An Oversimplified World: The Expectations and Threats of Scientific Professionalism

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In this age of exploding knowledge, increasing complexity and depth, it is becoming more and more difficult to understand everything. In such an ocean of information, representing phenomena by aggregating them into representative values, such as average values and most frequent values, helps our understanding, enables us to make quick decisions, and advances the development of society. However, the success of this representative value thinking has led to the construction of a worldview in which we process information with little awareness of what lies beyond the representative values. In today's society, the overemphasis on representative values has made various problems apparent. Hate speech, anti-immigration, anti-civil rights, and discrimination against LBGT are also examples of the lack of understanding and exclusion of those who are not part of the majority. The debate that overemphasizes representative values has made the world too simplistic.

Can we say that this is not the case with science? Below, I will examine the flow of the history of science from two perspectives: Simplification and Essentialization.

Success and change in science - The conflict between simplification and essentialization.

The overwhelming success of science was brought about by the attitude of wanting to understand the nature of the world. In reality, the natural world is full of complexity. Scientists have recognized this, discarded non-essential phenomena, and enjoyed the discovery of ideas and theories that make the complex world appear unified and simple.

When a force is applied horizontally to an object on a flat surface, the object begins to move forcefully at first, but gradually slows down and eventually stops. In order for an object to continue moving, a force must be applied to the object from the outside. This was the understanding of nature based on the Aristotelian view of nature that prevailed until the establishment of modern physics. It is based on our everyday experience. Newton's formulation of the law of inertia, as the first law of motion, turned this understanding of nature on its head. According to the law of inertia, a moving object slows and stops because a force called friction prevents the object from moving, but if this force is not acting, the object continues to move without slowing down. Modern physics arose from the rejection of friction and air resistance as "non-essential factors" and an attempt to explore the nature of motion. A mathematical approach to nature, systematized by Newton, created modern physics. It is a theory that is extremely beautiful, fascinating and powerful in the real world. Whether particle theory or string theory, physics questions the fundamental principles of nature and seeks a unified theory to explain the complex world.

The disciplines of chemistry and biology, on the other hand, pursue the laws that govern nature, focusing on its diversity. It can be called the natural history or taxonomic approach. It attempts to capture the complexity of the real world, but from the perspective of the physical approach, it can be said to provide only a relatively incomplete picture of nature. Chemistry and biology, of course, share the same attitude of trying to capture the regularities hidden in a complex world, for example, in the periodic table. However, they do not take this position as thoroughly as physics. One historian of science has called it "the impure science." It can be understood as complementary to the fact that the physics approach that tries to capture the "essence" of nature sometimes tends to fall into an oversimplification of understanding the natural world.

During the 20th century, the situation around science changed dramatically. This was the rise of technology, especially in the life sciences. In 1953, the discovery of the double helix structure of DNA led to the rise of molecular biology, which sought to understand the phenomena of life at the molecular level. Since the 1980s, the life sciences have made astonishing advances based on the establishment of PCR methods (which enabled the amplification of DNA fragments), the decoding of the human genome, and genome editing techniques (which facilitated genetic manipulations). The term "biotechnology" tells us that the nature of the discipline has shifted from understanding living phenomena to artificially interfering with life. Since the second half of the 20th century, the dominant role of science can be said to have shifted from the physics to the life sciences. The rise of molecular biology was characterized by an attitude of trying to map the complexity and diversity of life's phenomena into simple theories rather than trying to understand them. While this led to a deeper understanding of the phenomena, it also led to an oversimplification of the understanding of the phenomena of life and a uniformity of scientific method.

Integration with technology has continued to evolve with data science, which flourished in the late 20th century. Advances in computer technology, particularly artificial intelligence (AI), have made it possible to analyze all types of Big Data, which is now being used for applications such as autonomous driving and drug development. The use of Big Data to generate new scientific knowledge is different in nature from traditional methods in the natural sciences and promises to contribute to the diversity of scientific approaches. However, it could be argued that expectations for the use of AI itself also diverge from the oversimplified image of science. Science, as an intellectual endeavor to understand the nature of the natural world, has been transformed into a "technology" for "collecting" and "processing" data.

The meaning of diversity and complexity itself

Diversity and complexity continue to be of great importance in science. In the field of ecology, many mechanisms and models have been proposed to explain the conservation of biodiversity, but it is difficult to explain them with a single model. Among other things, it has recently been reported that the evolution of individual traits and useless behaviors seemingly unrelated to biodiversity is important for biodiversity conservation. A modern theory of coexistence that integrates different models has also been proposed, and it is hoped that this theory will lead to an elucidation of the mechanisms that conserve diversity. This demonstrates the importance of embracing approaches that were previously discarded and integrating multiple perspectives.

In earthquake engineering, the basic approach in the past has been to assume an impending earthquake and resist it. However, with the development of seismic observation networks, it has been found that earthquakes cannot be easily predicted, and dealing with earthquake uncertainty has become an urgent problem. The approach adopted by earthquake engineering has therefore been to introduce "insensitive" seismic isolation and vibration control techniques to deal with the unpredictability of earthquakes, in addition to seismic techniques that can withstand strong but average earthquakes. The emergence of this technique as an attempt to find value in the "complexity" of seismic phenomena, rather than in the refinement of predictions, embraces a simplified approach to earthquakes and illustrates the importance of different approaches that complement each other.

The changing nature of scientific careers

The nature of scientific careers has also changed dramatically over the course of the 20th century. Just as the analysis of the human genome was made possible by the concentrated investment of large financial and human resources, biotechnology has a strong affinity with commerce, and terms such as "patent," "intellectual property," and "venture" have become commonplace in the world of research. The logic of commerce has become an important factor, and modern scientists are now expected to play a role in innovation policy.

However, if we look back at the history of science, those responsible for the development of modern science have pursued nature alongside their primary profession. It is only in the last 200 years that professional scientists who earn their living from scientific research have emerged. In 1665, shortly after its founding, most of the members of the Royal Society of London were politicians, noblemen, physicians, and clergymen. They were what we would call amateur scientists today, driven by a desire to understand the mysteries of the natural world. The pursuit of scientific research had nothing to do with choosing a career as a researcher to make a living. The establishment of the scientist as a profession and the enormous research funds provided by the state provided a privileged environment for scientists to engage in scientific research without concern for supporting themselves financially, but also meant that scientific research became tied into the intentions of government and industry. Beyond the subjective feelings of many scientists, at least in terms of social status, science has undergone a major transformation from an activity driven by the intrinsic desire of those who love knowledge to one that supports the state and industry. In recent years, as competition for research grants and positions has increased, metrics such as impact factors and h-indices have been widely used as objective measures to evaluate scientists. Professional scientists are increasingly embedded in the system, acting as its pawns, and must struggle to achieve results based on simplified indices. The scientific community also seems to have lost its diversity and is dominated by oversimplification.

What's wrong with scientific research being systematic and arriving at new findings efficiently? Isn't that what society expects? You could say that. I won't dispute that, of course, but I would like to ask, "Is the knowledge you gain as a scientist, when you stop thinking and lose the desire to know, 'interesting?'"

Reclaiming amateurism

Even after science was established as a profession, amateur scientists played a role in the development of science. Einstein's discovery of relativity while employed by the Patent Office is a good example. In astronomy, individual amateur scientists continue to make new scientific discoveries. More recently, citizen science is a growing movement of non-professional scientists who play a role in scientific research.

Amateur scientists participate in science not because it is their job, but out of pure intellectual curiosity and concern for those around them. The world in which amateur scientists work is the opposite of the modern world of science, which is overshadowed by the logic of commerce. For professional scientists, scientific research has become a profession in which they compete for research funds, are influenced by national politics, and are deprived of the pleasure of delving into the study of the natural world out of pure intellectual curiosity. On the other hand, amateur scientists participate in science out of their own interest, and they are extremely diverse. Some of these amateur scientists are as active as professionals, and their activities show their strong belief in science.

In science, as with Mendel's Law, scientific achievements are sometimes not appreciated during a person's lifetime, but only after death. The true value of scientific research is validated over time, and the current oversimplified evaluation system does not adequately reflect this value. Precisely because we live in an age of increasing complexity and depth, we need to restore diversity to the world of science, which works to make sense of a complex world. Rather than focusing on responding to the short-term needs of society and adapting to existing systems, we need to challenge the system in which science currently finds itself, escape the curse of the system, and return to its roots rather than being swayed by simplistic indices. To do this, it is necessary to value amateurism more positively in the world of science, which has become embedded in the system, and to restore the role of the scientist as a seeker of the nature of the world. In my opinion, this would be an opportunity for scientists to regain their autonomy and bring about a scientific world in which competition and collaboration dominate at a more fundamental level.

Whose job is that?

I looked at the history of science from the perspective of both simplification and essentialization, and discussed the current oversimplification (≠ essentialization) in science and among scientists. Above, I highlighted a positive assessment of amateurism and said that we should return science to a world in which competition and collaboration between researchers dominate at a more fundamental level, but that this will not be easy to achieve. This is not fundamentally because it is difficult to change science and technology policies or the university system, but because it is a problem of our own view of research, nature, the world, and life as scientists. Reality is not so easy that we can blame it on others. "Science" should be renewed (to be more fundamental) by scientists themselves.