ADVANCES
IN
THE HISTORY AND PHILOSOPHY OF SCIENCE

This text (**Advances In The History and Philosophy of Science**) is an attempt to capture in one single text, all the basic studies and information that students in Universities, Tertiary Institutions of learning and other related field of studies need to grapple with as regards studies in the History and Philosophy of Science, a course of study that has since been approved by The Nigerian Universities' Commission (NUC) as a mandatory and prerequisite course of study which all undergraduate students must undertake and pass before graduation and the award of degrees in whichever disciple.

The ever increasing need for a text that offers a detailed study and analysis of all the relevant issues and matters arising from arguments and claims in the field of science has therefore been in high demand. The Project that birthed this text was approved with the sole mandate to meet this need and ease the stress that students and researchers have had to grapple with in their quest to meet with the demands of the course and other related studies. The approach of this text therefore takes into consideration, the complex nature of the comprehensive study that characterize the discipline of Science and Philosophy, one that often makes studies in these areas seem difficult, especially for none philosophy and science based students.

All the contributions made in this text were therefore done with simple and less complex analysis that were aimed at reducing to the barest minimum, the stress that students and the ordinary researcher often encounter when pursuing studies in these areas. Standard test and examination questions with their answers have been added at the end of the text to help students understand and adequately prepare for examinations in this course of study.

We are grateful to the team of intellectuals who worked tirelessly day and night to bring the aims and objectives of the studies in this text to pass through their contributions. We are grateful to DR. DOMINIC AZUH and DR. ESIAKABERA OVIA from Covenant University Ota. We are also grateful to Mrs. VICTORIA AKILEDWO, from the Dominican Institute Seminary Ibadan for her immense contributions.

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With foreword by Professor Charles Ogbulogo

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DEDICATION

We dedicate this book to 'HIS Majesty', The God of all creation. To 'HIM' who sits on the throne and unto the Lamb. Let all Glory, Honor, Wisdom, Dominion, Majesty, Power and Strength be ascribed to Him and Him alone, now and forever and ever... Amen.

To all the men and women who have taken the lead in meeting the needs of people all over the world. May His Grace continue to abide with you all ..... Amen.

Chidi Uhuegbu

Isaac Ukpokolo

Ikedinachi Wogu.

ACKNOWLEDGMENTS

Let us start by appreciating God for the grace and wisdom bestowed upon us during the process of the research and studies embarked upon which lead to the birthing of this new text in the History and Philosophy of Science. We acknowledge that the project wouldn't have been a success were it not for His grace.

We also appreciate God for the Chancellor and President of the Living Faith Church, Bishop Dr. David Oyedepo and the entire management of Covenant University headed by the Vice Chancellor, Professor Aize Obayan, the Deputy Vice Chancellor, Professor Charles Ogbulogo, the Registrar, Mr. J. N Taiwo, for the exemplary leadership they have continued to offer to academics here at Covenant University. We want to note that their exemplary leadership has continued to create the enabling environment for research and studies here at Covenant University. this is responsible for birthing this new text "ADVANCES IN THE HISTORY AND PHILOSOPHY OF SCIENCE".

We appreciate the students and team of lectures in the Department of Philosophy University of Ibadan for the meaningful discussions on issues that were raised in this new Text. We have benefited from teachers and students of Philosophy, Logic & Human Existence and students of History and Philosophy of Science at Covenant University. Our reviewers and editors have made insightful and valuable comments over the years which have guided us in developing this Text.. Worthy of note include Professor Owolabi, Professor Abiola Irele, Dr. Chris Agulana, and Dr. Amechi Udeffi all of the University of Ibadanas well as Professor Andrew Udugwomen, from University of Calaber. We also wish to use this medium to appreciate. Dr. Ebiakabere Ovia, Dr. Dominic Azuh and Mrs. Victoria Akoleowo, teachers who's articles and chapters where published in this text.

In closing, we wish to appreciate again, Professor Charles Ogulogo who amidst his very busy schedules, accepted to read through this text and write the foreword. We heartily appreciate the team of work force at IWAP VENTURES lead by Engr. Daniel Kayode Jacobs, the Manager of the Company and Engr. Ademola Elijah Olopade, a system and business analyst. Their team of work force were responsible for designing the cover page, typesetting, printing, and packaging of this book. The contributions of Dr. Philip Omoke is also noted and appreciated. We on behalf of all the contributors of this text, we appreciate you all. Thank You.

Chidi Uhuegbu
Isaac Ukpokolo
Ikedinachi Wogu.

FOREWORD

As part of the curriculum, the National Universities Commission (NUC) has mandated Universities in Nigeria to teach courses in Philosophy, Logic and Critical Thinking. Students are expected to appreciate aspects of the scientific processes connected with philosophy. They are also expected to show familiarity with the History and Philosophy of Science. It is in fulfillment of these requirements that this book has been prepared.

Dr. Chidi Uhuegbu and his colleagues have in addition to the core issues, introduced contemporary concepts in the field, illustrating their presentation with local examples. The Language of the Text has also taken into account the level of the students. Therefore this book, and the selections of articles therein, will satisfy the needs of the young undergraduate who may not have any professional knowledge of philosophy. The general reader will also find the book very useful.

Professor Charles Ogbulogo
Deputy Vice Chancellor
Covenant University

PREFACE TO THE FIRST EDITION

The shift in the western mind from the medieval to the modern was underpinned by the growth of science. However a two hundred year long intellectual battle was to take place between the established Church and the emerging **empiricism**, before the Enlightenment could flourish. **Nicolaus Copernicus** (1473-1543) challenged the view that the Earth was at the centre of the universe. He suggested that the observational evidence would be better explained by the theory that the earth orbited the sun. **Francis Bacon** (1561-1626) argued for the use of experiment rather than deduction as a means to increase knowledge. **Johannes Kepler's** (1571-1630) employment of observation and mathematics enabled him to supplant the Pythagorean (ancient Greek philosopher Pythagoras' (c. 530 BC)) theories of perfect heavenly spheres by showing how planets moved in ellipses. **Galileo Galilei** (1564-1642) was placed under house arrest for agreeing with Copernicus.

Despite resistance from the religious authorities, the success of science in explaining and predicting the natural world could not be ignored. **René Descartes** (1596-1650) thought he had found a rational foundation for science based on his arguments for his own existence and the existence of god. God, he argued, would not deceive our senses. This felicitous reconciliation between Cartesian **rationalism**, a belief in God and the support for empiricism did not survive for long.

Isaac Newton's (1642-1727) advances in physics based on his empirical and inductive methods were hugely influential to the philosophers of the Enlightenment. **Immanuel Kant** (1724-1804) thought that Newton's laws could be shown to be true by reason and that the scientific approach could explain the phenomenal world (the world of appearances). He retained a dualistic view of the universe: human beings lived in a world of rationality, autonomy and morality whilst the material universe which they observed was explained in terms of cause and effect.

Auguste Comte (1798-1857) argued that human thought developed through a number of stages: mythical and religious, metaphysical and its final positive stage which was characterized by the systematic collection of observed facts. He thought that these **"Positivist" methods** should now be turned to the study of society. With his invention of sociology, Comte was suggesting that our knowledge of human beings could be explained using similar methods to those of the natural sciences.

But the 20th century came with it a revolution that was championed by Critical rationalist thinkers. **Karl Popper** (1902- 94) was critical of the **inductive methods** used by science. The empiricist **David Hume** (1711-76) had argued that there were serious logical problems with induction. All inductive evidence is limited: we do not

observe the universe at all times and in all places. We are not justified therefore in making a general rule from this observation of particulars. Popper gives the following example. Europeans for thousands of years had observed millions of white swans. Using inductive evidence, we could come up with the theory that all swans are white. However exploration of Australasia introduced Europeans to black swans. Poppers' point is this: no matter how many observations are made which confirm a theory there is always the possibility that a future observation could refute it. Induction cannot yield certainty.

Popper was also critical of the naive empiricist view that we objectively observe the world. Popper argued that all observation is from a point of view, and indeed that all observation is coloured by our understanding. The world appears to us in the context of theories we already hold: it is **'theory laden'**.

Popper proposed an alternative scientific method based on **falsification**. However many confirming instances there are for a theory, it only takes one counter observation to falsify it: only one black swan is needed to repudiate the theory that all swans are white. Science progresses when a theory is shown to be wrong and a new theory is introduced which better explains the phenomena. For Popper the scientist should attempt to disprove his/her theory rather than attempt to continually prove it. Popper does think that science can help us progressively approach the truth but we can never be certain that we have the final explanation.

This kind of thought pattern became what was to lay the foundations for all the other claims and counter claims, arguments and counter arguments that followed among scientist and thinkers of science and philosophy; an argument that have continues to shape and change the face and direction of the scientific enterprise. This text sets out to basically examine the current trends in this arguments and the direction it has proposed for every passing decade.

I therefore employ you to join in this quest directed at totally examining the present ***thesis*** that science has proposed for this contemporary dispensation. I perceive that critical arguments resulting to an ***antithesis*** will soon be offered. What will the resolving ***synthesis*** be? Come, join us in this quest. It promises to be an eventful and exciting adventure as we probe the current activities of the scientific enterprise with our philosophical binoculars.

Chidi Uhuegbu

Isaac Ukpokolo

Ikedinachi Wogu.

TABLE OF CONTENT

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GENERAL INTRODUCTION TO THE TEXT

I. Introduction

History and Philosophy of Science, hereafter known as **(HPS) or (GST311)** for students at Covenant University, is perhaps, best described as a discipline and a program devoted to using a wide variety of historical and philosophical approaches to understand one of the most important conceptual and cultural enterprises of the modern world—***Science***.

Studies in (HPS) take many different forms, all with the common aim of understanding how science works. Some seek this understanding by looking at the history of science, others by analyzing the abstract structure of scientific theory and practice, still others by examining detailed foundational issues in specific sciences; and some employ a combination of these and other approaches. We shall avail ourselves of all the approaches available in the field of science and philosophy to explore, examine, and to understanding this conceptual and cultural enterprise, called science Special emphasis shall be made towards understanding the current trends and issues arising from the activities this scientific enterprise. The few areas that this test shall focus on include; **History of Science and Philosophy, the Science of Philosophy, the Philosophy of Science; Current Critical Rationalist Thinkers and Current Methods of Science; Contemporary Issues in the field of Science, Science and the Quest for New Energy among other things**

The major aims and Objectives of the text include:

a. It is expected that by the end of this course, students of HPS would be able to state and identify the philosophers whose works and findings laid the foundation and scientific discoveries of today.
b. Students would also be expected to be able to analyze the structure of scientific theories and practices that have evolved over each specific period of time.
c. Students are also expected to be able to state and examine foundational issues in specific sciences.
d. Because science claims to explain reality, students of (HPS) will be expected to, at the end of their study, provide arguments for or against this proclaimed goals and claims.
e. Students would also be expected to be able to probe into the rationale

behind the methodologies proposed by the scientific enterprise and offer justifications and critiques where the need arise

f. Students of HPS would also be expected to be able to critically examine the rationale behind the quest for energy and most of the current activities of science.

II. Overview and Structure of The Text

a. Part One

Under **The History and Philosophy of Science** we shall be considering how the history of science examines the origin and evolution of scientific ideas and practices within a cultural context. We shall also be considering how it deals with questions such as the following, where do new scientific ideas, tools, and practice come from? How is the development of science influenced by metaphysics, religion, technology and social institutions? How does the advancement of science, in turn, shape human society and culture? These questions and many more shall guide our study in this section and throughout the text.

In 'Part One', where we shall be studying about the history of science, the direct aims and objectives for students shall include:

a. Being able to identify the origin and evolution of scientific ideas.
b. Students should be able to state where scientific ideas, tools and practice come from.
c. Students should also be able to state how the development of science is influenced by metaphysic, religion, etc.
d. Students also will be expected to state how advancements in science in turn, shape human society and culture.

b. Part Two

In 'Part Two'; The Philosophy of Science, we shall be x-raying the Origin of Science and Its Methods: In studying the history and philosophy of science, it seems logical and reasonable to start with a definition of science. But it has been discovered lately that this is no easy task, for there is no one standard definition for the term. Instead of a standard definition of science, it is advisable to look at the different conceptions of science. This process has to some extent, revealed that

the scientific enterprise has been progressive especially at the beginning of the 16th century AD upwards. Most discussions in this line tend to follow a pattern or procedure that can only be called ***scientific methodology***. This procedure involves elements such as observational procedure, patterns of arguments, methods of representations and calculations and evaluations on the grounds of their validity from points of view of formal logic, practical methodology and metaphysics. The series of lectures under this heading shall x-ray issues arising from the various conceptions of science and their methods.

The aims and objectives under this part of the study shall include:

a. At the end of this section, students are expected to be able to state vividly the very origin of the scientific enterprise.
b. Students should be able to analyze the various conception of science with the view to offering an acceptable definition of science.
c. Students of HPS should also be able to identify and critically analyze the various methods of science.
d. Students of HPS should also be able to state and identify the Nature, and Structure of the discipline called science.
e. Students would also be expected to be able to offer vivid arguments for and against the various notions of science.

c. Part Three

Part three of this text is totally dedicated to the study of some of the most notable and influential **Scientific Schools of Thought** in **the field of Science** with the view to understanding the factors that influenced their thoughts and how these various schools of thoughts have molded and unfolded to what we presently have today as the discipline of science. From the thoughts of famous **Idealist** in ancient times, to the thoughts of **Realist, Rationalist, Empiricist, Materialist, Pragmatist** and **Determinist** of the present dispensation are some of the school of thought that shall be considered in this edition of the text. Our emphasis in this part shall directed at how these schools of thought have, and is still influencing the scientific enterprise.

The aims and objectives in this part shall include:

a. Students should be able to identify various thinkers with their various schools of thought
b. Students would also be expected to state the relevance of each of these schools of thought in the discipline of science

c. Students should also be able to identify which of these schools of thought is most influential in these contemporary times.
d. Students are also expected to offer vivid critiques to the various schools of thought under this part of the text.

d. Part Four

The fourth part of this text is devoted to studying the **various aims and claims of the scientific enterprise with regards to the Thinkers and their Methods.** No doubt, the methods of the scientific enterprises have over the years, raised a lot of issues and controversies arising from debates and discussions among philosophers and thinkers alike. The arguments we shall encounter in this part of the study shall be geared towards finding the authenticity of the various claims of these critical rationalist thinkers of science. We shall also consider the various critiques that have been offered for and against these methods which in most cases have been suggested to be infallible. The series of studies in this section shall also consider in some details, some specific critical rationalist thinkers and their postulations, with the views to finding whether these objections and critiques raised against the scientific enterprise are justified or otherwise.

The aims and objectives of the study in this part shall include:

a. Students at the end of the studies in this section, shall be expected to be able to identify and state the various critiques of the scientific process as presented by each critical rationalist philosopher/thinker.
b. Students should be able to identify the various laws and principles that characterize each dispensation.
c. Students shall be expected to identify the challenges that characterize the methods proposed by these thinkers.
d. Students should also be able to identify and state the similarity and differences that exist amongst the thinkers and their methods.
e. Students are also expected to be able to offer arguments for or against these methods and their thinker.

e. Part Five

In Part Five, Contemporary Issues in Science and Technology was considered. First on this list of issues considered was the controversy that surrounds the origin or evolution of man her on earth. On this subject, we interrogated most of the

arguments that have made headlines in this area of study. Our study here analytically considered most of the Darwinian arguments on evolution and the other arguments on creationism. The study on the '**Notions of Scientific Truth**' and the **Notion of Scientific Progress** was also carefully considered in this part with the view to ascertaining the degree of truthiness of their claims and the degree of progress if really any had taken place all this while. In all, the series of studies that we shall undertake in this part shall focus on critically analyze all the claims of truth and progress in the field of science since the beginning of the 16th century till date.

Some of the aims and objectives of the study in this section shall include:

a. Students here are expected to be able to vividly offer critical arguments for both the creationist and the evolutionist arguments about the origin of man.
b. At the end of studies in this section, students are expected to be able to state clearly, the major aims and objectives of the scientific enterprise with regards to their claims to truth and progress.
c. Students in this part are also expected to be able to identify and state specific progresses that science has made science inception if any really exist.
d. Students should also be able to say whether science explains reality or not.
e. Students should also be able to identify and state the role of science, if any, in human development.

f. Part Six

In Part Six, **Under Contemporary Science and the Quest for New Energy**, this text shall explore current trends in the field of science and technology with the view to capturing the direction and trends of thoughts in science and the effect and the influence it has had in the field of Science, technology and the human environment. Thus contemporary issues surrounding the Big Band theory theory, the quest for alternative sources for new and renewable energy, current issues on the subject of the ozone layer depletion and its consequences on man and his environment shall constitute the main focus of this part of the text.
We shall end the study with a review of past standard examination questions with their answers to help students practice and prepare for examinations in HPS.