Kakenhi and Me—The True Objective of Grants-in-Aid for Scientific Research

Michiko Konno
Professor Emeritus, Ochanomizu University
Former Senior Program Officer for Chemistry at the Research Center for Science Systems, Japan Society for the Promotion of Science

I shifted the target of my research based on X-ray crystallography analysis midway through my career. Since 1969, when I was a graduate student, I had been engaged in research into the phase transitions of organic conductors, spin crossover complexes, and mixed-valence complexes in view of aligned structures at the Institute for Solid State Physics, the University of Tokyo. At the 1981 Congress and General Assembly of the International Union of Crystallography held in Ottawa, I was awestruck by the power of a special lecture on the crystal structure of the tomato bushy stunt virus delivered by Professor Michael Rossmann of Purdue University. I found out that it is important to research the molecular scientific feature of a reaction field on the protein with the help of crystallography analysis in view of the chemical nature that the enzymatic reaction of protein is a catalytic reaction. I beat a path to Professor Rossmann's laboratory and devoted two-and-a-half years to the study of proteins. Although I obtained the post of assistant professor of the Department of Chemistry, Faculty of Science, Ochanomizu University in 1987, at the time the university did not possess any of the facilities required to conduct experiments for the structural analysis of proteins. Faced with these difficult circumstances, I cannot overstate my gratitude for the four-year Kakenhi grant I received for Scientific Research on Priority Areas, which allowed me to set up a research laboratory. I selected as the first target researching aminoacyl-tRNA synthetases and cyclophilin—housekeeping proteins whose reactions themselves had been identified through biochemical experiments but whose molecular-level mechanisms had not yet been elucidated. The 20 types of aminoacyl-tRNA synthetases exist in all organisms but each orthologous aminoacyl-tRNA synthetase from different species has low homology in the amino acid sequences. Even when the amino acid sequence involved in reaction is different, these are naturally selected and function normally with virtually no change in efficiency. In essence, those aminoacyl-tRNA synthetases are proteins that had undergone biological evolution while maintaining their reactions, and I therefore believed they are ideal targets for observing the molecular scientific nature of the mechanism of recognizing substrates in those enzymes. I also looked at the catalytic function of the isomerization reaction of cyclophilin, which exists in all organisms from *Escherichia coli* to humans. This is one representative example of the molecular scientific function of reaction fields on proteins. Additionally, on the administrative side of the Kakenhi program, I served a three-year term as a senior program officer for Chemistry at the Japan Society for the Promotion of Science (JSPS) Research Center for Science Systems from 2004, half a year after the Center was

established, where I worked to conduct a fundamental reform including reviews of Kakenhi applications, screening standards, and research fields.

I would like to take this opportunity to offer my opinion on the future of the Kakenhi program. The JSPS was founded to provide funding with the aim of furthering academic research and fostering young researchers. Thus far, in a period when Japan has maintained a sufficient population, Kakenhi grants served primarily to further academic research, while also helping develop young researchers. However, the generation born during Japan's first baby boom has now reached retirement age and retired from the front lines of their respective fields, while the population born during the second baby boom is only 80 percent that of the first generation. Furthermore, the current birth rate lies at less than 60 percent of the second generation. Considering that Japan's working population will undergo a further decline in future, what direction should the Kakenhi program take?

The increasing percentage of women's contribution to research in natural science and technology is one drastic measure to solve the problems with the declining birth rate that Japan should adopt as approach for retaining potential of industrial nation. Given the fact that the population of Japanese currently in their twenties lies at 60 percent of what it was during the second baby boom generation, and that this rate is gradually declining even further, the number of individuals possessing the inherent ability required is consequently also in decline. Increasing the percentage of women's contribution to research would relieve Japan from the influence of this 40 percent decline, and result in maintaining the total number of researchers required to keep the level of Japan's technology. Percentage of women's contribution should be increased at least up to 30 percent to maintain that level. Women face unique hurdles—for example not being able to work full-time due to maternity leave. By training young female researcher as scientist who can utilize their abilities during shortened working hours, raising women's contribution to research to 40 percent of the total is the goal. This task is essential, not only from the perspective of achieving a gender-equal society, but also considering the circumstances Japan will face 10 or 20 years in the future.

Let us consider the effect that a decline in Japan's population will have on society in future. The ratio of workers available to provide the necessary social support to the elderly will decline. One way of addressing this problem is to equip each caregiver with the capability to care for a greater number of elderly, and support from science and technology will be essential to achieve this objective. This could include, for example, the development of care assistance robots or systems for monitoring elderly patients at night. Meanwhile, although consumption of food will decline, a certain level of output will nonetheless need to be maintained. It will be particularly important to maintain the output volume of vegetables, which are an essential source of nutrition for children and the elderly. However, vegetable-growing is not suited

to part-time farming, meaning that commercialization and hence the development of related agricultural technology will be needed. The same can be said of medical treatment for the elderly. As illustrated, applied research will become ever more important to society in the future. In addition to basic research, Japan will also need to develop researchers skilled in applied research.

Despite a lack of natural resources, Japan has thus far been able to secure a comfortable life for its citizens through its technological prowess. I am sure readers have already understood that potential of technology contributes to this comfortable life and potential of technology essentially depends on human potential. If Japan's young population continues to fall, the population of working-age individuals available to maintain and further advance these technological capabilities will naturally decline. However, given the country's population structure, a future reduction in Japan's gross domestic product (GDP) is not an option. A rise in efficiency is therefore essential to maintain Japan's GDP level amidst a declining population, and a considerable portion of this increase in efficiency must be realized through applied research. Raising the competency of applied researchers who can help maintain Japan's GDP level is therefore becoming a long-term strategic issue. Naturally, a precondition to this will be achieving a further increase in the skill level of basic researchers, who create the foundation for applied research. Considering the circumstances Japan will face in the future, the Kakenhi program should give priority to the education of young researchers. From when should we start bringing up students to researchers—after graduate schools or in graduate schools? Further, is bringing up started in graduate school or in education course of undergraduate? Up to now, target researchers of education program are mainly limited to researchers working at universities. In future, besides education of researchers engaged in academic research, bringing up students to numbers of researchers interested in applied technology for the purpose of developing technology in corporate is important. We have reached a time when it is necessary to reconsider the role universities have to fulfill in society. Is giving knowledge only enough to realize education? Developing the capability of searching for a problem to research and an approach for research is also required to realize education. In future, we should bring up students to researchers who are keeping in mind both basic research and research that will be developed by applying basic research. The JSPS now should start to weigh the education of young researchers against academic research under the Kakenhi program.