Transformation of Science

Yoichiro P. MURAKAMI

The present author once discussed "scientization" of science[1] which occured in nineteenth century Europe. Until then "science" in English, for instance, did not have the same meaning as we now have. It stemmed from the Latin word "scientia", which meant simply knowledge, and thus "science" used to be interchangeable with knowledge. The word, however, began to change its meaning in the nineteenth century, so that it came closer to its current meaning. This change was parallel to the change of what was called by the word. Namely it was in the nineteenth century that what now we regard as "science" appeared in the history of Europe, not in the seventeenth century as usually believed. This interpretation implies that Newton, for example, was not a scientist, nor was engaged in science of today's sense. As a matter of fact, what Newton did was exactly a kind of theological philosophy based on Christian faith. After the Secularization Revolution, which was originally proposed by the present author, such theological philosophy as Newton's was secularlized all through the Enlightenment era. As a result new type of knowledge and the persons who were involved in it began to emerge. That was "science" of today's sense and "scientists".

This was roughly the essence of what the present author proposed by "scientaization" of science. The present essay shall deal with the changes and shifts that science, a newly emerged intellectual activity, has experienced after its birth in the nineteenth century.

Science of Prototype

When "science" appeared in the nineteenth century, it was of course a part of knowledge. It did not cover knowledge in general any more, but only a specific type of knowledge. Specific in many ways. Firstly, it confined itself to dealing with material objects, to appealing to natural laws and related theories, to being independent from other genres and fields, to making use of experimental methods. Secondly, it was highly institutionalized. Scientists formed their own societies, established educational institutions such as the department of science in universities, started the academic journals where their results of research were to be published, organized

The International Christian University
Mitaka-shi, Ohsawa, 3-10-2, Tokyo, 181

laboratories to exercise their experiments and to train their students, and even provided reward systems such as the Nobel Prize for those whom achieved outstanding results and outcomes of research.

Each academic society in science was a community of scientists who shared peculiarly same curiosity to same objects. Thus those who were curious to know about physical objects formed the physical society, and to know about geological ones did the geological society. This tacitly implied that all the members of a scientific community were the experts in the specific field. Between its members and outsiders there should be a sharp demarcation, which distinguished experts from lay persons.

Although scientists tended to form scientific community, each member of it was quite individualistic. He or she was driven by the curiosity or the zeal for truth which stayed only in him-or-herself to make research, to get results and to publish the results. In other words, a set of these matters themselves satisfied him or her, soothed his/her desires for truth, even without any reward. On science emerging in the latter half of the nineteenth century, there was no institutionalized reward system like the Nobel Prize, but only the eponymy. The eponymous expressions like Heisenberg's uncertainty principle, or Schroedinger's equation, were only the signs of honour and respect that individual scientists obtained for their discoveries of new laws, new particles, new equations, and so on. This also shows that the intellectual enterprize of science was quite individualistic.

Of course, the communal recognition such as the favourable citations of the published results by other colleague scientists was, and still is, a good reward to a scientist. It might give a fellowship, subsidies or even a job oportunity to him or her.

In 1859 Charles Darwin published his famous *Origin of Species* in the form of a book, whereas in 1905 Albert Einstein did his first publication of special theory of relativity in *Annalen der Physik* in the form of a paper. What took place between these two dates seems to be quite significant. A book, as a matter of fact, is written to the general readers. Authors want to appeal what they have in their mind to the public. Papers, on the contrary, are addressed only to the peer, the colleagues of scientific community which are rather small in number. The authors of academic papers do not take into consideration the general readers, or lay readers at all, when they write them. In that sense, scientists seem to be quite unique and peculiar intellectual creators. Other intellectual creators such as novelists, poets, composers and so on do want to get good reputations from their colleague members, when they published their new works. But they also eagerly want the public, the lay people, to appreciate, accept and understand them. It is only scientists who do not want so among these intellectual creators.

Sientists initially could expect almost no social supports for their research. It

was rather natural, because they were driven by the personal curiosity, and the performance of scientific research only satisfied their curiosity personally. The scientists of the first generation in the latter half of the nineteenth century had to conduct their research even at their own expense. Gradually the foundations started to offer financial supports to scientists, and subsidies provided by government became a reliable financial source for scientists. But the philosophy underlying these supports was rather quite simple, namely philanthropic. That is these supports were distributed to scientific communities, or to individual scientists, on the same rationale as to other cultural activities like ballets, operas, plays and so forth. Of those days science was regarded as one of the cultural activities, which deepened and extended human comprehension of the world. As a matter of fact, the foundations and government did not expect direct returns for their costs at all.

In his works[2], R. Merton proposed the ethical norms shared by the members of scientific community. The norms, sometimes called by the acronym CUDOS, are expressed in the following four items;

communality
universality
disinterestedness
organized skepticism

The knowledge produced within the scientific community is not proprietary by a certain particular person or a particular group, but quite open and communal to everyone not only in the scientific community but also to the public. In other words, the results of research must be "published" or "publicized" at the earliest opportunity, so that they could be communal property of scientific community and the public as well.

Scientists would search for knowledge that is not specific to some persons, to some groups, to some communities, to some races, but universal and valid for everyone, every group, every community. The knowledge should be true and open to all the competent people.

Scientists would do their research only for pursuing the truth in nature, not for their own worldly interests.

Scientists would carry on their works with sound and organized skepticism. They do not put their confidence to anything in an easy way, without critical tests. At the same time in case that there should be some sufficiently reasonable evidences for them to believe such and such a thing, at least for the time being they would assume it to be true until they find some clear refuting evidences against it.

These Mertonian norms above mentioned obviously cannot be applied to the current situation of science and scientists, since we observe today various phenomena

betraying that scientists behave differently from these ethical norms. We can safely say that even almost five decades ago, when Merton proposed these norms, they were rather questionable, for the situation of those days was by no means identical with what Merton described.

It may be possibly considered that the CUDOS were proposed by Merton not for describing the existing ethical norms in scientific community of the day, but for expressing some idealized norms in his mind. This can be supported particularly when we know that it was just after the World War II that Merton published it. During the war, in the Nazi dominated Germany, Einsteinian physics was rejected by reason of being "Jewish". The authorities of Soviet Russia adopted the genetic theory of Lysenko instead of Weismann-Morgan genetic theories. They did so because they regarded the former as the "proletarian" theory, whereas the latter as "bourgeois", and they procecuted the Weismann-Morganian theoreticians and even executed many of them. The unhappy memories of these seemed to make Merton idealize the ethical norms of scientists as above.

Having said that, I addmit that the Mertonian norms well elucidated, at least to some extent, the features of scientific community where the individual scientists pursued the truth driven by their own curiosity. But obviously a new type of science is now replacing such science. I am not going to say that scientific activities of this type have completely disappeared from the front of science. They remain alive there. It is also true, however, that research activities of quite different type are now emerging and replacing science of the old type as described above. I will name the two different types of science, old and new, as science of prototype and science of neotype respectively.

Science of Neotype

Science of neotype, emerging for these some twenty years, can be best characterized as "mission-oriented". Scientific research of this type is not driven by personal curiosity of individual scientists. The mission from outside of scientific community initiates research in such a way that the mission is presented to scientists first and scientists respond to them. The spectrum of the missions should diverge depending on what sector of society, what organization, provides them. The scientists who regard themselves competent for the presented mission design their proposal of research to achieve the mission and apply with the proposal to the organization presenting it. The organization selects the most feasible proposal among the applications and commission the group of the scientists of the selected proposal to conduct the research.

The research of this type necessarily has a limitted term for the commissioned scientists to accomplish it, contrasting sharply with the research of the prototype.

Because in the latter, research is almost always open-ended. Of course, a scientist might feel full satisfaction when he or she has a sufficient result on what he or she has been curious to know. But we have been never told that after getting such a full satisfaction a scientist quitted his or her research works. The scientist surely find another door to the new mystery that induces him or her to be curious to know. On the contrary the research of the neotype usually has a clear timelimit when the scientists involved in it should end their research.

The research of the neotype is always connected with the development. In the prototype of science research was simply research. Sometimes the outcome of research might be exploited and developed by the sectors and institutions outsides of scientific community. Scientists, however, could say that it was none of their business, and it was not connected with their research. They did not need to feel or take any responsibility for the results of the development. Actually after the development of nuclear weapons many of the nuclear physicists responded in that way.

But the scientists who are involved in the research of the neotype cannot afford to respond in the same way any more. The mission is not simply the goal of research but the goal of development. And the scientists must be ready to take the responsibility for the final goal of the development, when they voluntarily and intentionally accepted the mission as the goal of their research. Thus in this type of science research and development are not the concept of the combination of two different activities, but one, united concept. And scientists clearly have responsibility for the outcomes of the research they are involved in.

In science of the neotype research opportunities are only job opportunities for scientists. In the prototype, scientists could be regarded as amateurs in the original sense of the word, namely "those who love it". In other words there were, in principle, no scientific researchers who did not have their own identity in the subject that they were involed in. If not, all that they should do was to quit research. Their research goal was always exactly the same as what they wanted to do as scientists.

This is often not the case in the neotype science. The research is usually conducted as a form of project, where each involved scientist is requested to function exactly as a cogwheel of the mechanic structure of the whole project.

Even in case that what is requested to function in the project fails to agree with the research identity of a scientist, the scientist often takes the opportunity as one possible job opportunity and joins the project just for getting subsidies.

A project leader of this type of research must play the same role as a president or a managing director of a private enterprize. Taking into consideration all kinds of the elements which may affect the perfomance of the project, he or she should manage the whole mechanism of the project in a most effective way. With regards

to the elements, they include not only the technical problems directly related to the scientific subject, but also more general problems such as human relations, the distributions of the resources, effective public relations and so forth.

We can assume the reasons why such new type of research emerged in these say twenty years. The principal reason is obviously the expansion of science both in its scale and its strength. Science has ever expanded its scale so drastically, on the one hand, that the expences for research cannot be sufficiently covered by the supports from outside based only on the philanthropic principles. Thus scientific community is in a sense forced to sell, so to speak, the outcomes of the research to the other social sectors in order to get enough money to meet the scale expansion of research. In other words, the principles for supporting the scientific research is now shifting from philanthropic ones to the give-and-take type.

Science has expanded its strength so drastically, on the other, that the outside social sectors began to regard the knowledge produced in scientific community as exploitable. The exploitability of knowledge is a basic concept of the neotype science. Thus from outside of scientific community people are always anxious to exploit the knowledge production of scientific community on the one hand, and sicentific community is now always quite ready to be exploited by the outside sectors. The mutual interests are agreeable each other.

In this context, the members of scientific community are now forced to watch what the outside sectors expect them to do. Prototype scientists used to be always inward-looking within their scientific community. The papers were addressed only to the peer. Scientists would care only about what the peer thought, what the peer evaluated, and what the peer recommended. Today scientists do care about what the outsiders think, what the outsiders evaluate, and what the outsiders recommend.

Thus, today the accountability of scientists to the public becomes the greatest issue. They are requested to take the responsibility and obligation to explain what they do to the outsiders in such a way that the outsiders can easily understand. In the prototype science, only the responsibility for scientists used to be to contribute the progress of science. The responsibility was taken to the peer alone. In that sense the prototype scientists were very close-minded.

The neotype scientists are forced to be open-minded to the public, to the outsiders, and to the laypersons. This implies the well institutionalized structure of science, which was completed in the earlier half of this century, is now experiencing a great change in character.

John Ziman, in his witty work, *Prometheus Bound*[3], proposed a new set of norms which cover the members of scientific community of today. They are also succinctly summed into an acronym, PLACE, as following:

Proprietary

Local
Authoritarian
Commissioned
Expert.

The Zimanian PLACE are quite opposite to the Mertonian CUDOS. Proprietary against communal, local against universal. Certainly knowledge produced by a certain gourp of scientists is now protected from being used freely by others, which coagulates into the concept of IPR (the intellectual property right). But among the five new norms the most essential one to be the neotype science must be "commissioned". It shows clearly that the new type of science activities are initiated not by scientists themselves but by the outsiders.

As already shown, these two types of science are coexisting today. Seemingly the ratio of the two will grow in the favour of the neotype science. In some decades science of the prototype may be quite obsolete and almost a historical fossil. Witnessing this drastic shift, we, philosophers of science, are strongly advised to reconsider what science is, and what science could be, so that we can meet the shift of the concept of science.

References

1) Murakami, Yoichiro P.: "Scientization of Science", *Annals of the Japanese Association for Philosophy of Science*, March 1993, p. 175ff.
2) Merton, R.: e.g. *The Sociology of Science*, University of Chicago Press, 1973
3) Ziman, John: *Prometheus Bound*, Cambridge University Press, 1994