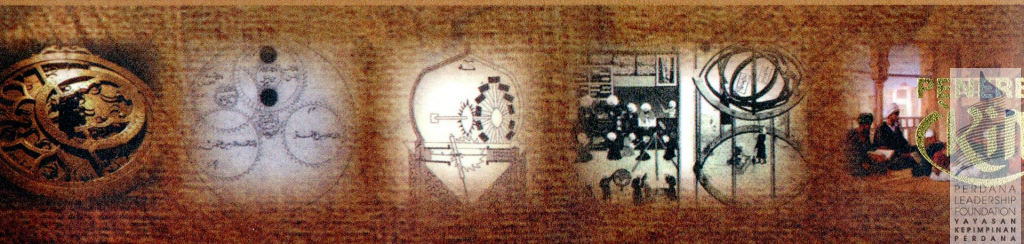


ISLAMIC

Scientific Tradition in History

Alparslan Açıkgenç





ISLAMIC SCIENTIFIC TRADITION IN HISTORY



Alparslan Açıkgenç

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To my Father
Kahrimanların Benli Abdullah
(as he was called)

Abdullah AÇIKGENÇ
(1925-2011)

A Life Dedicated for the Service of Humanity
Began in Zile, lived and served in Malazgirt and
completed in Ankara



PREFACE

The main objective of this work is to place the history of science and philosophy in Islamic civilization into the proper historical perspective. In order to explain what we mean by the proper historical perspective, we may briefly outline how history acquires meaning through its proper frameworks. In fact, history without a framework becomes almost meaningless. A framework is the outline of a period or epoch in the flow of time sequences. It is thus the border of an event, or a series of events in the history of a nation or a civilization. We may look at a historical occurrence from a very narrow perspective, in which case, we may understand that something is happening. But we may not be able to understand its meaning in history as a whole; nor can we ever extract the exact identity which that particular occurrence may endow the people involved in it. To give an example which I would like to borrow from Professor al-Attas,¹ this is just looking at the portrait of a human being from a very narrow angle, in which case, the part of the body in front of our eyes will look huge and we may or may not know that it is the part of a human body. All we know is that we see a painting. But we cannot identify the portrait. If, however, we try to enlarge our perspective as we go farther from the portrait, we can first see that it is the part of a human body, a little farther we can see that it is a human being and that it is a man, for example, or a woman. If we go to the right distance, we can see that the portrait is the painting of Sultan Mehmet II. If we go further from the painting, we can

¹ Professor Syed Muhammad Naquib al-Attas, a prominent contemporary Muslim thinker is the Founder-Director of the International Institute of Islamic Thought and Civilization (ISTAC), Kuala Lumpur, Malaysia.

attribute more characteristics to it, such as it is in a special room, next to so many other artefacts and that the room is in a museum and so on.

We can look at historical events in a similar fashion. If, for example, we examine Ibn Sînâ's theory of the planets and the motion of heavenly bodies, we can understand what Ibn Sînâ says about this subject and how he explains the movement of the planets within the heavenly spheres. But in order to understand why he defends such a system of universe and its significance for the history of astronomy, we have to move farther away from Ibn Sînâ's cosmology and search into the theories before him and after him. If, on the other hand, we would like to understand the significance of Ibn Sînâ's astronomy in the history of astronomy within Islamic civilization, then we have to look at his astronomy from this largest perspective which will then reveal its particular characteristic identity it gives to that history. This would mean examining the whole period beginning before him until the end of the relevant period in history.

What I have been describing as "moving in closer" to or "away farther" from the subject of historical study is the framework through which we look at history. Therefore, the "proper historical perspective" for the history of science and philosophy in Islam would be the grand distance from where we try to view that history. In order to get that perspective, we need to move out to a proper distance from where we can properly identify it. But how can we do that? We need to develop certain tools by which we can see that history from such a great distance. It is the purpose of this study to develop such tools by which the history of science and philosophy in Islam can be properly identified. We need an epistemology of science that will enable us to develop such tools. On the other hand, it is the basic thesis of this study that such an epistemology must be taken in history so that we can do our task adequately. This is because what we are dealing with is a process that takes place within a socio-cultural context of a space time continuum. In that case, we must add both of these aspects of history into our method; namely, when we

apply a certain epistemology of science, we have to do this with respect to the socio-cultural context and the space time continuum. The former would mean sociology of science and the latter a historical development which we have identified in this work as “scientific process.”

I am aware that I am struggling here with the difficult task of re-establishing the historical framework of Islamic scientific tradition on the basis of an epistemology which is developed in the first chapter. The rest of the book is basically application of this new historical framework to the actual events in Islamic civilization. It is clear that we are not doing here a history of science or a history of philosophy in the traditional sense. In fact, before this can be done properly, this epistemological ground must be prepared. Otherwise, the entire studies done in this area will remain as pieces of historical occurrences out of which no identity can be ascertained. For this reason, we are not going to expose in detail what individual scientists discovered or put forward in their respective times so that we expose their achievements. But rather, we shall try to see what they have done so that we have a history that is called “history of Islamic science and philosophy.” Therefore, our presentations of thinkers, philosophers and scientists and their achievements are based on existing histories. I do not claim any originality in this respect and that is why I have not done any hard historical research to bring their achievements to light other than what has been already known about them. In this sense, I would like to acknowledge my indebtedness to two encyclopedias: *Encyclopedia of Islam*, E.J. Brill, second edition, and the *Türkiye Diyanet Vakfi Islam Ansiklopedisi*. Both encyclopedias have scholarly researched articles on all these great scholars. In very few cases I did not check the original sources but all others given in the footnotes are searched and studied in detail also. I may not have been careful enough to cite proper references as many of my historical sources are competent in their areas. The experts can easily find these sources and their proper references. I did not have the required time to spend on checking some of my sources meticulously as it

should have been done. However, I assure my readers that they are all read out and thoroughly digested in the course of my research. Therefore, I acknowledge beforehand my indebtedness to my sources. Since this was done in a rushing manner, I apologize if some of my sources were not properly cited in the references. Some of the research in this work was done at separate intervals, as a result, different editions of the sources are consulted and indicated in the references.

My main purpose in giving the achievements of these scholars is to show the characteristics of each period and stage in what I call scientific processes. It is not the purpose of this work to present a history of science and philosophy and in this sense, it claims no originality. However, this work is original as it presents a new framework for the history of science in Islamic civilization. The method used here can be applied to the history of science in other civilizations, too. I would like to describe the approach adopted in this work as "the perspective of the scientific tradition." For this reason, it is not a study in the history of Islamic science, nor yet in the history of Islamic philosophy. Scientific achievements have been studied from the historical perspective; the present study is an investigation into the nature of a scientific tradition from not only the historical perspective, but also from the philosophical (epistemological) and sociological perspectives. More properly, it can thus be called a study of "Islamic scientific tradition in history".

I believe that a work of this kind is very useful not only to question our methodology used today in history of science and philosophy, but in any comparative study of intellectual history. Derk Bodde points to this fact quite clearly:

Only too often it is possible to find even notable western scholars making such statements as; "The Dark Ages in Europe brought the world to its lowest cultural level," quite oblivious to the fact that at that very period one of the most flavourings of human culture was taking place in China under the T'ang dynasty, and that the world's first printed book was produced in that country in the ninth century. Too many of us in the West still possess the viewpoint

described by the Chinese Taoist philosopher, Chuang Tzu, as that of the well-frog, who could see only the little circle of sky above his well, and imagined this to be the whole world. For too many of us the cultural heritage of Greece and Rome is still the world, at a time when comparative studies of civilizations are more needed than ever before, not only for gaining an understanding of these alien cultures, but also for the understanding of our own culture, which today stands in serious need of an impartial evaluation.²

Arabic words and scientific terminology was not transliterated properly into the Latin script because it makes it difficult for fluent reading. I rather adopted a middle road by simplifying the transliteration with just a few signs one would commonly come across in English also. Moreover, I avoided the definite article “al” in many places. The verses of the Qur’an are given as chapter number first and the name of the chapter after a slash thereafter the verse numbers are given. Sometimes, I used transliteration marks just to distinguish the word and omitted in the other usages of the same word.

Research for this book began in 1996 when I was given a position at the International Institute of Islamic Thought and Civilisation (ISTAC), Kuala Lumpur. I continued my research after I started teaching at Fatih University in Istanbul. When all the material was collected, the Institute of Islamic Understanding Malaysia (IKIM) provided a research grant for a term sponsored by the Permodalan Nasional Berhad (PNB). It was a productive stay in Kuala Lumpur in 2008 when I had the time to put together all my research into book form. The completion of my editorial work remained to be completed at my new appointment at Yildiz Technical University. I am grateful to all these institutions for providing a friendly atmosphere to work efficiently in order to complete my work; and particularly the then Director-General of IKIM, Datuk Dr Syed Ali Tawfik al-Attas, and Chairman, Tan Sri Ahmad Sarji Abdul Hamid.

² *A History of Chinese Philosophy*, “Translator’s Preface,” vol. 1 (Princeton: Princeton University Press, 1983), xi.

My special thanks to the present Director-General, Datuk Nik Mustapha Nik Hasan and the Chairman, Tun Abdullah Haji Ahmad Badawi, former Prime Minister of Malaysia for taking great effort towards the publication of this book. Dr. Wan Azhar Wan Ahmad, IKIM Senior Fellow, extensively ran after the technical editorial work and other related technical standardizations as well as improving the Bibliography, for whom I am very appreciative. My thanks also extend to Muhammad Na'im Kamarul Zaman, a trainee at IKIM, who, under the supervision of Dr. Wan Azhar, reconciled the earlier version of the Bibliography. Last but not least, I am grateful for my wife for her patience and support to complete my work.

Alparslan Açıkgenç
Istanbul

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INTRODUCTION

Human nature has an extremely complicated system. It is built upon layers of more complicated systems, some of which are biological and as such, accessible in experimental studies, whereas some of them appear as manifestations of these experimentally accessible systems eluding any experimental and observational scrutiny. Most of the issues to be dealt with in this chapter fall within the second category of human nature. There are some issues that seem to be accessible in experimental approach but when they are investigated deeply, one comes across impediments to be overcome and puzzles to be solved. As this may be the case, this study shall deal basically with two issues; one is the notion of “tradition” as reflected in the phrase used in the title of the book “scientific tradition,” and the other topic is the nature and historical process of such a tradition in Islamic civilization.

The first issue, namely tradition which mainly falls within the area of a sociological study may seem at first sight to present a problem to examine in relation to a human activity, the product of which is known as ‘science,’ that is primarily epistemological in nature. This problem actually forces us to pay attention to human nature in order to show that any human behavior is, no matter out of which system in our body it springs, is necessarily performed within a *community* and as such, it inevitably carries the character of the social context. This makes every human activity necessarily sociological which we shall briefly outline in this introduction.

The second topic may sound like a brief history of

science in Islam. But it is not such a systematic history if by the term “systematic” the chronological order of scientific activities and discoveries are understood. It is, however, a systematic attempt to capture “science as such” as a process within Islamic civilization. The difference between taking the history of science as a process and simply presenting a history of science is that the latter is a chronological account of the scientific discoveries in history, whereas the former, as it is understood and applied in this study is an attempt to capture how these discoveries are built one upon another and to unravel the mental states as frameworks of these achievements.

Although the issues mainly taken as the aim of investigation in this study are Islamic scientific tradition and its process in history, as one problem will lead to another, we will be forced to discuss many other problems surrounding these issues. As such, we need a working definition of science because this is a concept used in a variety of senses. It is the central aim of this introduction to attempt such a definition which is then applied to the sociological concept of ‘tradition.’ This way, we hope to develop afresh the fundamental concept of this work “scientific tradition” which is built completely on human knowledge system and as such, we need to outline it as epistemology of science in history, which is the task of Chapter I. In this chapter, we shall try to unfold the mental states that support scientific activities as human behavior. For, we shall argue that there are certain mental states that act as epistemological frameworks for our scientific behavior. These frameworks render science a product of a process in history, and since this process is continuous within a social context an activity that is purely epistemological, is colored with social traits of this context. We shall identify this approach as a new branch of study that can be justifiably entitled “historical epistemology.” In this book, as a preliminary approach, I shall take *historical epistemology* as “applied epistemology of science to the

history of a society or a civilization.”¹ I would like to argue that historical epistemology as a new branch of epistemology can explain how a new ‘tradition’ arises within a society which represents a civilization. But this tradition and the historical process leading to this tradition is governed by “human epistemology” which I like to call “human knowledge system.” This system consists of our external and internal senses together with mental faculties such as memory, consciousness, imagination, intellect and intuition. In this work, we shall not deal with our system of knowledge unless at certain places where we need to elucidate certain points on the basis of this system.²

The first chapter will, therefore, deal with the course this epistemology of science takes in a given civilization. This is what we identify as historical epistemology. In a sense, there will be a double application of epistemology: first, to scientific activities, which is epistemology of science; then this epistemology of science is applied to the history of a civilization. We thus discover the course which history of scientific awakening and progress takes in Islamic civilization that is identified in this chapter as “scientific process.” As this historical process develops, it reveals certain characteristics reflected in the attitude and mentality of the scientists involved in the process. The collection of these mentalities and attitudes together then with the special behavior exhibited by these scientists constitute a collection of mores

¹ As I was discussing this issue with my colleague Rainer Brömer who was wondering about this work when I was preparing it for the press, I mentioned to him about my discovery of what I call here “historical epistemology.” He informed me of Hans-Jerg Rheinberger’s work entitled *On Historicizing Epistemology: An Essay*, trans. by David Fernbach (Stanford: Stanford University Press, 2010). I would like to thank him for taking my attention to the works which appeared in the West on “historical epistemology.” But unfortunately as my work was already in press it was too late for me to incorporate what has been said in these works. I am hoping that in future I will be able to evaluate these works and try to show the differences and similarities, if any, between these two approaches, namely my approach in this work and the approach of those scholars in the West.

² For a brief outline of human epistemology utilized in this work, see Alparslan Açıkgenç, *Scientific Thought and Its Burdens* (Istanbul: Fatih University Press, 2000), Chapter 1.

and customs called “scientific tradition.” It is, therefore, important to explain the nature of scientific processes and try to understand how they lead to a tradition. The second chapter is an application of the epistemology developed in the first chapter. In other words, we shall attempt to show the epistemology of science in Islamic civilization and its historical process within that civilization. In this chapter, we primarily develop the first stage of the Islamic scientific process: The Worldview Stage (12 B.H.-80 A.H./610-700 C.E.).³

The third chapter traces the Islamic scientific process at the earliest of its stage, which is named here “The Stage of Problems.” At this stage there is primarily the early classical, Muslim intellectuals such as Muhammad ibn Hanafiyyah, Abân ibn ‘Uthmân, ‘Urwah ibn al-Zubayr, Zuhri, Hasan al-Basri, Mujâhid ibn Jabr, Ibrâhîm Nakha’î, Sa’îd ibn al-Musayyab, Ma’bad al-Juhani, ‘Umar ibn ‘Abdul ‘Azîz, Wahb ibn Munabbih, ‘Atâ’ ibn Abî Rabâh, Hammâd ibn Abî Sulaymân, Ghaylân al-Dimashqî, Wâsil ibn ‘Atâ’, Ibn Ishâq, Jahm ibn Safwân, Ja’far al-Sâdiq, Ibn Hishâm, Hishâm ibn al-Hakam, Awza’î, Abû Hanîfah and Sufyân al-Thawri.⁴ Mainly through the works of these intellectuals was there a tremendous accumulation of knowledge, which at its early stage, exhibits a chaotic structure and as such, the coming generations of intellectuals were having problems to follow the training program in the pursuit of knowledge. At this stage, there came scholars who were able to classify and systematize the existing accumulated knowledge. This way, the chaotic accumulated knowledge was disciplined and well ordered. This new development in the Islamic scientific process is called “The Disciplinary Stage” and investigated in Chapter IV. This way, each classified area of knowledge

³ For the sake of simplicity, I shall use mainly one system of calendar referring to Common Era (C.E.). The dates from the Islamic calendar are cited in important events and periods only as A.H. (after the *Hijrah*) and B.H. (before the *Hijrah*); “circa” is abbreviated as “c.” to indicate approximate dates; “d.” is an abbreviation for “died in.”

⁴ For a more practical reading purpose, I shall avoid the standard transliteration procedure and the definite article “al” from well known names unless they are unavoidable.

came gradually to represent an area of study called “discipline” or “science” in the technical sense (second and third centuries of *Hijrah*/700-950). Towards the end of the third century through the accumulation of more scientific knowledge in many different areas, a new outlook with a specific attitude towards knowledge and learning with its clear mentality emerged as Islamic scientific tradition. This historical development is investigated in this chapter.

After this development, Islamic scientific process entered “The Stage of Progress” (fourth-ninth centuries of *Hijrah*/1000-1500), which will be taken up in the fifth chapter. We shall trace the ages of progress made by Islamic science in this chapter and its further diffusion throughout the world thus, dominating the world of learning and scientific activities.

There are three more stages that need to be deliberated upon. But, I would say that these three chapters deserve to be taken up in another book. For the next immediate stage, we shall try to examine the impact of Islamic scientific tradition on the West. This will be followed by a study on the later progress and the eventual stagnation of Islamic scientific tradition. Unfortunately after the eighth century of *Hijrah*, namely the 1500’s C.E., scientific activities came to a halt and thus, Islamic scientific process entered a new phase. This new stage may be called “The Stage of Stagnation and Fall” (1500-1900). In the final analysis, we shall investigate the possibility of the return, or as the early philosophers discuss the problem of the return of the souls in the hereafter, let us utilize their concept, the *ma’âd* of Islamic scientific tradition. This shall give us a fresh enticement as to what to do to revive this significant scientific tradition. As my next work will be based upon this book which will hopefully see the daylight it will pay attention to what I shall call the “Global Scientific Process” as such it will pay attention to Islamic scientific tradition within the global perspective. This is because my analysis shows that in future there will no longer be scientific traditions belonging specifically to civilizations. For this reason most probably we will integrate Islamic scientific

tradition to the global current, which, I believe shall yield very successful results and at the same time turn science into a more beneficial enterprise for the humanity.

In order to efficiently present this grand project of the historical rise and progress of the Islamic scientific tradition from epistemological perspective, we need to develop certain tools and frameworks. As outlined above, the epistemological perspective will be developed in the first chapter. As an introduction to this perspective, we shall outline the concept of science as employed in this work. Then, we shall try to relate it to the concept of 'tradition' as understood here in relation to the scientific enterprise.

I. DEFINITION OF SCIENCE

It has been noted that a number of scientists systematically tried to codify the meaning of 'science' in a "precise way that would make it possible clearly to distinguish science from pseudo-science but they were unable to produce a satisfying definition."⁵ It is possible to find this complaint in all the works on history and theory of science. We shall also claim that it is not possible to produce a definition that is satisfying to all. This is because there is no single conception of science that is acceptable to all. Under such circumstances, how can we come up with a definition that is satisfactory to all philosophers and scientists? On the other hand, some historians of science and sociologists suggest that for something to be called science, it must submit knowledge to a "rational investigation and try to trace causal relations among its parts."⁶ Yet, others maintain that science is commonly used to denote one of the following:

1. A set of characteristic methods by means of which knowledge is certified;

⁵ Clifford D. Conner, *A People's History of Science* (New York: Nation Books, 2005), 10. See also his reference to Colin Macilwain, "Physicists Seek Definition of Science," *Nature*, April 30, 1998, vol. 392, issue 6679, 849f.

⁶ See William C. Dampier, *A History of Science* (Cambridge: Cambridge University Press, 1989), xiii.

2. A stock of accumulated knowledge stemming from the application of these methods;
3. A set of cultural values and mores governing the activities termed scientific;
4. Any combination of the foregoing.⁷

All these attempts are not proper definitions of science, but rather try to provide certain criteria by which we can distinguish science from other kinds of knowledge. We claim that if science is taken to mean one of the above, taken singly or in any combination of the above or the combination of all, then science is definitely misconceived. In that case, what can we do in order to produce a definition of science that would be satisfactory to most, if not all, scientists? First of all, if we examine the definitions provided for science, we shall find in all of them that each definition cites a criterion that is extremely important only for the scientists attempting that definition. Secondly, what they provide in these definitions are only certain characteristics of science as it is conceived by them. They never take into account how science is conceived by the scientists of other scientific traditions. For, if they did, they would have tried to find the common characteristics shared by all scientific traditions. Of course, if we claim this, they will raise the question whether there is or are any characteristics that are shared by all scientific traditions. We claim that there are such characteristics but the problem is, what kind of a method one should develop in order to deduce these common grounds. We shall develop an epistemology of science in the first chapter that can cope with this problem. In this context, we may offer only a simple solution as a part of our general theory of knowledge on which such an epistemology of science should be built.⁸

We shall claim in this vein that the systems in human nature are uniform and as such, they provide common characteristics under all circumstances. If we compare the

⁷ Robert K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations*, ed. Norman W. Storer (Chicago and London: The University of Chicago Press, 1978), 268.

⁸ See footnote 2.

human digestive system, for example, anatomy will tell us that this system is universal. But the culinary tradition is not universal and as such, if we try to look at the culinary traditions humans developed in their civilizations, there will be diversity. We cannot claim as a result of this diversity that every human being has a different digestive system and that is why it is not possible to give a uniform definition of the art of cooking. True; if we look at the diversity of the characteristics of culinary art in every tradition, it is not possible to come up with a definition that is satisfactory to all chefs. But if we look at the uniformity of our system of digestion, then we can attempt at deducing only the common characteristic(s) by which there would be a uniform definition of the culinary art. This definition will not obviously reflect all the diversified characteristics found in all traditions. It needs not do so because everyone then can add his own understanding into the definition.

We may apply this analogy to our system of knowledge. We thus claim that human epistemology as a system is uniform and does not change from culture to culture. But its output is diversified just like the culinary cultures. All we have to do is to decipher the features in our system of knowledge that is the ground of this uniformity. Since science is basically a “knowledge-acquisition activity,” then we must admit that it is as such based on our system of knowledge. Let us then attempt to find the uniform elements of this system which is reflected in all scientific traditions. In this respect, we shall find above all that science is *disciplined* knowledge that is reached as a result of a particular human behavior called scientific activity. As such, the product of that activity constitutes “a body of knowledge,” organized in accordance with the principles and methodology that emerge as a result of this activity. The activity itself is not science as claimed by many.⁹ Rather, the product of that activity is *science*. This

⁹ Almost all the definitions or rather attempts to explain the meaning of science associate science with “knowledge-producing activities.” See for example Conner, *History*, 11; Muzaffar Iqbal, *Science and Islam* (Westport, Connecticut: Greenwood Press, 2007), 6 and 21-2; and Ibrahim Kalin, “Three Views of Science in the Islamic World,” Ted Peters, Muzaffar Iqbal, and Syed

means that science as a disciplined knowledge is the product of a long historical process within a certain social context, a context which can be perceived as a civilization.

If science is taken strictly to refer to disciplines, it cannot but exist only as the output of scientific activities carried out within a *consciousness* that the subject under investigation can be organized into a body of knowledge. In order to reach at a working definition of science, therefore, we need to examine only the essential characteristics of disciplines. For, other characteristics belonging to these disciplines individually, and to scientific activities, in a stricter sense, do not constitute what we ordinarily call 'science.' Individual characteristics of disciplines are what make each individual science distinct from each other, and as such, they cannot be taken as criteria in the definition of sciences. Moreover, contextual characteristics each science may acquire from the scientific tradition to which it belongs cannot also be included in our definition. For, we accept these characteristics as general mental framework in which scientific activities are carried out. That is why they give their color to science. We must, furthermore, understand that science is essentially a knowledge acquisition process; as such, it should be defined from an epistemological perspective. It is, therefore, possible to observe in the present conceptions of science, an emphasis on one or more aspects of science. The sociological conception, for example, views science as a social phenomenon; the historicist school takes it to be primarily a process, and the positivist approach pays attention only to its cognitive aspect. Yet, many others hold science to be an activity. If we combine all these aspects, we shall find that science emerges as a result of a long process of learning. At some point of this process, members of that learning tradition become aware of the fact that a systematic arrangement of each subject which has been investigated by their predecessors constitutes an organized body of knowledge that can be named. By this time, that organized body of knowledge has already

Nomanul Haq, eds., *God, Life, and the Cosmos* (Aldershot: Ashgate, 2002), 47–76.

acquired four fundamental characteristics; having a well-defined subject matter, clearly formulated methodology, a body of theories and accumulated scientific discoveries. This development requires a historical process within which arises a consciousness from our epistemological constitution, which I call “scientific consciousness.”

Scientific consciousness is actually a characteristic of our faculty of knowledge through which we perceive things in unity. In a sense, it is an epistemological function of our mind, and as such, has nothing to do with science *per se*. But I would like to call this epistemological function “scientific consciousness” because it is through this function of our system of knowledge that we perceive a classified subject of learning as a unity that can be given a name and it is that unity of the organized body of knowledge under that name that we later call and perceive as ‘science.’ We thus came to perceive science as a unity of organized body of knowledge, and as such, science acquires the character of scientific consciousness from our faculty of knowledge. Therefore, the organized body of knowledge is *named* through it as a result of which individual sciences arise. We may thus offer the following definition:

Science is an organized body of accumulated theoretical knowledge and discoveries, named through scientific consciousness which arises as a result of the process of investigating a well defined subject matter with a certain method.¹⁰

In this definition, we find the four uniform characteristics of science, viz., subject matter, method, theory and accumulation of scientific discoveries (knowledge) together with what I have tried to explain as “scientific consciousness.” If this characteristic of our system of knowledge is not included in the definition of science, we cannot accurately describe this phenomenon of acquiring knowledge. Hence, we argue that scientific consciousness is an integral part of the concept

¹⁰ This definition is based upon my previous definition which I have given in my earlier works. E.g., see *Scientific Thought*, 16. I do not think that I depart significantly from the earlier definition.

of science, without which science cannot be adequately interpreted. In fact, because of this feature of science, earlier studies in ancient Egypt and China do not constitute what we call “science” today. I do agree with Dampier’s observation that “The earliest and most successful of such attempts was the conversion of the empirical rules for land surveying, mostly derived from Egypt, into the deductive science of geometry, the beginnings of which are traditionally [and one may say correctly] assigned to Thales of Miletus and Pythagoras of Samos, while the final formulation in ancient times was made by Euclid of Alexandria three hundred years later.”¹¹

Although we may specify this definition as universal, the application of it by different scientists can never be universal. This is because the application of a certain concept requires a *conceptual environment* together with its social context which is necessarily different in each case. I hope that it is clear what we mean by the ‘conceptual environment’; we try to refer to the worldview of individuals within which scientific activities are carried out. Therefore, the above definition takes science to be primarily a product of knowledge activities. But this product, we are arguing, is not yielded haphazardly; rather, it is organized in accordance with the principles and functions of the faculties in our system of knowledge. Therefore, science definitely has a cultural aspect which we call its “context” and has an epistemological ground that is based on our system of knowledge. The conception of science within a certain context may reveal differences because the scientific community may develop different ways of doing science and carrying out scientific research. But the latter, namely the epistemological ground will remain universal and unchanged from one context to another.

I believe that I have sufficiently explained the concept of scientific consciousness as used in my definition. There are four more concepts that are used in the definition that need clarification; subject matter, theoretical knowledge (by which I would like to refer to the body of theories in a

¹¹ Dampier, *History*, xiv.

science), method and finally accumulated body of theoretical knowledge and discoveries. I need to further dwell upon these individual issues because these are also concepts that may be perceived differently in different traditions. I do accept these differences which make it difficult to define science. But as these concepts are also based upon the human epistemology, namely our system of knowledge, then there must be universal aspects of these concepts as well. I may thus try to lay bare the universal aspects of these concepts, namely, their epistemological content.

1. Subject Matter

Logically speaking, every human activity has an object, but usually objects of such general activities are not defined as subject matter. In that case, only those activities that are aimed at learning must have objects of study which can be defined as 'subject matter.' Even this broad characterization does not qualify any subject of study to be science. For, a subject of study usually defines its subject matter in such a way that it includes as subject matter only those objects, entities and phenomena which can be classified only under that subject matter; it thus excludes all unrelated subjects of inquiry. It is in this sense that we claim the subject matter of a science is well defined. Though a subject matter is essential for a body of knowledge to be science, the kind of a subject matter is determined for a specific science by the convention of the scientists involved in that activity. This means that even this characteristic of science has two aspects: one, epistemological and hence, *a priori* renders it to be *uniform*; and the other is sociological, hence conventional, and thus relative to the community of scientists involved in specifying that subject matter. The fact that our mind requires a clear cut subject defined for an inquiry constitutes the former aspect; and the fact that a certain type of topic is chosen for a certain discipline constitutes the latter. It is because of this epistemological and sociological nature of the subject matter that we sometimes find the same science having different problems in different civilizations. But one fact never

changes in all these different civilizations; having a well-defined subject matter delineated for a specific science.

A subject matter can be well-defined if there is a sufficient accumulation of knowledge around that subject of investigation. The accumulated knowledge includes not only the discoveries in that learning activity, if there are any at all, but also the theories developed and the methodology used in these activities. In fact, once the subject is defined and limited by excluding other discussions in the learning activities through the efforts of the scientific community involved, there usually arises a method of investigation which is peculiar to that subject matter. Therefore, a well-developed method is also essential for the newly-emerging body of knowledge to be qualified as science.

2. Method

The manner in which a scientific investigation is carried out constitutes the concept of method as an essential characteristic pertaining to science. The concept of method may be perceived differently in different scientific traditions. But the fact that for a body of knowledge to be called 'science,' it must have a *method*, whatever that method may be and in whatever way it may be conceived, is a requirement of not only convention but also of our knowledge system. Therefore, it is not a mere accident that in all traditions of learning in which there emerged an organized body of knowledge with a specific name of *science*, only those knowledge-seeking activities that are carried out with a certain method are regarded *science*. This is so clear with regard to Islamic scientific tradition that the concept of method itself is also investigated as a science, called *methodology*, and '*ilm usûl*.

3. Scientific Theories

Science is essentially theoretical knowledge. If we examine all sciences, we shall find that the greater majority of information found is a collection of theories. This is because science is always after the unknown. So, if something is discovered in a science it acquires the status of the *known*,

and as such, it is gradually put outside the scope of that science. Since our mind works its way from the known to the unknown we need new discoveries in sciences in order to come up with better theories. But as soon as there is a sufficient accumulation of theoretical knowledge that acts as the known, then the previously discovered scientific knowledge becomes general information, and thus may be taught only at elementary level in order to train prospective young scientists.

We must be careful that any theoretical knowledge cannot be qualified as a 'theory.' When a method is applied to a certain subject matter, usually a provisional formulation, called "theory," is reached. Just as a science cannot be without a method, in the same way, it cannot be without a body of theories. Though this is a universal characteristic belonging to science, the way a theory is conceived and required to be formulated is by no means universal to all the scientific traditions.

4. Accumulation of Knowledge

I borrow this concept from al-Ghazâlî (d.1111), who did not admit metaphysics as a science primarily because he did not admit that there is any possibility of having an accumulation of discoveries that would count as fresh knowledge in metaphysics. Ghazâlî defended this thesis on the basis of his argument that although philosophers agree upon the solution of many mathematical problems, and we may add to this upon the solution of the problems in physics and astronomy, metaphysics has never succeeded in reaching a conclusion upon which all philosophers agreed.¹² This is because there is no scientific discovery in metaphysics which would lead to the accumulation of knowledge, and hence, it is not a science. The same thesis is defended by Kant 600 years later.¹³ Both philosophers argued from an epistemological

¹² Abû Hâmid al-Ghazâlî, *Tahâfut al-Falâsifah*, ed. by Maurice Bouyges, S. J. (Beyrut: Al-Matba'at al-Kathulikiyah, 1927); especially p.39 and "The First Introduction."

¹³ See Immanuel Kant (d. 1804), *Critique of Pure Reason*, trans. by Norman Kemp Smith (New York: St. Martin's Press, 1965).

perspective and therefore, their conclusion is a uniform characteristic of science. We must admit that there is a huge accumulation of theories in metaphysics and these theories are formulated perfectly in accordance with the requirement of a scientific tradition, and in that sense, one may assume of their construction scientifically, but they stand in no position of ever being proved or disproved. Hence, accumulation of a certain type of knowledge is possible in metaphysics. But the arguments of Ghazâlî and Kant give us a good clue as to reject the claim of metaphysics being a science. As a result, we draw a characteristic of science based on our system of knowledge.

We must, on the other hand, admit that the accumulation of knowledge already includes in itself the methodology of that science, as well as the discoveries made and the theories constructed in that science, especially the current ones. Then, that organized body of knowledge is *named*. Naming an organized body of knowledge is forming it into a science, which requires a group of scholars working in a specific subject matter for a period of time, which may take centuries. Therefore, there must be certain unifying principles not only recognized by the members of that group, but accepted and elaborated by them as well. In this way, a tradition is established by the group, which thus constitutes a *community*, which will be called in this work 'scientific community' that roughly corresponds to the term utilized in Islamic scientific tradition as '*ulamâ*'. If it is such a community to name a science, or in some cases it may be just one prominent member of that community to name it, we can argue that naming a science is a process, which will be elaborated in the subsequent chapters.

II. THE CONCEPT OF SCIENTIFIC TRADITION

We shall try to show in this work that the way a *group* of scientists carry out their scientific activities constitutes a 'tradition' that carries the mentality developed in that community as a framework of these activities. We shall call

ISLAMIC Scientific Tradition in History

This work is a scholarly blend of history and philosophy. Its main objective is to place the history of science and philosophy in Islamic civilization into a proper historical perspective. Attempting to provide a framework of history, this book aims at developing tools by which the history of Islamic science and philosophy can be properly examined and identified. To adequately carry out of task, the author argues that we need an epistemology of science that must be extracted from history. In short, this piece aspires to re-establish the historical framework of Islamic science tradition. 'Science' and 'scientific' here are not to be understood exclusively as referring to empirical or experimental disciplines dealing with the physical phenomena, but rather, more inclusively, they portray a systematic and formulated knowledge of a specified subject. The work is original in the sense that it offers a new framework for the history of science in Islamic civilization, which is interestingly applicable to other civilizations as well. It is an investigation into the nature of a scientific tradition not only from the historical perspective, but from the philosophical (epistemological) and sociological perspectives as well.

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