

Conclusion: Why the Accumulation and Application of Chapter 5 Knowledge Gained Through Basic Research Are Important

“Hoshi to Tanpopo” (literally translated to Stars and Dandelions), a work by the poet KANEKO Misuzu, has a passage that says, “I can’t see it, but it’s there. Just because you can’t see it doesn’t mean that it’s not there.”¹ The history of science and technology, especially that of efforts for making progress in basic research, is the history of tireless endeavor to understand the “unseen,” driven by insatiable, fundamental human desire to know.

Part I discussed basic research from various perspectives and looked at examples where researchers pursued and pioneered new frontiers of knowledge with utmost effort and an unwavering faith that there must be a universal truth behind the veil of the “unseen.” The following are the key concepts that have been covered in Part I, which are important in considering the accumulation and application of knowledge gained through basic research.

[Value of basic research]

Different people may have different answers to questions like “Why is basic research important?” and “In the first place, what is basic research?”. As mentioned in Chapter 1, KAJITA Takaaki said, “Basic research is not something that can be immediately useful in our lives. Basic research is meaningful in two ways. Firstly, it will serve people’s lives in the due course of time. Secondly, it gives us intellectual property as shared assets of all humanity by leading us to the truth and a deeper understanding of the natural world.”

His notions are right. Regarding the first meaning of basic research that he pointed out, we know that basic research has never been “useless,” as we saw in Chapter 2. Furthermore, while the research periods and situations vary greatly among different research fields, science and technologies are evolving and fusing with each other beyond fields so rapidly that we are seeing more and more cases where research results come to have a great impact on our lives and society and deliver value that we can see in our day-to-day life in a fairly short time. The second meaning of basic research referred to above is also very important. Japan should aspire to become a country that is respected in the international community and that people can be proud to be part of by proactively contributing to the establishment of the shared intellectual property of all humanity.

Intellectual curiosity that makes us want to know things, including the answers to big questions like where we come from and where we are going, is the fundamental desire of humanity. It is important to establish within our social system various means that allow such desire to see its fruition, while also building a society where basic research projects are treated with respect as products of unfettered mental activities which modern people value and should be appreciated on a different dimension than economic value.

[Researchers’ passion for basic research]

The researchers that we looked at in Part I exuded a strong tenacity that allowed them to patiently withstand a staggering number of trial and error experiences. We could see researchers’ pride and integrity

¹ KANEKO Misuzu: Nursery Rhyme Collection (JULA Publishing)

in them. OMURA Satoshi was determined that he would never do the same as others, while NAKAMURA Shuji imposed a strict rule on himself that he must develop and commercialize a blue LED using a completely unique method that no competitors could come up with.

They also seemed to have worked hard on their research with a passion for pursuing the “unseen” and a faith that there must be something of great value only in the “unseen” and in the truths that cannot be understood by just looking at the surface. They also dared to take on challenges and use methods that other researchers deemed impossible or difficult to handle, with a great insight into what lies in the “unseen” and flexible ideas that defied the norms and preconceptions.

OKA Kiyoshi, an internationally recognized mathematician, said, “Discovery always comes with an undiluted sense of joy. That sensation is almost like a proof that you have made a great discovery.”¹ The researchers featured in Part I also were pursuing research from day to day in a state of intellectual excitement and in anticipation of the “undiluted joy of discovery.” Not only looking at social and economic benefits from basic research, but also getting a glance into researchers’ passion driven by intellectual curiosity as well as their excitement and “undiluted joy of discovery,” can give us inspiration and positive energy to move forward towards the future.

[Overcoming fear of failure in basic research]

TANAKA Koichi said, “We fail at experiments in order to succeed eventually. A first-ever experiment often ends up in failure, but there also often lies an unexpected new opportunity.” It is no exaggeration to say that the history of research was largely an accumulation of failures. We can also see this in researchers covered in the overview in Part I, such as AMANO Hiroshi who finally succeeded in creating a GaN crystal after going through over 1,500 failures over the course of a year, and OMURA Satoshi who always carried a plastic bag in his wallet and continued to analyze collected substances, believing that he would succeed one day no matter how many times he failed.

These examples tell us the importance of taking on the challenge of exploring unique research areas without fearing failures. They also showed that many attempts and failures and insights gained through them are the very fruits of basic research. To make this happen, it is important to build an environment where such attempts are appropriately appreciated and researchers can utilize lessons learned and insights gained for the next research project.

[Time required for basic research]

As discussed in Chapter 2, there are some examples like iPS cells where it took only several years from the success of basic research to the commencement of clinical research, while there are other examples like superconductivity where it took more than 50 years from discovery to social application, and after 100 years we still have not figured out the entire picture of this phenomenon yet. This is why it is important especially in basic research to continue long-term efforts without being blinded by the presence or absence of short-term results.

[Inheritance of basic research]

Basic research in its nature is not something that can be entirely established by a single genius, but is

¹ OKA Kiyoshi, *Shunsho-Juuwa*, 1963.

built on many attempts, successes, failures, and struggles of our predecessors.

For example, as seen in examples in Part I, the function of a region with a special base sequence called CRISPR, which was discovered in Japan, was unknown at the time. However, after 25 years, overseas researchers solved this mystery, which subsequently led to the development of a genome editing tool. It is important to foster basic research projects in various areas from a long-term perspective, as the scope of basic research is vast and projects may sometimes blossom in a different area than what was initially intended.

Basic research is a pursuit of universal truths and values that has continued from our predecessors, and at the same time, it is a work that should be passed down to future generations. We must not let this light go out for any shortsighted reasons. Inheritance of efforts is part of culture.

[Synergy between basic research and technologies supporting it]

We covered technologies supporting basic research in Chapter 3 to show that Japan's advanced technology has contributed greatly to the daily progress of basic research around the world. In that chapter, we also saw that technologies supporting basic research are also supported by basic research, highlighting its importance again.

Although Japan boasted the world's leading technology after the war, we are entering a new phase as we transition to a knowledge-intensive society. In addition to efforts to manufacture and improve high-quality products, it is necessary to make a strategy for the future by applying a bird's-eye analysis to manufacturing network and platforms.

[Importance of accumulation and development of basic research in today's world]

Japan is entering a new era where science and technology has a new meaning from a different perspective, as we move forward to Society 5.0, a society where digital innovation and the imagination and creativity of diverse people are tapped into to solve social challenges and create new values. In the anticipated knowledge-intensive society, future possibilities and options will vary depending on how much of diverse and varied knowledge we can draw together. For this reason, basic research as an intellectual activity to pursue and create new excellent ideas will become even more important.

As we can see from the examples covered in Part I, there are quite a few highly anticipated basic research areas. With an awareness of this situation, the government, universities, national R&D agencies, industry, and other organizations and people are collaborating with each other to promote open innovation and establish an ecosystem for the accumulation and application of knowledge gained through basic research.

While Japan has seen glorious achievements in the field of basic research as we discussed in Part I, there is also a concern about its declining global presence in the world of basic research, amid difficult social and economic situations. Japan is now standing at major crossroads.

There is a need for national debate and fostering a shared understanding as to how Japan can continue to pursue universal truth and value for all humanity in the field of science and technology, pioneer the horizon of knowledge as a global frontrunner, and return the benefits of research results to society, while also showing the world how we could deal with upcoming challenges as one of the first countries to face them.