SCIENTIFIC COMMUNITY AND THE SCIENTIFIC PROCESS

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ABSTRACT

There are some sociologists who claim that science is a social institution, and as such there is an obvious need to study it from this perspective.[1] In this sense, they argue that the sociology of science is concerned with the social structure of science in order to define the nature of scientific ideas and describe their relations both to other kinds of ideas, such as philosophical, theological and aesthetic, and to various institutional and personality factors.[2] This cannot be acceptable to us; for science is defined here primarily as a body of organized knowledge; and therefore, it cannot be defined at the same time as a social institution. There are certain social institutions which can contribute to the emergence and development of sciences; but this cannot render science a social institution. If science cannot be defined as a social institution, then obviously sociology cannot deal with its nature and structure. The main reason for this is that as a body of organized knowledge, science is primarily a cognitive activity and as such its real nature can be dealt with only in the epistemology of science, which can be taken as a branch, or simply a subject, in the philosophy of science.[3]

Keywords: Scientific community, scientific process, sociology of science, epistemology of science

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1 The main proponent of this thesis is Robert K. Merton; see his *The Sociology of Science*, ed. by Norman W. Storer (Chicago and London: The University of Chicago Press, 1973).

2 See Bernard Barber, "The Sociology of Science", *Encyclopedia of Social Sciences*, q. v., 92.

3 This article is based primarily upon a previous work by the author. See *Scientific Thought and its Burdens* (Istanbul: Fatih University Publications, 2000), especially Chapter 3.

The fact that science is not a social institution does not mean that it has no social aspect; for no human phenomenon can escape the social aspect. Moreover, if we can talk of a scientific tradition we must at the same time accept that there is a *community* (of scientists) who establish such a tradition. In that case sociology of science must discuss primarily the nature and structure of such a *community* and how it can shape science. But at the same time we must state that every sociology of science must take into account the epistemology involved in scientific activities.[4] This is primarily because science, as a discipline, is not a social activity; if we take every human action performed within a society to be necessarily a social activity, then actions done without any relation to a social context must necessarily be considered as such. Scientific activities of a community of scientists can be social, but its product, as a discipline can have only social aspects, because of the fact that such activities are carried out within a mental framework which is the dominant worldview of that society. In this sense, we can distinguish primarily two issues that are fundamental to our history that need to be examined sociologically: the first is to understand the nature and the social character of the group of scholars who are actively engaged in scientific activities, to which we shall appropriate the already existing term *scientific community*; the second issue is to understand, interpret and disclose the real nature of the process through which a science comes to emerge within a society as a discipline, which we have already identified as *scientific process*.

It is through the worldview of the group of scholars working under one scientific tradition that gives science its social character; such a group of scholars constituting a unity in outlook and scientific conceptual scheme is called 'scientific community', or *'ulamâ'* in the Islamic scientific tradition. Our definition of scientific community or *'ulamâ'* leads us to ascribe all social aspects found in scientific activities to this community rather than directly to science. For, there is a reciprocal relationship between science and society. We may now lay down the following characteristics of a scientific community in general, which lead to that kind of a mutual relationship: 1. methodological aim; 2. scientific ideals; 3. formal linkage; 4. marginal ideals. Of course particular scientific communities will have more characteristics than what we have enumerated here. For instance, in the Islamic case, the scientific community, called *'ulamâ'* has characteristics which other scientific communities do not have, because of the

4 Almost all sociologists dealing with science never take into account the epistemology of science. If we do not consider how we acquire scientific knowledge how can we deal with its sociology? For instance, Robert K. Merton notes that "the subject-matter of the sociology of science is *the dynamic interdependence* between science, as an ongoing social activity giving rise to cultural and civilizational products, and the environing social structure." *Social Theory and Social Structure* (New York: The Free Press, 1968), 585.

Islamic worldview and the worldview of the other scientists. We shall point to some of the characteristics of the Islamic scientific community that follow from the Islamic worldview in the next chapter.

A scientific community is a necessary element for the emergence of a scientific tradition, and hence, prior to it. In fact, for the existence of a scientific tradition a pre-scientific community is required with a long history, which we tried to describe in relation to the contextual causes. But the way this community leads to the emergence of sciences will be shown below in our exposition of the scientific process. When the initial group of scholars begins to work on certain issues, they attract students who are interested in their knowledge seeking activity in the way they carry it out. In this way a *group* is formed as a result of their knowledge-seeking activity. We may pose a question concerning this new emerging group *vis-à-vis* the larger group within which they live, i. e., their society: what is it that distinguishes this group of people from their fellow commoners? It is possible to cite two characteristics that belong primarily to the group of scholars which their fellows of the same society do not have: first is that the group of scholars are those who are interested in knowledge-seeking; second but more importantly is that their interest in knowledge-seeking is in a way that is more systematic and methodical, which distinguishes them from the same activity that may be manifest by everyday people; therefore, that which brings scholars together as a group is the methodological aim of their activity, not the daily needs of life. In fact, the daily needs of life bring them together with their other fellow beings into the same society, but not into the scientific community.

It must be clear that the aim and objectives of the scientific community is different from that of the general society in which it emerges. Its primary aim is knowledge-seeking, which is an aim that is very broadly identified here so as to include all scientific traditions. It is possible for the Islamic tradition, for example, to have other aims as well. To pinpoint all the characteristics of a scientific tradition requires research within that tradition. This characteristic of the scientific community is what identifies science as a cognitive activity which thus necessitates its definition in terms of discipline. The common objective of the scientific communities is the search after truth. In fact, it is this derive to truth that attracts most members of the scientific community, though it may be more idealized in certain traditions, such as the ancient Greek scientific tradition.

This aim to pursue knowledge and having the objective of searching for truth leads the group of scholars to organize their community in accordance with the needs and requirements

of their activity. Once such an attempt is made a cognitive organization is usually achieved in almost all scientific communities. For the *cognitive organization* is required by our epistemological nature; if all humans acquire knowledge in the same way then there will necessarily be similarities as a result of their epistemological nature. *Cognitive organization* means setting up the necessary means and the tools needed not only executing their search for knowledge and truth, but also teaching the knowledge they acquired and the ways in which they thrived to search for that knowledge. In this way an educational initiation prepares and thus passes on the scientific tradition developed by the earlier members of the scientific community.

From the fact that the aim and organization of the scientific community is different from those of the general society, we may infer that the scientific community acquires another methodological aim in that most members, if not all, accept the fact that knowledge-seeking activity must have a method. It is this characteristic together with the scientific consciousness that conventionally gives rise to identify their activity as science. We, therefore, distinguish the scientific community from its society with respect to their aims and organization; all characteristics that distinguish both groups of people from each other are expressed here as 'methodological aim', because, as we have shown, they are primarily related to the cognitive aspects of the activities of the members of the scientific community which involves their method. But the scientific community usually idealizes these aims, which do not belong as characteristics to the society in general. We have identified these characteristics as *scientific ideals* that may belong to any scientific community.

There are certain scientific objectives which may change from one scientific tradition to another, such as the fact that there are impersonal criteria, impartiality and even certain moral ends that are attached to scientific inquiries. All such objectives that are idealized in a scientific tradition can be referred by a general name as 'scientific ideals'. Since the term *science* is strictly applied to the product of the activities of a scientific community in the sense of discipline, scientific ideals cannot be applied to science, but only to the scientific community and their usual practices, the product of which is science.

Merton applies the scientific ideals to science as a social institution and uses the term 'disinterestedness' to refer to them.[5] First of all, there is no institution called science; however, there may be in a society an institution that is governed by the scientific activities and thus can

5 Robert K. Merton. *The sociology of Knowledge: Theoretical and Empirical Investigations*, ed. by Norman W. Storer (Chicago and London: The University of Chicago Press, 1973), 275.

be called 'scientific institution'. Science has only four characteristic elements; subject matter, method, a body of theories and accumulated knowledge, which we have discussed above in our definition of science. Secondly, it is clear that all these elements are intimately related to our epistemological constitution and thus are cognitive, not social. Therefore, ideals cannot belong to science, but rather to the scientific community as defined here.

We cannot count scientific ideals in a general way because each scientific community depending on their own scientific tradition has a different set of ideals. But the following may be enumerated as scientific ideals that belong to some scientific traditions with a varying combination; passion for truth, quest for knowledge, benefit for humanity, disgust for plagiarism, sincerity for impartiality, request for and high esteem of originality, scientific objectivity and even commitment for the scientific method acquired from the former masters.

Science, as we see it, is the product of also a master-student relationship which is linked in an unbroken chain of successors and followers to produce a tradition. It is this self-maintained continuity that we call 'formal linkage' as a characteristic of the scientific community. We referred to it briefly in relation to the concept of originality above, which may be found in this formal linkage as providing continuity. It is indeed the scientific community that prepares the ground for such a scientific continuity which thus enables the establishment of a scientific tradition at the same time.

The formal linkage as a characteristic of scientific communities is based like the others upon the epistemological make up of our faculties of knowledge. For instance, we do science in the way we learn from our instructors, just as we live in the way as we *learn* from our environment including our parents and social surrounding. This learning cannot be transcended totally, but only minimally which is what we call 'originality'. Therefore, *originality* is a break from the tradition and it cuts of the usual continuity of a scientific tradition, although *it is* the necessary element of continuity of scientific progress. On the other hand, since originality itself is the product of the continuity implanted within the formal linkage, there is a superimposed formal continuity that governs the very process of originality itself. Therefore, when such originalities are continually attached through the formal linkage, a new scientific scheme is produced in individual sciences; a process that may take hundreds of years. For example, the Ptolemaic and the Copernican models in astronomy; Aristotelian dynamics and the Newtonian mechanics in physics; the Ash'arite atomism and the existentialist theory of creation by the sufis (Muslim mystics) in Kalâm.

Since formal linkage is also a necessary element in the rise of a scientific tradition, no

scientific community can avoid to dispense with it. The establishment of such a link requires a well-organized teaching system and an educational institution. Such establishments make its product, i. e., science, seem as a social institution. But as we have demonstrated, it is rather the community involved in such activities together with all its establishments that must assume the social character. It is for this reason that we assign the formal linkage as a characteristic of the scientific community.

There is also a set of rudimentary characteristics which appears peripheral to scientific activities, such as scientific career and education should be open to talents, scientific activities must be supported not only financially, but socially and politically as well. All such idealized principles of a scientific community we term 'marginal ideals'. In this context we do not think that these are important in any way, except for the history of education. Therefore, we shall not concentrate on the marginal ideals, and try to apply our conclusion to the process through which sciences emerge, viz., the scientific process.

Since this process may sometimes take years, usually generations of scientists are involved in its development. As a result, not only a group of scholars at a particular time, but rather a group of generations of scholars in a sequence of time periods may involve in the scientific process. If there is no uniformity in the social and epistemological structure of these scientists, there cannot be a uniformly organized body of knowledge called science. If, on the other hand, there is a uniformity between these scholars, we may, lacking a better one, adopt the term *community*, since at least one significant aspect of a community is uniformity; especially if this uniformity is of a social character, then we can talk of a community with some justification. This community has already been identified as 'scientific community'. In order to see how this community is formed gradually through a natural process, we can just imagine the earliest human history when there is absolutely no science. We do see, however, that at some point in history there arose those who are simply interested in *knowing* certain problems in a way others do not *know*. We must keep in mind that the reason for the gathering of such a group is essentially contextual in character as explained above. But once this gathering happens the temperament of these people must also be taken into consideration in that they are somehow inclined to know things in *a different manner*. There are many *modes* in which we can know things; but there is one way of knowing things, which is not only systematic and organized, but also it questions its own findings. In other words, this way of knowing is not satisfied by just having an information about the subject of inquiry, it rather questions it and analyzes its findings, if any, or else its own mode of handling the inquiry so that it can actually know

the thing inquired as *it* is. If in this way someone establishes himself, there usually grows around him a group of interested disciples who are also interested knowing things the way the *Master* knows things. As soon as this happens, then this group of people have a good chance of establishing a tradition of studying things in order to know them in a way that is different from the ordinary way of knowing things.

Let us suppose that this group of people who are interested in knowing things as they really are have established a tradition. Usually, as we have argued in the second chapter, we name something in order to be able to communicate about it, as this is also one natural operation of our intellect to name things in order to produce concepts about them. The tradition thus established also will be *named* because as we have said these groups of people are interested in knowing things in a way that is different from other types of knowing. In that case they will give a name to it, i. e., they will produce a concept expressing their activity so that they can distinguish it from other activities of knowing. We usually choose names, or concepts from the related activity; since the activity is *knowing*, the best name for this tradition is also *knowing*. That is why in the Greek tradition Aristotle gave the name *episteme* for science; in Islam first, as we shall see, the term *fiqh* (to grasp, comprehend, which still means 'to know *differently*'), then '*ilm* is used to name sciences; in the Western scientific tradition also the Latin term *scientia* is used for this purpose.

The time that passes in this naming of the activity varies from civilization to civilization. In the Greek case, for example it took almost five hundred years until Aristotle finally came up with this name; in the Islamic case, if we take the date of the first Revelation, 610 A.D., as the starting point, we can say that it took about 150-200 years until the term *fiqh* is used in this technical sense (we shall investigate the history of this usage in the following chapters). This means that it takes not only a scientific community to establish sciences, but also the nature of our faculties of knowledge is required in this process. We may illustrate this on the basis of our historical account: the first master gathers students around him, then some of these students also establish themselves as authorities in *knowing*. They may begin teaching their learning even when still their master is alive, and thus carry the characteristics of his circle to other newly emerging groups of people interested in knowing things as they are. Then, this process will obviously continue with the same epistemological background in such a way that always the newly emerging groups of people interested in *knowing* will carry the characteristics of their masters' teachings. Let us assume that after the Ninth Master who came, say, 350 years after the first one, a tradition of learning emerged and it was named 'scientific tradition'. All

the learning activities preceding this naming can be called 'pre-scientific learning'. Then, all the scholars involved in this process constitute the *pre-scientific community*. They do not come together with the intention of establishing such a community; but rather it is in our nature that when we see certain common elements between our fellow human beings we try to be *with* them, a phenomenon which naturally leads to the establishment of a community. In this case the most striking elements are first our epistemological constitution, second our desire to *know* which now has been identified as *knowing scientifically* and third to help each other in this activity of *knowing*. The third element can be identified as social; for one significant factor in forming societies is the need for help from other fellow human beings. By the first element, namely our epistemological constitution, on the other hand, we mean the need for an accumulation of some organized knowledge, so that we can built new ones on this basis. If there is no such accumulation we cannot produce new knowledge.

We must realize that the subjects investigated are scattered in the first years of a scientific tradition and, therefore, they do not constitute as yet one specific discipline. But after a long period of time, when these subjects accumulate in such a way that they cause many problems in handling them systematically. Since it is the nature of our mind to perceive things in the unity of a system, the scholars of a pre-scientific community cannot continue their investigation unless they begin to organize, systematize and thus to classify the findings of their community. If they achieve this then they will see that each subject of study constitutes a specific *discipline*. If, however, they cannot achieve this, then no science will be established in that scientific tradition. For by science we understand primarily a discipline, which is distinctly something other than a human activity; it is rather the product of an activity. This means that science cannot be defined as a behavior; a scientific behavior is, therefore, not science, nor is a scientific activity science. For science is only a body of knowledge produced by such activities that it eventually constitutes a discipline.

When a pre-scientific tradition thus produces a classification of its subjects of investigation, each subject is named in this classification and thus is identified as a specific discipline. This process as it begins from the first master of a tradition seems to exhibit stages: First, as we have seen, the first master lays down certain scholarly principles that make up the initial cultural mores of that pre-scientific community, which acquire a general acceptance by the subsequent followers who in turn carry this tradition to their students. This way the scattered and discrete studies begin to acquire a unity. The body of collected knowledge thus acquires the status of a discipline. Then, in this process, a scientist gives a *name* to that discipline, either according to

its subject matter, or its method. Therefore, a science is a *named* discipline with a well-defined subject matter, method, theories and an accumulated body of scientific knowledge. Hence, we distinguish primarily three stages in the scientific process through which sciences emerge:

1. The Stage of Problems, where scattered and discrete studies of various problems are carried out for a period of time;
2. The Stage of Disciplinary Tradition, where a tradition arises as a result of conventional consensus among the scholars; general subject matter and method are determined;
3. The Stage of Naming this scientific enterprise.

If we observe what is customarily called science, we shall see that it is what emerges as a result of the third stage of the scientific process. Every science must pass through a preliminary stage where only certain problems are discussed in a scattered manner. This is the initial stage in which a subject matter has become a candidate to emerge as a discipline. If the knowledge-seeking activities continue in a uniform manner, then this subject matter has a greater potentiality in its future to emerge as a science. Before this subject matter, however, emerges as a science, the knowledge-seeking activities at the stage of problems cannot be called *scientific activities*. This is because we have already restricted the usage of the term 'science' to such activities in which there is a consciousness in the minds of scholars that their activity actually constitutes a discipline. Obviously at the initial stage of a science this consciousness cannot be found. For this reason it is more apt to call the scholarly activities at the stage of problems 'knowledge-seeking activities', or as we have done, 'pre-scientific activites'.

Historians of science have found out that in ancient Egypt and Babylon there were some scientific activities, such as units and rules of measurement, simple arithmetic, constructing a calendar of the year and measuring the periodicity of astronomic events. All these scholarly activities are named *scientific*, not because these subjects were actually formed into specific disciplines as we have them now, but rather we find some similarities between them and the scientific activities that already have the consciousness of their subject constituting a specific discipline. Moreover, those ancient Egyptians and Babylonians did not name their activities *scientific* which means that they definitely lacked such a consciousness, which we identified as "scientific consciousness". To claim that there were actually scientific activities in these civilizations, one must be able to point to a science with a specific name; e. g. in the ancient

Greece we can say that there was physics after Aristotle who gave a name to this discipline. This means that the Greek civilization had the consciousness that a subject of study can be formed into a discipline.

It is thus the ancient Greeks who first in human history became aware of the fact that subjects of inquiry can be formed into disciplines as organized body of knowledge in accordance with the principles and methodology developed in those subjects. They knew that their knowledge-seeking activities constituted specific *disciplines* which could even be *named*. As a result of this scientific consciousness they named such activities first *philosophia*, 'love of wisdom'; an expression which clearly refers to the activity rather than the subject of study as a discipline. It seems to have been used first by Pythagoras (c. 572-497 B.C.) by distinguishing the technical meaning he attached to the term *sophia*, which is, for him, knowledge attained by contemplation rather than knowledge based on practical shrewdness and the one based on skill like that of a carpenter. What Pythagoras means is clearly scientific knowledge which he does not name it so. It is, therefore, apt to demarcate this phase of Greek scientific development from the subsequent developments by calling it the 'stage of problems' which extends from the beginning of the Greek civilization until the time of Pythagoras, i. e., 500 B. C. Then, after him begins the disciplinary stage (c. 500-300 B. C.) when more rigorous methods were invented and the subject matter of investigation is widened, as a result there is a tremendous accumulation of knowledge. Scholars contributed to this development are Parmenides, Heraclitus, the Sophists and the Socratic thinkers, until Aristotle. With Aristotle Greek pre-scientific activities entered its naming stage (c. 300 onwards) when many subjects of study emerged as specific disciplines. We have given this brief sketch to clarify our terminology, but in connection to the concept of science in Islam they will be applied in a detailed descriptive manner.

If the knowledge seeking activities in a society is carried out long enough, then usually there arises a need to classify and reorganize the subject of investigation due to a great accumulation of knowledge on that subject matter. If this is not done it will be hard to handle the subject; therefore, the human mind tends to classify the accumulated knowledge in such a way that it will be easy to handle the subject of investigation. This effort of reorganizing the accumulated knowledge of a subject of investigation usually leads to the rise of a new methodology; it thus gradually leads to the scientific consciousness. For if a subject matter is conceived within a *body of unity* (which is the accumulated knowledge in this case) to be studied systematically in a certain manner (i. e., the method), then it is inevitable to perceive the subject matter as

constituting a specific discipline. It is for this reason that this stage can be called 'disciplinary stage' in which the scientific consciousness concerning each discipline arises.

The length of this stage can change from one scientific tradition to the next. Usually the disciplinary stage of a scientific process cannot be distinguished from the stage of problems at its initial level; and from the stage of naming at its end. This is because of the uniformity of the scientific process in a scientific tradition: the stage of problems merge with the disciplinary stage in such a way that they cannot sharply separated from each other, and the disciplinary stage consolidates itself with the stage of naming in such a way that no clear cut boarder is possible between them. In fact, sometimes it is possible for any of the two stages to be merged with each other and form only one stage. For instance, as we shall see, the development of scientific tradition is so rapid in Islamic science that in case of *kalâm* and *fiqh*, for example, the disciplinary stage and the naming stage emerge more or less as one stage.

The scientific process becomes more palpable at the disciplinary stage simply because knowledge-seeking activities begin to lead already to the rise of a scientific consciousness. The scientific community involved in such activities begin to feel that certain subjects are so different from certain others that they cannot be studied by the same methodology. This way certain scholars may begin to classify subjects in such a way that it will already imply a name for each subject matter. At this level of the disciplinary stage we can distinguish it from the stage of naming, which indeed leads to the emergence of sciences as specific disciplines.

It is not actually apt to call this final phase of the scientific process a stage. For with this stage the process ends, therefore, it may not appear in some scientific traditions as an independent stage. In the Greek case, for example, it appears as the final development in the emergence of sciences. But even in this case some sciences, such as arithmetic and geometry, tend to exhibit a scientific process in which the stage of naming is prolonged. When this happens we should not look for a specific name as the name of a science in the sense of a discipline. The name given to the science, however, may be used to refer to such activities, but obviously without specifying it as a discipline. This is usually the case also with Islamic science, as we shall see. But let us take history of mathematics with its branch, geometry, as an example. Both these sciences are still at the stage of problems when they were borrowed by the Greeks from the Egyptians and the Babylonians. Dampier, a prominent historian of science, makes the following observation:

> 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 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.[6]

What he means here by saying "the earliest and most successful of such attempts" is those activities at the stage of problems that lead to the emergence of mathematics as a science. On the other hand, all mathematical studies during Thales and Pythagoras until the time of Euclid represents the disciplinary stage in which both the term 'mathematics' and 'geometry' were used though these sciences had not yet entered the final phase of naming, which actually came along with its proper scientific consciousness as a result of Euclid's work. Hence the scientific process ended for the science of geometry with Euclid and this science entered into the phase of its normal development. In this case the stage of naming and the disciplinary stage converge for some time.

Naming a science can be by a person or by a group of scientists, or a certain concept which is utilized prominently in a specific subject of inquiry can emerge as the name of a specific science in the course of its scientific process. The third is the case with such Islamic sciences as *fiqh*, *kalâm* and *tafsîr*. But Aristotle's naming of physics, theology and many other disciplines is an example of the first case. The emergence of *metaphysics* as the later name of theological studies in the Aristotelian fashion is a case example of the second situation.

It seems clear from this example that the scientific process which we have tried to put forward here represents only the stages of the emergence of a subject of investigation as a science, and as such it does not deal with its later developments, nor does it deal with the process through which a branch of science emerges as an independent discipline. Therefore, all the other scientific development taking place after the naming stage is a progress in the scientific process but mainly with regard to these branches of disciplines emerging as independent sciences.

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