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Philosophy and Science after the East Japan Disaster

KEIICHI NOE
TOHOKU UNIVERSITY

Abstract: The severe accident at the Fukushima-Daiichi nuclear power plant caused by the March 11 Great East Japan Earthquake in 2011 was a typical disaster in the age of "trans-science," which means the situation that science and politics are closely connected and inseparable. The stage of trans-science requires a philosophy of trans-science instead of a philosophy of science such as logical positivism. I would like to characterize norms for techno-scientists in the risk society as RISK, which includes Regulatory deliberation, Intergenerational ethics, Social accountability and Knowledge-product liability.

1. FROM "SCIENCE" TO "SCIENCES"

Both philosophy and science stem from natural philosophy in ancient Greece. After that, philosophy and science made exciting progress respectively especially in Europe. As is well known, the word "philosophy" etymologically goes back to the ancient Greek. On the other hand, the origin of the word "science" goes back to the Latin word "*scientia*" which means "knowledge." Therefore, the word "science" was an uncountable noun at the beginning. Later, it became a countable noun and acquired the plural form "sciences." According to a popular English Dictionary (*Longman Dictionary of Contemporary English* 1995), the word "science" has two different meanings, uncountable and countable.

> Science [U]: knowledge about the world, especially based on examination and testing, and on facts that can be proved.
>
> Science [C]: a particular part of science, for example BIOLOGY, CHEMISTRY, or PHYSICS: *the physical sciences.*

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Interestingly the Japanese translation of "science" is *kagaku* [科学], which literally means "many branches of science." This is a newly coined word after the Meiji Restoration about 150 years ago. To be accurate, *kagaku* is not the translation of "science," but "sciences." *Kagaku* corresponds to the German word *Fachwissenschaft*. Another Japanese translation of science is *rigaku* [理学], which literally means "learning of law and order." It is parallel to the uncountable noun "scientific knowledge." However, in the modernization process of Japan, the word *kagaku* became very popular and dominant in contrast with the word *rigaku*. The latter nowadays remains only in the name of a faculty in Japanese universities, *rigakubu* or the faculty of science. Such circumstances depended on the historical condition when modern Japan introduced science and technology from Europe. I would like to look back on its historical background briefly.

Through the Scientific Revolution in the seventeenth century, natural science began to live its own life independent of the matrix of natural philosophy. Natural science established the scientific methodology, i.e., the hypothetico-deductive method, which was composed of logical inference and experiment. At that time, science and philosophy went their respective ways. Science aims at inquiring into unknown phenomena, e.g., black hole, dark matter, etc., whereas philosophy devotes itself to elucidating known issues, e.g., being, knowledge, time, or something like that. However, in this first stage, science and philosophy were still closely connected, as is shown in Newton's main work *Principia*, which includes the words "natural philosophy" in the title.

The next stage was the second scientific revolution, which was named by J. D. Bernal, in the latter half of nineteenth century. This revolution is usually characterized as "the institutionalization of science." Specifically, it comprehends the appearance of scientists (the word "scientist" was coined by William Whewell in the 1840s), specialization of scientific knowledge, formation of academic societies, founding of the higher education system of science and technology and so on. In a word, "science" was transformed into "sciences."

Just at that time, Japan opened the country to the world and rapidly introduced the newest products of science and technology. Japan imported, so to speak, institutionalized science as a ready-made package. This fact was advantageous to the development of industrial policy in the Meiji period. On the other hand, most Japanese were indifferent to natural philosophy, which had constituted the background of the natural sciences. Though there has been a specific distinction between science and technology in Europe, the Japanese people at that time equated science with technology. The most obvious example is the Japanese word *kagakugijutu* [科学技術], which means "science and technology" or "science based technology." We express it by one word like "techno-science."

We can see the same way of understanding science and technology in Yukichi Fukuzawa's thought. He was a representative enlightenment thinker in the Meiji period, and his ideas are still influential. Fukuzawa emphasized that science should be practical knowledge, in Japanese *jitsugaku* [実学]. His attitude toward accepting science and technology was rather utilitarian or instrumental. For him, scientific knowledge ought to be an instrument to change our way of life and should contribute

to achieving human well-being. Therefore, Fukuzawa thought that the exponent of physics was not Galileo or Newton, but James Watt.

Such identification of science with technology has to bring a kind of distortion to our understanding of science. The pursuit of utility as well as economic efficiency may be a remote cause of the severe accident at the Fukushima-Daiichi nuclear power plant.

2. FROM "SCIENCES" TO "TRANS-SCIENCE"

Two years ago, the March 11 Great East Japan Earthquake and the resultant disaster in Fukushima caused extensive damage to the Tohoku district and awakened a lot of argument concerning scientific civilization.

About eighty years ago, Torahiko Terada, who was a geophysicist and a well-known essayist, had an insight into the relation between disaster and civilization. In the essay entitled "Natural Disaster and National Defense," he points out the fact that the more civilization progresses the more natural disasters increase in degree of severity. He continues,

> As civilization advanced, human beings gradually had an ambition to conquer nature. Gradually, they built many kinds of structures which resist gravitation, wind pressure and waterpower. While they are on the road to blocking out the violence of nature, nature eventually begins to rampage around like a troop of wild animals escaping from a cage. It collapses high towers, destroys banks, puts human life in danger and takes away their possessions. It is not unjust to say that the original cause of such a disaster is nothing but human beings' work to resist nature. Except for civilized human beings, no one accumulates potential energy which can become kinetic energy of disaster and makes an effort to enlarge the scale of damage.

This remark is very interesting, because it seems as though he had predicted the background of the March 11 disasters. Perhaps it was natural disaster like earthquake and tsunami that Terada had in mind at that time. However, the March 11 Great Earthquake was unfortunately followed by a man-made disaster. Especially, the severe accident of the Fukushima-Daiichi nuclear power plant reminds us of the danger of overconfidence about science and technology.

Takeshi Umehara, a famous Japanese philosopher, called this accident "the disaster of civilization [文明災]." According to him, Japan suffered "the disaster of civilization" twice. One is the destruction of the cities of Hiroshima and Nagasaki by atomic bombs, and the other is the ongoing accident in the Fukushima nuclear power plant. Both unfortunate occurrences are closely connected with products of high technology, i.e., nuclear energy. The problem of nuclear energy includes not only scientific but also political and economic issues. It is too complex for science to handle, because both fact and value inseparably intertwine with each other. In this sense, it transcends the narrow field of science. Nuclear physicist Alvin Weinberg called such a problem "trans-scientific." His explanation of this concept is as follows:

> Many of the issues which arise in the course of the interaction between science or technology and society—*e.g.*, the deleterious side effects of

> technology, or the attempts to deal with social problems through the procedure of science—hang on the answers to questions which can be asked of science and yet *which cannot be answered by science*. I propose the term *trans-scientific* for these questions since, though they are epistemologically speaking, questions of fact and can be stated in the language of science, they are unanswerable by science; they transcend science." (Weinberg 1972, p. 209)

After such an argument, he takes examples of trans-scientific questions such as biological effects of low-level radiation and catastrophic reactor accidents. In addition to these, we can also list, for instance, environmental pollution, BSE, public health as typical trans-scientific problems. Concerning these problems, there is no clear border between cognition of facts and value judgment. Science and politics are closely connected and inseparable. Although scientific knowledge is necessary, scientists alone cannot solve these problems. Trans-science requires a kind of "civilian control."

The age of "trans-science" started in the middle of the twentieth century. The conspicuous symbol is the Manhattan Project to develop atomic bombs. Its success transformed scientific research from individual study to organized joint project. At the same time, science transformed itself from curiosity-driven academic science into mission-oriented industrialized science. To borrow Jerome Ravetz's phrase, a "scientist" metamorphosed into a "scientific entrepreneur" in the stage of industrialized science. Such transformation of science demands from scientists not only "peer review" but also "social accountability." This is a specific characteristic of "trans-science."

We are now living in the so-called "risk society," which is the concept proposed by the German sociologist Ulrich Beck in the year of the Chernobyl accident. Risk society and trans-science are two sides of the same coin. According to Beck, it is a society in which distribution of risks, rather than the fair disttribution of wealth, becomes an urgent problem. Not to speak of Chernobyl or Fukushima, the source of risks is nowadays none other than big science and high technology. Beck describes the lessons of the Chernobyl accident as follows;

> Thus Chernobyl has taught us at least three lessons. First, that the worst-case scenario is possible and real, and probabilistic safety is deceptive; second, that the abolition of nuclear power has become an accepted political possibility; third, that the amateurish mélange of state and technological authority has given way to near-perfect procedure." (Beck 1995)

After pointing out these lessons, he calls the naive assumption that hazards can be tracked down and dealt with technologically "the system of organized irresponsibility." The outstanding example of "organized irresponsibility" is the disposal of nuclear waste. The half-life of radioactive waste is incredibly long. Therefore, we cannot help postponing the final disposal and shifting the responsibility onto future generations. Here, a new problem of intergenerational ethics has arisen. It is difficult to find a proper answer, because the concerned parties are not yet born. Nevertheless, the wisdom of American indigenous people gives us a useful suggestion, which is called "law of seven generations." This law requires that, whatever

matter we decide, we must fully deliberate the influence of our decision on the next seven generations. In the twenty-first century risk society, there is an urgent need for philosophy of trans-science rather than philosophy of science.

3. THE PHILOSOPHY OF TRANS-SCIENCE

Let me summarize the main points that have been made in the above two sections. Science as particular knowledge of nature was methodologically established through the Scientific Revolution in the seventeenth century. Later science was differentiated into specialized disciplines, namely "sciences" in the middle of the nineteenth century. This is called the second Scientific Revolution. At that time, modern science took shape as a social institution. In the latter half of the twentieth century, the fusion of science and technology was realized. Science based technology or techno-science becomes dominant and products of high technology have a major impact on our social life. In a manner, the boundary between laboratory and market is gradually disappearing. The curtain of the age of trans-science is raised.

Each stage of scientific development corresponds to a certain philosophy. The first stage of science as knowledge requires methodological inquiry about science. Logical positivism and critical rationalism played an important role in this stage. They developed the synchronic logical analysis of scientific theories. As a result, the main stream of logical analysis amounted almost to the scientific philosophy to realize the so-called unified science. On the other hand, Robert Merton, the founder of the sociology of science, characterized the ethos of scientists as CUDOS or Merton Norm. CUDOS is composed of the following four items; Communality, Universality, Disinterestedness and Organized Skepticism. These virtues are, as it were, the ideal conducts of scientists in democratic society just after the Second World War.

The second stage required the philosophy of "sciences," i.e., specialized disciplines. Such a kind of philosophy was embodied in Thomas Kuhn's book *The Structure of Scientific Revolutions* published 50 years ago. He brings the rise and fall of scientific disciplines into relief by using the concept of "paradigm" and "normal science." MSRP (Methodology of Scientific Research Program) proposed by Imre Lakatos is also an attempt to explicate the "disciplinary matrix" through diachronic analysis. In the latter half of twentieth century, "scientists" slowly transformed themselves into "scientific entrepreneurs." John Ziman caricatured the norm of conduct for a scientific entrepreneur as PLACE instead of CUDOS. PLACE represents the initial letters of the following features; Proprietary, Local, Authoritarian, Commissioned and Expert. These are ironical characteristics of scientists in the age of industrialized science.

The third stage to which we belong, needs the philosophy of "trans-science" above all things. However, the philosophy of "trans-science" is not yet complete. We can only get a glimpse of its image in the study of STS or J. Ravetz's concept of "Post normal science." Nevertheless, it is evident that scientists after the March 11 Disaster have to obey trans-scientific norms. I would like to propose norms

for techno-scientists in the age of trans-science as RISK instead of CUDOS and PLACE. It is composed of the following virtues.

- Regulatory deliberation
- Intergenerational ethics
- Social accountability
- Knowledge-product liability

This is my present proposal concerning philosophy and science after the Great East Japan Disaster.

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