Stretching the Frontiers Of Science

By Kozo Iizuka

"We welcome the initiative of the Human Frontier Science Program presented by Japan. We note that this study will be continued and we would be pleased to be kept informed about its progress."

Thus, in a passage in its Economic Declaration, the summit meeting of seven major industrialized nations held in Venice in June 1987 put Japan's Human Frontier Science Program (HFSP) front and center on the world scene. For the first time, Japan has taken the lead in an international endeavor to push forward the frontiers of human knowledge.

Since the Industrial Revolution, technology has been man's chosen tool for conquering, managing and controlling nature. Technological development have helped us enter the scientific domains of higher temperature, higher pressure, higher speed and greater magnitude. Our knowledge base has expanded, and with it the whole range of human activities. Yet at the same time, serious problems have emerged, including increased resource and energy consumption, the heavier load imposed on the environment, and intensification of the conflict between man and machine. If humanity is to be assured of greater prosperity in the 21st century, we must move now to create a new system of scientific technology which fosters harmonious relationships with society and nature.

Wealth of ideas

In light of this great need, basic research on the precise mechanisms of living organisms is believed to have the potential for becoming a driving force in many areas of research. It could become a treasure chest of ideas for further scientific and technological development. Such research is also expected to prove a powerful impetus for the creation of new scientific and technological systems that harmonize nature and man, bringing tremendous benefits to mankind as a whole.

Living organisms possess superior functional characteristics which have become extremely sophisticated and precise through a billion years of biological evolution. In contrast, only a few centuries have passed since the Industrial Revolution. Even the most advanced of today's scientific technology is no match for the superior mechanisms of life itself. By using state-of-the-art science and technology to elucidate such biological functions, we can make a major contribution to the history of natural science, and explore the common frontiers of all mankind. To meet such lofty goals, the Human Frontier Science Program, as an undertaking addressing issues common to all humanity, should marshal scientific wisdom on a global scale.

In order to extend the scope of scientific knowledge, it is essential to bring together outstanding scientific knowledge and differing scientific ideas and to have their various advocates cooperate in joint undertakings. The interdisciplinary approach, too, can often result in important findings. For these reasons, it is the goal of the Human Frontier Science Program to involve some of the world's most outstanding scientists from many fields.

This in turn requires a transnational system that will enable scientists from different disciplines and countries to pool their widsom, participate in joint research, and smoothly exchange human resources and information. The program is thus not only intended to promote basic research into the mechanisms of life, but to do so through international cooperation and ultimately to apply the results of such research for the benefit of all mankind.

Japanese initiative

Behind Japan's decision to propose the Human Frontier Science Program at the Venice summit were growing calls for Japan to make a greater international contribution to basic research and to take the initiative in promoting new ideas. Following the summit declaration, an international committee, including a number of Nobel laureates, was created to follow up on a feasibility study conducted by Japanese scientists in 1986. After deliberating, the international committee proposed the following three major activities for the Human Frontier Science Program:

Research grants—These grants would provide financial assistance for research

An international meeting of scientists held in Tokyo last November following the announcement of the Human Frontier Science Program in the Economic Declaration adapted at the summit meeting in Venice in 1987 of seven major industrialized nations.

by international joint research teams, and particularly for the work of younger researchers.

Fellowships—These would be granted to young researchers going to study in foreign countries, and would cover their travel and living expenses.

Workshops—These would extend financial assistance for staging meetings to discuss and exchange information on state-of-the-art research in the biological functions.

The committee proposed two priority research areas for the Human Frontier Program: 1) basic research to elucidate the functions of the brain; and 2) basic research into living organisms at the molecular level. Although the life sciences cover a vast range of subjects, these two areas are presently the most pressing. Research in them is expected to make rapid progress, and will have far-reaching ripple effects on other areas of study. Naturally, these priority areas will have to be reviewed from time to time to ensure that the program continues to address the most immediate issues in the life sciences.

The brain functions to be covered in the first area of study include cognition and the learning function, and have already drawn the keen interest of scientists. Progress in elucidating these key functions could open new vistas for information science and other fields. Research is already under way from physiological, psychological and information-engineering perspectives, supported by the improvements in our analytical capabilities provided by computer science and new technology to indirectly monitor the activities of living organisms without direct intervention in their bio-systems.

The second area of research will try to understand the principles behind the mechanisms of living organisms at the molecular level, no longer treating these most basic functions as "black boxes" that cannot be opened and studied. Progress in analytical methods have greatly expanded our knowledge of life at the molecular level in recent years. More concentrated research should provide valuable insights into the mechanisms of life itself.

The results of the international committee were reported to the 1988 Toronto summit. "We note the successful conclusion of Japan's feasibility study on the Human Frontier Science Program and are grateful for the opportunities our scientists were given to contribute to the study," the summit's closing economic declaration said. "We look forward to the Japanese government's proposal for the implementation of the program in the near future."

Choosing priorities

Japan has now begun work to actually put the Human Frontier Science Program into action. Following the Toronto summit, the Ministry of International Trade and Industry and the Science and Technology Agency, in charge of promoting the program, applied to the Ministry of Finance for the funding needed to establish a nongovernmental/nonprofit international organization to implement program projects. The request was approved, with ¥2.4 billion earmarked for the program in the fiscal 1989 budget approved by the Japanese Cabinet in January.

Meanwhile, scientists recommended by summit countries have met twice since Toronto, once in November 1988 and again in March this year, to study details of the program, including priority research areas and the kind of organization needed to implement program projects. The Japanese government will shortly be presenting a concrete proposal for implementing the Human Frontier Science Program to interested nations.

Based on the findings of the 1988 international committee, the following principles have been adopted to guide the work of this ambitious program:

1. Many advances in basic research depend on originality, innovation, fresh ideas and insights. The program must allow for the expression of individual ability and initiative.

2. Importance is attached to the training and support of young researchers, who are expected to play an important role in originating and pursuing creative research.

3. Interdisciplinary exchanges should be stressed since different ways of thinking and approaches play important roles in arriving at new ideas and discoveries.

4. The program should serve as a stimulant for the promotion of international cooperation among scientists in the fields included.

The Japanese government is now discussing with other countries where to locate the Human Frontier Science Program organization and how the program shall be implemented and the organization run. As soon as the organization is established, applications will be invited for research grants, fellowships and workshop assistance. The first recipients are slated to be announced by the end of 1989, signaling the start of the Human Frontier Science Program as a major force for international promotion of basic research.

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