

THE PHILOSOPHY OF SCIENCE. A DELINEATION OF ITS SCOPE AND BOUNDARIES

Jerry Obi-Okogbuo, B. Phil Hons, M.A., PhD Reader
Institute of Management and Technology, Enugu, Nigeria

Abstract

There is currently going on in our institutions of higher learning a worrisome conflation of the philosophy of science with some other areas of research especially the history of science, the sociology of science and science education. There are a number of reasons for this anomaly. The most pathetic is the conflation done because of lucre: the sordid material or pecuniary gain to be made from doing so. Sometimes the conflation arises from the confusion of a task of the philosophy of science to foster the unity of the sciences. Practitioners of such other sciences often tend to conflate the philosophy of science and the science. Sometimes the conflation arises from confusing the philosophy of science with its essential tool, the history of science. Historians of science often conflate philosophy of science and history of science. I suspect, however, that the more serious reason for most of the conflations is ignorance of the philosophy of science as a discipline on its own right. Whatever the reason for the conflation, this paper as the theme states, has the objective to delineate the scope and boundary of the philosophy of science and this implies establishing the objects, methodology and definition of the philosophy of science. This paper fills the need to present the philosophy of science as a distinct discipline, standing on its own rights, which does not need to be fused with any other discipline.

Keywords: Philosophy of science, objects of study, and methodology

Introduction

Introductions are not easy. One of the fathers of analytic philosophy, G. E. Moore (1873 - 1958) was once asked, “What is philosophy?” He pointed at his bookshelf and said: “That is philosophy” (Flew, 1979, p.3).

This ostensive introduction was Moore’s subtle way of acknowledging the difficulty involved in introducing a discipline. Be that as it may, there are two major approaches, both suggested in Moore’s cryptic answer, to introduce a discipline. They are the historical approach and the

analytic approach. The historical approach involves a chronological presentation of the literature on the historical development of the discipline with the aim to glean what the discipline is all about. This approach is laborious considering the amount of literature to cover. The analytic approach involves the analysis of the objects (material and formal), the method(s), the purpose, and aims of the discipline. It is called analytic approach because to clarify, it resolves the discipline into its constituent elements bringing out the subject or material object, the formal object, and the methodology. The analytic approach is what we intend to apply in this paper to delineate the scope and boundary of the philosophy of science as a discipline in its own right.

Subject-Matter of the Philosophy of Science

Each science studies a particular being or an aspect of reality. Philosophy differs from the sciences in that it studies all reality: physical, spiritual, logical or virtual. Philosophy tries to give intelligibility to the multidimensional facets of reality. Philosophy, so to say, delegates her daughters to tackle every kind of problem that confronts man. Philosophy of nature for as long as it lasted, for instance, studied the natural world. When modern science was born in the 17th century and in the 18th and 19th centuries became successful and triumphant in gaining positive knowledge of the natural world and in having immense practical gain to show for this, new challenges and problems and consequently new role was created for philosophy. The point being made is that when science usurped from philosophy of nature the study of natural world, philosophy was left with nothing but science and its challenges and problems as its object of study.

Philosophy of science is the branch of philosophy or the new discipline that emerged to play this role and take on these challenges and problems. It follows, according to the *Concise Routledge Encyclopedia of Philosophy* (2000), that the subject-matter of the philosophy of science is science: the scientific enterprise, scientific theories, experimental and observational reports of scientists. The scientists are usually busy with scientific research: the collection of data, the collation of data, formulation of hypotheses, the construction of theories and the discovery of natural laws.

The philosopher of science has the task of explaining and making sense of what the scientists do.

Formal Object of the Philosophy of Science

The formal object is the perspective or the point of view from which a discipline approaches its material object. For instance, psychology and anthropology are two distinct disciplines. Both of them have man as their material-object but while psychology has the *mind* or the *psych* as its

approach (format-object); anthropology has man's artifacts as its approach (formal object). Two disciplines may have exactly the same material object but no two disciplines have exactly the same formal-object. It is the formal object of a discipline that makes it unique and differentiates it from another discipline. This is the import of the Latin saying, *Scientia non duplicanda est* – sciences are not duplicated arbitrarily. A new science is born directly a new approach to being is discovered. In like manner, sciences are not fused together arbitrarily.

We can disclose the formal-object of the philosophy of science by contrasting the sorts of questions it raises about science with other questions.

In doing this, the formal-object of the philosophy of science will be displayed. Curd, Cover, and Pincock (2013) testify that “contrasting different sorts of questions can bring out the difference between the philosophy of science and other disciplines that study science” (p.xvii). They illustrate with the following questions: “When was the planet Neptune discovered?” “Why did Soviet biologists under Stalin reject Mendelian genetics?” “Why did James Watson underrate the contributions of Rosalind Franklin to the work that led to the discovery of the double helix structure of DNA?” These are respectively questions within the domain of history, sociology or political science, and psychology. Now contrast those questions with the following: “What is science?” “What is a law of nature?” “When is a theory confirmed?” These other set of questions is essentially fundamental and general and philosophical. They are not fact-finding questions. They cannot be answered by digging past happenings or by what people believe now. They cannot be answered by doing more science. They are fundamental, general, and philosophical questions about science. They are philosophy of science questions.

Just as there are many aspects of the scientific enterprise, there is a miscellany of such philosophy of science questions. Attempting these questions but more importantly raising them show the approach of the philosophy of science but over and above clarifies the scientific enterprise. Let us outline samples of these questions to show the formal-object and the unique approach of the philosophy of science.

Some of these questions of the philosophy science relate to the nature of science. Examples: What is science? How does science differ from non-science and pseudo-science? What are the criteria of demarcation of science from non-science and pseudo-science? What is the aim(s) of science? What are the goals of science?

It is also among the central concerns of the philosophy of science to raise questions about the epistemology of science, the theory of scientific knowledge, the cognitive aspect of scientific knowledge. Is set of questions relates to the investigation of the nature, genesis and sources of scientific

knowledge. How do scientists come by the theories they propound? Do the scientists come by their theories by educing hypotheses from the data of individual observations or by conjecture, supposition, inspiration, guess, hunch or dream? Is there a direct logical path from observation experiences to hypotheses? Or do scientists deduce their theories?

Some philosophy of science questions are about the nature of the relationship between scientific theories and the realities they talk about. This is the problem of the nature of the representative status of scientific theories. What is a scientific theory and how do scientific theories relate or represent the world? Should scientific theories be best understood as the logical empiricists do (as axiomatized sentences connected to their observational bases by correspondence), or as semantic theorists do (as models)?

Some philosophy of science questions relate to the evidence upon which scientific theories are based. These are issues relating to the secure base of science in observation and experiment. In this regard, philosophy of science asks such questions as, how are scientific theories to be accredited? Is it simplicity, explanatory power, pragmatism, or probability that accredits scientific theories? When a scientific theory is said to be accredited, what does that tell us about the theory, and the entities postulated by it? Are theoretical entities real even though unobservable?

Some philosophy of science questions are about the methodology of science. Such questions as, what is the method(s) by which science arrives at its posited truths about the world? Is there a logic of scientific conclusion, discovery and justification? Both the rationalist and non-rationalist philosophers of science agree with Nagel (1961) that it is the task, a major if not the exclusive task, of the philosophy of science to carefully analyse the procedure by which scientific conclusions are established.

There are also, philosophy of science questions related to the metaphysics of science, scientific concepts and values. Curd and Psillos (2008) put all philosophy of science questions into four groups: those related to the nature of science; those related to scientific theories and their relation to the world; those related to the nature of scientific concepts; and those related to the nature of theory-change or theory-choice and the place of values in science. What is to be noted about these questions is that they are philosophical in nature. They are questions that, though they are about science, can only be answered by philosophy and not by science. This indicates that the perspective of the philosophy of science to the study of science is philosophical.

The Method of the Philosophy of Science

In plain language, method is a set way of doing something, a procedure of getting a task done. In the epistemic community, method is the

process by which knowledge is produced. Boyd, Gasper and Trout (1991) define methodology as “The procedures and techniques governing inquiry, or the study of such procedures and techniques” (p.778). The question could then be asked, is there a method of the philosophy of science? Yes, there is a process of generating knowledge in the philosophy of science. There is a method of the philosophy of science. This is the method of philosophical analyses. The philosophy of science uses the method of philosophical analysis because, foundational questions, the kind that philosophy of science raises are philosophical question that often require the special analytic techniques of philosophical analyses for their resolution.

It should not be understood that philosophy of science has just one method. One method would prove inadequate to investigate the different ramifications of the scientific enterprise. The philosophy of science requires a great variety of procedures and philosophical analyses sometimes also called conceptual analysis takes a variety of forms. In one form, it is the procedure of clarifying or explaining a concept, belief, theory, question or even an answer by drawing attention to its constituents, presuppositions and implications. In a more narrow form; it is conceived as reductive analysis: a procedure in which the elements of a concept, belief or theory can be reduced to the elements of some other more basic concept, belief or theory. In yet another form, philosophical analyses means to provide the necessary and sufficient conditions that define a term. For instance, the term *bachelor* is analysed as *an adult unmarried male*. Being *an adult* and being *a male* are the necessary conditions for being a bachelor. The two necessary conditions added together give the sufficient condition for being a bachelor. In general, philosophical analyses are used to unload loaded statements; to unpack extra baggage, so to say; to render precise imprecision; and this is the central task of the philosophy of science.

Since the twenty-first century when philosophy of science emerged as a sub-discipline of philosophy and professional area of research, logic and history of science, have both together come to become necessary tools for doing and understanding philosophy of science. But this was not always the case and needs explanations.

Logic is taken as the language and tool of the philosophy of science. This view is plainly expressed by Kyburg, (1968, p. vii): “One cannot understand physics without knowing calculus. The same is true of philosophy of science. The philosophy of science can be understood without knowing physics (though perhaps not without really understanding some science), but it cannot be understood without some logic.” The point Kyburg is making is that the knowledge of logic or familiarity with it or a disposition to understand it is a *sine qua non* for doing philosophy of science.

Among the central tasks of the philosophy of science are making intelligible the scientific enterprise, the precise definition of scientific concepts, the validation of the model of reasoning in science, and the accreditation of scientific knowledge. Logic, formal logic, is a necessary tool which facilitates doing these for as Batens (2014) says, logic determines the meaning of logical operators such as ‘and’, ‘not’, ‘if...then’, etc.; logic assists one to achieve mathematical precision; logic helps in categorizing and putting issues in proper perspective and logic makes easy the drawing out of consequences and implications. In doing these logic facilitates making intelligible the scientific enterprise by the philosophy of science.

Some logicians, however, take exception to regarding classical logic as the true and standard logic. There are logicians who take as standard for specific purposes alternative logics such as intuitionist logic, dialectic logic, and interrogative logic. Classical logic has the shortcomings that it is essentially a deductive form of reasoning and it is also based on the presupposition that the world is consistent; that is, that there are no contradictions. But we know that there are other forms of reasoning such as induction, abduction and retrodution. We also know that in real life there are situations where contradictions co-exist or occasions we have to accept a statement and its negation. There are many logics suitable for different purposes. Logicians believe that the standard and “... true logic is a relevant one” (Batens, 2014, p. 60).

The view that logic is a necessary language and tool of the philosophy of science derives from logical positivism also called logical empiricism or neopositivism. Logical positivism was a predominant and influential approach in the philosophy of science, dominating the area for about thirty years. From its inception in the context of Moritz Schlick’s Vienna Circle, Logical empiricists regarded “... logic, formal logic... central for the philosophy of science” (Batens, 2014, p. 59). Their reason is based on the generally accepted distinction between the context of discovery and the context of justification. The context of discovery has to do with the subjective (historical and psychological) circumstances that cause the initial formulation of scientific hypothesis, theory or inquiry. The context of justification, on the other hand, has to do with the observed reality or observational consequences which cause the formulation of hypothesis, theory or inquiry. The logical empiricists entirely focused on the context of justification and in so doing failed to see that the context of discovery (subjective element) also impacts scientific progress. The logical empiricists saw objectivity as a characteristic of science and the scientific method as simply the application of rule to data. Thus they conceived the philosophy of science as the logic of science, and so as playing a normative function: the analysis of the logical-syntactic structure of the basic concepts of science.

This proved to be a severely restricted view of the philosophy of science and this was made evident by the criticisms of the historicists.

History of science, not surprisingly, has also today come to be taken as a necessary tool for the philosophy of science. This is just becoming current in the philosophy of science circle and this is in spite of the fact, as Bird (2014) observes, that the history of science itself has a long history, achieving disciplinary status in the nineteenth century following the initial efforts of William Whewell and securing that status in the twentieth century by the efforts of George Sarton. Sarton is acclaimed as the father founder of the discipline of the history of science. The reason history of science is just achieving currency is due to the domineering influence of logical empiricism and its exclusive focus on the context of justification in scientific progress.

Today in the twenty-first century, “historical” or “descriptive” philosophy of science, using the words of Bird (2014, p. 88) enjoys wide spread acceptance over “prescriptive” philosophy of science. Yet even among the historicists such as Thomas Kuhn, Imre Lakatos and P.K. Feyerabend, “the relationship between history of science and philosophy of science is a difficult one” (Bird, 2014, p. 85). While Kuhn holds that the relationship is “asymmetrical”, Lakatos thinks it is more “subtle”. By “asymmetrical” relationship Kuhn means that the philosophy of science needs history of science while history of science does not need philosophy of science. History of science could be a useful data for philosophy of science to ensure that the latter’s descriptions of science indeed match actual practice. The “subtle” relationship is explained in the *locus classicus*: “Philosophy of science without history of science is empty; history of science without philosophy of science is blind” (Lakatos, 1971, p. 91).

Lakatos appropriates Hegelian view that history has an underlying logic. There could be history, a mere chronology that fails to discover this underlying logic. A philosophical history should uncover this underlying logic in history. So what is needed in history, according to Lakatos, is not mere description but a reconstruction to unravel the rational (logic). To do this philosophy is needed. Hence the philosophy of science needs the history of science and vice versa. P.K. Feyerabend stands with Kuhn that even if philosophy of science is conceived as a normative enterprise, it should still need to be accredited by the history of science.

We should not dwell further in the “difficult” relationship between philosophy of science and history of science. It is not our thrust here. Our business is to demonstrate, and I suppose we have so done, that history of science has come to be widely accepted as a tool for the philosophy of science. The two areas now so impact each other that Bird (2014) records that in the 1960s and 1970s there became prevalent the establishment of programs and departments of history and philosophy of science.

Philosophy of Science: A Definition

Philosophers of science do not agree on a single definition of the philosophy of science. The reasons are not farfetched. In the first place, there is the convoluted nature of philosophy: philosophy has various conceptions. Secondly, science itself, even in its modern sense, does not admit of a single definition. Science is an analogous term legitimately used in diverse senses. Any definition of the philosophy of science presupposes a conception of philosophy and of science. Hence there are many conceptions of the philosophy of science. Thinkers in the Critique of Science Movement, a coalition of philosophers of science such as E. Mach, J.H. Poincare, E. Leroy, P. Duhem and H. Bergson, conceive the “philosophy of science as a work of criticism.” They are of the opinion that the philosophy of science should be able to expose the limitations of science. Some of these thinkers’ approach in the philosophy of science is anti-metaphysical while some preserve the validity of metaphysics (Wallace, 1967). In a different vein, Burt (1954, p. 27) says “the philosophy of science is a methodic skepticism about many of the traditional foundations” of the scientific enterprise. “Methodic scepticism” in this context means a critique, a vigorous philosophical analysis of scientific ideals and concepts. Mario Bunge proffers that the philosophy of science should more appropriately be a “Metascience”. He considers that the expression “philosophy of science” is too restrictive for the content covered in the discipline. He suggests “Metascience” which is broad enough to include “a Philosophy of, in, from, with, and for science” (Wallace, 1967, p. 1216). Some other authors conceive philosophy of science as a second-order enterprise. One such author is William Oliver Martin. He opines that because the philosophy of nature deals with nature and not with science, then it is about “first intentions”. But because the philosophy of science is concerned with “the philosophy of our knowledge about nature”, then it is actually a part of logic and as such is of the order of “second intentions” (Wallace, 1967, p. 1217). In yet another vein, Y. Simon conceives the philosophy of science as a “mélange” of elements from natural philosophy and modern science. He is of the view that the philosophy of science is a complex matrix lying on the boundary between philosophy and science. He writes: “When a philosopher informed of positive science or a scientist interested in philosophy considers philosophical problems raised by the study of positive question, the philosophical and the positive point of view appear successively in his exposition.... If there is an ascending analysis towards ontological concepts, the work is essentially philosophical; if there is a descending analysis toward definite experiences, the work is scientific. On such an understanding, the philosophy of science is a mélange of elements from philosophy and modern

science that cannot be definitely restricted to either discipline” (Wallace, 1967, p.1217).

From these various conceptions we can draw-forth a definition of the philosophy of science more or less generally acceptable. We can deduce that the philosophy of science is the discipline charged with the task of the analysis, evaluation, and synthesis of the philosophical problems associated with modern science. Put in other words, the philosophy of science is the investigation of the philosophical questions that arise from reflecting on science. Such philosophical problem might relate to the metaphysics of science, the epistemology of science, the methodology of science, or problems related to the end of science (its value, technology, ethics, politics and religion).

Branches of the Philosophy of Science

The philosophy of science could be divided into two major branches: “general philosophy of science and the philosophies of the individual sciences” (Curd & Psillos, 2014, p. xxiii). The latter is also variously referred to as particular, specific or applied philosophy of science. General philosophy of science endeavours to comprehend science as a cognitive enterprise, that in a special way is able to give creditable information about the world. It also strives to see science as one and unified. Thus it addresses general and foundational problems about science. For instance, what is science and how does it differ from pseudoscience? We have given elaborate treatment of this kind of philosophy of science questions in the section under the formal object of the philosophy of science.

The philosophies of the individual sciences or applied philosophy of science addresses more specialized problems within the individual sciences or particular scientific theories. This explains designations such as philosophy of physics, biology and economics. The development of this branch of the philosophy of science in the 1980s is consequent upon the shift in attention from the macro-structure of science to micro-structure of the individual sciences with its promise to address a broader range of philosophical questions about science.

In a similar fashion, Horwich, (2014, p. 589) also thinks that two sorts of the philosophy of science is distinguishable. They are “theory-Oriented philosophy of science” and “problem-Oriented philosophy of science.” Horwich explains that the theory-oriented philosophy of science aims at a detailed and systematic and accurate account of the scientific method. Problem-oriented philosophy of science, on the other hand, has to do with the resolution of deep puzzles and paradoxes that arise from reflecting upon science; such puzzles as induction, confirmation, prediction

and evidence. It is observable that Horwich's two sorts of the philosophy of science correspond to the general philosophy of science in our first division.

It follows that the two branches, though distinct, are not mutually exclusive. The views a philosopher of science holds in general philosophy of science should be compatible with those he holds in applied philosophy of science and vice versa. Perhaps the significant place occupied by foundational issues and consequently general philosophy of science derive from philosophers penchant for abstraction and universalization. But it also has historical support in logical empiricism. Logical empiricism, as observed earlier, was a predominant approach in the philosophy of science and it concerned itself with general and foundational problems. So the primacy of foundational issues and thus general philosophy of science is a vestige of logical empiricism.

Conclusion

The need for this paper is created by the worrisome phenomenon in many of our universities and polytechnics. This refers to the conflation of the philosophy of science with some other disciplines akin to it; such disciplines as the history of science, the sociology of science, or science education. The objective of this paper, as stated, is to delineate the scope and boundary of the philosophy of science; and this implies to establish the philosophy of science as a distinct discipline that could stand on its own and need not be fused with any other. The task of the paper is to establish that the philosophy of science has its own objects and methodology.

This paper successfully established the objects of the philosophy of science. It showed that the material object is science, the scientific enterprise. The formal-object is philosophical approach. And the methodology is philosophical analyses. In this way the paper delineates the scope and boundary of the philosophy of science and thus establishes it as a distinct discipline with "... its own professional structure, departments, and journals" (Curd & Psillos, 2014, p. xxiii). It follows that the conflation, the fusing and appropriation of the philosophy of science by subjects akin to it is not only unnecessary but counter-productive. The task of clarifying science using the special analytic tool of the philosophy of science is made impossible with every instance of conflation.

References:

Batens, D. (2014). The Role of Logic in Philosophy of Science. In Martin Curd & Stathis Psillos (Eds.), *The Routledge Companion to Philosophy of Science*. (2nd eds.) UK: Routledge.

- Bird, Alexander (2014) *The Historical Turn in the Philosophy of Science*. In M. Curd and S. Psillos (eds.) *The Routledge Companion of the Philosophy of Science*. London: Routledge.
- Boyd, R. Gasper, P. & Trout, J. D. (Eds.). (1991). *The Philosophy of Science*. Cambridge: The MIT Press.
- Concise Routledge Encyclopedia of Philosophy*. (2000). London: Routledge.
- Curd, M. Cover, J. A. and Pincock, C. (eds.). (2013). General introduction. In *Philosophy of science: The central Issues*. London: W.W. Norton and Co. Inc.
- Curd, M. and Psillos, S. (2008). Introduction. In *The Routledge Companion to Philosophy of Science*. UK: Routledge.
- Flew, A. (1979). *Philosophy: An Introduction*. Britain: Hodder and Stoughton Ltd.
- Horwich, P. (2013). Therapeutic Bayesianism. In Martin Curd, J.A Cover, C Pincock (eds.). *Philosophy of science: The Central Issues*
- Kyburg, H. E. Jr. (1968). *Philosophy of Science: A Formal Approach*. New York: The Macmillan Co.
- Lakatos, I. (1971). History of Science and its Rational Reconstruction. In R.C. Buck and R. S. Cohen (eds.) *PSA 1970, Boston Studies in the Philosophy of Science*. Viii, Dordrecht: Reidel, PP. 91-108.
- Nagel, E. (1961). *The Structure of Science: Problems in the logic of the Scientific Explanation*. New York: Harcourt Bruce and World Inc.
- Wallace, W. A.(1967). Science, Philosophy of. In *New Catholic Encyclopedia*. Vol. xii (pp.1215 – 1217). New York: The Macmillan Co.