it is safe, to say, in conclusion, before anyone considers dismissing Popper's philosophy as not relevant or to consist of falsificationism alone, there is a rational need to rethink seriously, think again, and do such twice or more. What is more, philosophy cannot remain blind to what others see in Popper's philosophy and there seems to be more in Popper's philosophy than has been popularised about his philosophy. The evidence of this abounds in the embrace, applications and appropriation of Popper's ideas by several experts in various other fields outside philosophy. In other words, others are "opened" to the potentials in his philosophy whereas the immediate constituency within which he flourished has somewhat remained "closed" to his ideas. Could it be the case that a prophet is not respected in his hometown? The efforts, more than attending to the problem of science in Nigeria, makes a clarion call, an urgent call, for a reappraisal and renewed appreciation of Karl Popper beyond the boundaries/territories of philosophy of science to the whole programme of history, philosophy and science studies.

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