

## Science and Scientificity

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### A question about science

We are now living in a scientific era, in which the theory and practice of science have penetrated into all aspects of society and science is often a hot topic. However, what on earth is science? This question is largely neglected by many people, even researchers focusing on scientific studies may not have a very clear understanding of it.

The idea that science is value-free is quite common. This is reasonable to some extent, but is biased on the whole. In this criterion, it is hard to understand properly the relationships between science and value and between science and society, as well as the status and effect of science in modernization drive. The origin of this thought is that some people regard science as only a “knowledge system” and a theoretical form, without realizing that science actually is a kind of practical activity and also a special cultural form during the human’s exploration of the world. Taking science for static theoretical knowledge will prone to draw the conclusion that science is independent of value. However, from a dynamic, historical, and cultural angle, it will be easy to find the value-laden of science and the interaction between science and other practical activities and cultural forms of the human. Therefore, a comprehensive understanding of the essence of science is indispensable.

Of course, this is only a general view on science. There remain many points for thinking and studying on the question that what science is. For example, the original concept of “science” and its historical changes, the relationship between science and scientific theories, as well as the relationship between science and the so-called “scientificity” for judging whether a thought or achievement is scientific. There often exist ambiguous understandings of such concepts of “science” and “scientificity” that are

frequently used without questioning, which are linked with hot topics like the arguments between science and scientism and between science and humanities. Obviously, it is quite necessary to think about the question of science and scientificity.

### The term “science” and natural science

The word “science” appeared in ancient Greece (written as “episteme” in Greek and “scientia” in Latin), whose basic meaning was any theory or belief system with the characteristics of precision and certainty (1). In broad sense, science meant any systematical knowledge. The ancient Greek philosopher Aristotle thought that any knowledge closely related with human mental activities could be called “science”. At present, the closest meaning to this original concept can be found in the German word “wissenschaft”, which still has the extensive meaning of any systematical knowledge. Both of the two words in ancient Greek and in German are mainly in broad sense, not only including natural science that deals with nature, but also including social science that deals with society and humanities that deal with human spirit and value.

It should be pointed out that in history the concept of “science” had been used in broad sense from ancient Greece, however, in modern time the usage was changed after the rising of natural science in a form of independent and integrated theory system. Generally speaking, the concept of “science” was gradually used in narrow sense in the first half of the 19<sup>th</sup> century to refer to natural science represented by physics, and this concept was not normalized in English until the middle of the 19<sup>th</sup> century. The Oxford English Dictionary in 1867 edition clearly demonstrated that, “We shall . . . use the word ‘science’ in the sense which Englishmen so commonly give to it; as expressing physical and experimental science, to the exclusion of theological and metaphysical” (2, 3). Likewise, it was no earlier than 1830 or 1840 that the word “scientist” was created to mean a person who

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works or studies in an area of natural science (2, 3). It can be seen that the word “science” in English has been used in narrow sense to denote natural science for only over 100 years. Nowadays, this is the dominant sense in ordinary use in many countries like UK and USA. In referring to other kinds of studies, it will be expressed by adding other modifiers, such as “social science”, “moral science”, and so on. However, in Germany, as mentioned above, the word “science” (“wissenschaft”) still refers to all kinds of systematical knowledge and learning instead of restricting to natural science.

In addition, another point that might need to clarify is the relationship between “science” and “subject”. The term “subject” here means an area of knowledge that is classified by different objects, fields, or methods of study. For example, natural science includes branches of physics, chemistry, biology, *etc.*, while physics includes subbranches like experimental physics and theoretical physics, and chemistry includes subbranches like organic chemistry, inorganic chemistry, biological chemistry, *etc.* With more and more emerging branches, the classification is more detailed. The same can also be found in social science and humanities. These branches can all be called “subjects”. On the contrary, although “science” has such meaning in some sense, it mainly denotes systematical knowledge that is organized by a certain internal theoretical principle. In the words of Kant, “Any system that has an integration of knowledge organized by a certain principle can be called ‘science’ (‘wissenschaft’)” (4). The so-called “internal theoretical principle” is equal to the so-called “scientificity” in modern sense, namely scientific characteristics. Only when a subject has “scientificity” can it be called “science” that is “scientific”.

### Scientificity and truth

It seems that the term “scientificity” did not emerge until modern time, which very likely came with the rising of natural science in this period. Nowadays, the thinking manner, research methods, programs, and models of natural science are largely employed as the normal and standard to judge whether there is scientificity in the research process and results of a thought. This is accustomed by most people. How-

ever, the concept of “scientificity”, derived from “science”, has its specific connotation, which maybe has not been demonstrated before.

From the context of some works elucidating the concept of “science”, it can be found that the so-called “scientificity” that meets the original meaning of “science” primarily refers to the systematicity, logicity, certainty, and precision of knowledge. That is to say, knowledge and learning for certain objects must have a theory system that is integrated and systematical in structure, clear and definite in concept and category, as well as logical and precise in elucidation.

Scientific theories are knowledge that reveals essence in the reason of science and expresses and demonstrates truth in the power of theory. Undoubtedly, what makes scientific theories scientific is that they do not stop at the empirical level of sense but go deep into the essential level behind or among phenomena. Scientific theories acquire and master essence by abstracting, analyzing, and synthesizing, form clear concepts, symbols, and logic among them on that basis, and then construct a whole theory system. Therefore, the concept of “scientificity” generally consists of two parts: one is a theory system with consistent content and form, and the other is a kernel of truth that can truly reveal the essence of research object at certain levels. Both of the two parts are indispensable. With only the theory system and its certainty, precision, and logicity, it is just a form of science without mastering essence. This kind of “scientificity” is far from a true one. Likewise, only saying to have mastered the truth but could not express and elucidate it clearly, systematically, and logically, such “scientificity” is also quite doubtful.

After the establishment of natural science in modern time, it has been proved very effective for the founding of scientific theory system. On one hand, natural science constructs powerful self-consistent theory systems by extensively employing mathematical tools to abstract and calculate complex phenomena in nature and by using concise laws, formula, or models to denote the internal essence of nature. On the other hand, natural science persists in proving the true or false of pervious conclusions from the empirical level by using technical means like observations and experiments, in order to obtain certainty and accuracy

of theory through such processes and methods. For hundreds of years, the thinking and research manner of natural science has been proved extremely effective in its fields, with great achievements emerged one and after another both in theory and in practice, winning a good reputation and a high culture status for natural science in a short time. Consequently, the concept of “science” has been restricted to the dominant use for natural science in many countries since the first half of the 19<sup>th</sup> century, and the career of “scientist” came along almost at the same time, which has been more and more respected by the people. As a result, it seems to be quite reasonable to demonstrate the “scientificity” of science by using models of natural science.

However, the myth of the absolute truth of classical natural science theories was broken in the 20<sup>th</sup> century by great breakthroughs and innovations in scientific theories marked by the theory of relativity and the quantum theory, which cast doubt on the certainty and precision of natural science theories that seemed to be unchallenged before. It is found that currently there are still numbers of natural phenomena that could not be explained by natural science and the unknown fields it faces are endless. Although some scientific theories have been confirmed repeatedly by observations and experiments, they are still in likelihood and are uncertain to be universal laws. Moreover, theories in many fields are proposed just as hypotheses. That is why Edmund Husserl, the Germany master of phenomenology, tried to establish the “strict science”, namely the science of science, in the hope of founding a clear theory basis for scientific studies to overcome the theoretical defects of natural science. Therefore, the “scientificity” of natural science is unlikely to be perfect not only in the form of theory and logic but also in the kernel of truth. It is only the understanding of essence or laws of nature at certain levels and specific categories. This fact was already indicated more than 100 years ago by Friedrich Engels, who expressed like this: In sciences like physics and chemistry, “it can be asserted that *certain* results obtained by these sciences are eternal truths, final and ultimate truths; for which reason these sciences are known as the *exact* sciences. But very far from all their results have this validity” (5).

In sciences of “the investigation of living organisms”, it often takes centuries to study, and the results are usually in the form of hypotheses (5). Therefore, he stressed that, “Real scientific works therefore, as a rule, should avoid such dogmatically moral expressions as error and truth” (5). This does not mean to deny the truth of natural science theories but reminds us to avoid simply using the judgments like “absolute truths” or “eternal truths”, which would result in the problem of lacking scientificity. In addition, the question of truth is not only a pure question of theory. As indicated by Karl Marx, “The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question” (6).

In summary, the relationship between scientificity and truth generally can be concluded as follows: (1) Scientificity is certainly related to truth, but its truth is not depended on theory but must be verified and developed by practice. Any theory system or method is unlikely to have eternal or ultimate truths. This point is universal not only to natural science but also to social science and humanities. (2) Scientificity surely contains certain truths, but must reveal the kernel of truth in a systematical, logical, and precise theoretical form. Only scientific theories that meet the above requirements have “scientificity”. (3) Although the concept of “scientificity” was extended from the brilliant achievements of modern natural science, the forms, methods, and models of natural science are not the embodiment of “scientificity”. They can be used as references for studies of social science and humanities, but could not replace their own ways of studying.

(Translated by Xin Zhang, Beijing Genomics Institute, Beijing 101300, China.)

## References

1. Lindberg, D.C. 2001. *The Beginnings of Western Science* (Chinese translation by Jun Wang *et al.*), p.4. China Translation & Publishing Corporation, Beijing, China.
2. Snow, C.P. 2003. *The Two Cultures* (Chinese translation by Ke-Jian Chen and Xiao-Hu Qin), pp.5-6. Shanghai Science and Technology Press, Shanghai,

- China.
3. Hayek, F.A. 2003. *The Counter-Revolution of Science: Studies on the Abuse of Reason* (Chinese translation by Ke-Li Feng), p.3. Yilin Press, Nanjing, China.
  4. Cassirer, E. 2004. *The Logic of Humanities* (Chinese translation by Zi-Yin Guan), translator's preface. Shanghai Translation Publishing House, Shanghai, China.
  5. Engels, F. 1995. Anti-Dühring (Herr Eugen Dühring's revolution in science), in *Marx/Engels Collected Works* (Chinese translation), vol.3, p.428. People's Press, Beijing, China. (English text: by Emile Burns from 1894 edition, Marx/Engels Internet Archive)
  6. Marx, K. 1995. Theses on Feuerbach, in *Marx/Engels Collected Works* (Chinese translation), vol.1, p.55. People's Press, Beijing, China. (English text: by W. Lough from the German, Marx/Engels Internet Archive)