

**RIKEN: LAYING THE FOUNDATION FOR CREATIVE
ADVANCEMENT**

Report of the
7th RIKEN Advisory Council (RAC)
to the President of RIKEN

2009
RIKEN Advisory Council (RAC)

CONTENTS

EXECUTIVE SUMMARY.....	3
Introduction	3
Summary of findings	4
Recommendations	5
INTRODUCTION	9
THE 7th RAC MEETING	11
Terms of Reference	11
ASSESSING THE RESPONSE OF RIKEN TO THE RECOMMENDATIONS OF THE 6 th RAC.....	14
General Assessment	14
Maintain RIKEN's outstanding history of achievements in science and technology	16
Enhance the scientific personnel and culture of RIKEN	17
Increase RIKEN's contributions to society	18
Enhance RIKEN's visibility and international standing	19
PLANNING FOR THE FUTURE: RECOMMENDATIONS OF THE 7 th RAC	20
Enhancing Individual Scientific Creativity	20
Institutional Initiatives to Promote Scientific Success	26
Collaboration within RIKEN	33
RIKEN and Society	35
RIKEN and the International World of Science	38

RIKEN: LAYING THE FOUNDATION FOR CREATIVE ADVANCEMENT

Report of the 7th RIKEN Advisory Council (RAC) to the President of RIKEN

EXECUTIVE SUMMARY

Introduction

The 7th RIKEN Advisory Council (RAC) met in Tokyo on April 22-24, 2009 with all members except Professor Rainier Metternich in attendance. Professor Zach W. Hall served as chair, and Professors Yuan-Tse Lee and Hiroo Imura as vice-chairs. The Terms of Reference, stated below, were given by President Noyori in his opening remarks and were accepted by the RAC. At the conclusion of the meeting, Dr. Hall and the other members of the RAC presented their findings to the President and Executive Directors.

Terms of Reference for the 7th RAC

- I. Evaluate RIKEN's responses to the 6th RAC's proposals in *RIKEN: Leading Japanese Science to Global Pre-eminence*
- II. Propose to the RIKEN Executive Board a management policy to realize the three pillars of the 2nd 5-year plan:
 - RIKEN will strive for dramatic advances in science and technology
 - RIKEN will strive to contribute to society and win society's trust
 - RIKEN will strive to create a RIKEN brand for strong global presence
- III. Evaluate RIKEN's collaborations within its own centers and institutes and with outside institutions, and propose to the Executive Board means to further promote these collaborative efforts

Summary of Findings

The 7th RAC finds the overall scope and quality of scientific research at RIKEN to be outstanding, by both national and international standards. RIKEN successfully combines “small-scale” and “large-scale” discovery research with mission-directed projects and with the development of world-class large-scale facilities in the physical and life sciences to achieve the impressive scope of research that is one of its distinguishing features. RIKEN’s structure and organization make it an ideal place for the development of interdisciplinary research, which is often at the leading edge of science. RIKEN thus stands poised to play a major role in scientific advancements of the future.

The 7th RAC was gratified by the active and thoroughgoing response of RIKEN to the recommendations of the 6th RAC. The consolidation and reorganization of the Discovery Research Institute and the Frontier Research System into the new Advanced Science Institute is an important step toward encouraging interdisciplinary interactions and integrating discovery and development activities. Other changes to increase collaboration both within and beyond RIKEN can be seen in expanded access to existing infrastructure such as the Radioactive Isotope Beam Factory, the NMR facilities in Yokohama, and the SPring-8 synchrotron, as well as in plans for new large-scale projects involving the development of the X-ray Free Electron Laser (XFEL) in Harima, and the Next-Generation Supercomputer in Kobe. Importantly, these world-class facilities are being opened to the global community, in line with President Noyori’s vision of RIKEN as an integral part of the international scientific community.

To help RIKEN achieve the ambitious aim expressed in the Terms of Reference, to make “dramatic advances in science and technology”, the 7th RAC makes a number of recommendations to help RIKEN identify and encourage creative individuals. In particular, we suggest that RIKEN encourage the independence and development of early- and mid-career scientists and that it more aggressively pursue the goal of more effectively employing the under-utilized

pool of Japanese women scientists. We also strongly urge a central effort to increase the number of graduate students at RIKEN through alliances with Japanese universities.

The 7th RAC also suggests institutional initiatives, both scientific and administrative, that it believes will maximize scientific advancement at RIKEN. We suggest that RIKEN explore the possibility of new interdisciplinary initiatives in environmental sciences and in bioengineering. We also strongly support reforms of the administrative systems of RIKEN and urge the formation of an Administrative Advisory Council to advise the President and Executive Directors on matters of management and administration.

Scientific advancement is increasingly a cooperative effort, undertaken through collaborative efforts with other scientists, often at great distances. To maximize these interactions, the 7th RAC recommends policies to increase collaboration within RIKEN, to strengthen relations with Japanese society, particularly with universities and other research institutions, and to increase RIKEN's participation in the international scientific community.

In the face of difficult times, RIKEN will increasingly be looked to for solutions to problems confronting both Japan and mankind in general. We believe that now, more than ever, RIKEN is a unique and valuable scientific institution, poised to make vital contributions to Japan and to the world.

Recommendations

The specific recommendations of the 7th RAC are organized around focal issues identified as vital to the institute's continuing growth and success.

Enhancing individual scientific creativity

1. Foster and support young and mid-career scientists through funding, mentoring and intramural interaction.
2. Maintain or increase support for curiosity-driven, “bottom-up” research.
3. Increase the number and quality of graduate students at RIKEN through closer relationships with outside graduate and medical schools, both within Japan and elsewhere.
4. Increase the number of women scientists and scientific leaders at RIKEN. To this end, we suggest that 25% of all new hires of principal investigators over the next four years be women.
5. Establish a clinical fellowship program to enhance research opportunities for clinical scientists.

Institutional Initiatives to Promote Scientific Success

1. Increase operational support for the Radioactive Isotope Beam Factory (RIBF).
2. Consider initiating new programs in environmental studies and in bioengineering/quantitative biology.
3. Expand support for the Bioinformatics And Systems Engineering Division and for new bioinformatics efforts.
4. Further strengthen independent scientific input for decisions on scientific priorities by engaging eminent scientists in advisory and directorial capacities.

5. Make clear to the government the need for adequate and predictable funding to ensure sustainability.
6. Establish a business plan for the support of large-scale infrastructure that includes a fair and transparent recharge system.
7. Increase the effectiveness and efficiency of the RIKEN administrative system by instituting reforms, including eliminating mandatory rotation of staff, implementation of career and skills development programs, and emphasis on a bilingual administrative environment.
8. Appoint an Administrative Advisory Council, similar to the Research Advisory Council to evaluate RIKEN administrative practice and procedures and make recommendations to the RIKEN leadership.
9. Establish RIKEN standards for research on human subjects.

<i>Collaboration within RIKEN</i>
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1. Consider offering joint appointments, where appropriate, in different Institutes or Centers of RIKEN to facilitate interdisciplinary exchange and collaboration.
2. Consider establishing one or more interdisciplinary programs across Institutes.
3. Build on the existing President's workshops program to establish RIKEN-wide workshops for the promotion of interdisciplinary discussion.

RIKEN and Society

1. Strengthen ties to academia by encouraging scientists to circulate to and from universities at various career stages.
2. Continue to develop intellectual property strategies to facilitate the return of the benefits of research to society and enable new revenue.
3. Establish a science policy office to monitor issues related to emerging developments in science and technology.
4. Engage the public in outreach and dialogue to foster mutual trust and understanding.
5. Project a positive image of RIKEN through surveys and public communications activities.

RIKEN and the International World of Science

1. Review RIKEN policies with respect to release of human genetic data to ensure compliance with international standards.
2. Continue to recruit outstanding international talent to scientific and administrative positions.
3. Continue to cultivate an English-speaking culture in both the laboratories and the administration.
4. Continue to serve as an international hub for scientific activities and to promote RIKEN's image, both within Asia and world-wide.

RIKEN: LAYING THE FOUNDATION FOR CREATIVE ADVANCEMENT

Report of the 7th RIKEN Advisory Council (RAC) to the President of RIKEN

INTRODUCTION

The mission of RIKEN, expressed in the words of President Noyori, is to promote “the integration of individual wisdom into ‘RIKEN Wisdom’, and its further integration into social wisdom”. As a center for scientific research of international excellence, RIKEN makes a major contribution to society, both in Japan and around the world. Through its research, RIKEN contributes to the health, prosperity and quality of life for the Japanese people. As a source of innovative research and new ideas, as the developer of unique instrumentation, and as a training ground for research personnel, RIKEN also contributes strongly to the international scientific community. As one of the world’s elite scientific institutions, working to benefit mankind, RIKEN should be a source of great pride for the Japanese people.

RIKEN is now planning for the future: for the next mid-term program which will begin in 2013; and for the RIKEN centennial in 2017. The three pillars of the RIKEN Second Mid-term Plan are:

- Making dramatic advances in science and technology
- Contributing to society and winning the trust of society
- Making RIKEN a globally recognized brand

These three pillars are not separate, but are interconnected. Through advances in science and technology, RIKEN contributes to society, earns its trust and

increases international visibility. Likewise, RIKEN can only realize its maximal scientific potential by participating fully in the global scientific community – i.e. becoming a “globally recognized brand” – by attracting the most talented trainees, investigators and leaders, both scientific and administrative, from all over the world. Finally, to achieve its scientific goals, RIKEN must contribute to society by pioneering changes in culture that nurture the talent and creativity of individuals. These points have been eloquently made by Professor Kiyoshi Kurokawa in an editorial on Japanese science and society in *Science*, November, 2008 – “meeting the future challenges in any country requires a circulation of human capital and resources that supports a vibrant international exchange of ideas and talents.”

As the 6th RAC noted, RIKEN’s stature and record of accomplishment is at a very high level in the international scientific community. To maintain and exceed its present level of excellence, RIKEN must continue to foster innovation and adapt to a constantly changing scientific landscape by recognizing and exploiting new opportunities. In parallel, RIKEN must adapt its administrative and infrastructure support to the changing demands of science. RIKEN must provide the scientific and administrative tools that will enhance the ability of its most creative scientists to explore the unknown. By using the discoveries made at RIKEN to influence and shape the overall RIKEN research program, they become part of “RIKEN wisdom”. As the benefits of RIKEN research are returned to society as knowledge and as useful products, they become part of “social wisdom”. The most important factors that will help RIKEN achieve its mission are its adherence to the highest scientific standards, its flexibility in seeking new opportunities, and its openness to the new global world of science.

The current economic situation provides a challenge for the changes that RIKEN wishes to make, as financial resources are likely to be limited. Viewed differently, the global crisis provides an opportunity for making substantive change, an opportunity that will be taken by leading countries around the world. By its full

participation in the interconnected, international community of science, RIKEN can lead the way for Japanese society to participate more fully in the new, interconnected global economy.

THE 7th RAC MEETING

The 7th RAC meeting was held on April 22-24, 2009 at the Tokyo Bay InterContinental Hotel. All members of the RAC were present except Professor Rainier Metternich who was unable to attend. The Terms of Reference for the 7th RAC were presented by RIKEN's president, Dr. Ryoji Noyori, in his opening remarks.

Terms of Reference for the 7th RAC

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- III. Evaluate RIKEN's collaborations within its own centers and institutes and with outside institutions, and propose to the Executive Board means to further promote these collaborative efforts

During the first day of the meeting, the RAC members heard presentations by the President and Executive Directors on RIKEN's recent evolution, current issues facing the organization, and the changing environment within which RIKEN operates. President Ryoji Noyori presented his vision of the future of RIKEN as well as his analysis of the most urgent issues confronting RIKEN. Presentations by RIKEN's Executive Directors featured the following:

- an introduction to RIKEN's management principles and governance
- an overview of the RIKEN second mid-term plan
- an overview of research activity and personnel
- a summary of technology transfer strategies, public relations and international strategic relationships
- an introduction to the RIKEN administrative structure and proposed reforms.

During the morning of the second day of the meeting, RAC members split into three groups, one focused on the physical sciences, one focused on basic life sciences, and one on biomedical science, to hear presentations from the directors and the chairs of the Advisory Councils for each of the centers and institutes. In the afternoon, the RAC heard presentations on the ASI, the Center of Research Networks for Infectious Disease, the Supercomputer R&D center, and the XFEL Project.

In addition to these presentations, RAC members also received the following materials:

- Report of the 6th RAC
- RIKEN Responses to the 6th RAC recommendations
- Terms of Reference for the 7th RAC
- Profiles of the 7th RAC members
- RIKEN 2009 White Paper with appendices
- Reports made by each of the Advisory Councils

- Other RIKEN publications and, where available, annual reports of the various centers and institutes

Presentations were followed by discussion and brief *in-camera* sessions by RAC members. A first draft outline of the report was developed during a working dinner, followed by an extensive writing and discussion session on the morning and early afternoon of April 24. At the end of the meeting, Drs. Zach W. Hall (RAC Chair), Yuan Tseh Lee and Hiroo Imura (RAC Vice-Chairs) met with President Noyori; Dr. Hall then presented a summary of the report of the 7th RAC to the RIKEN President and the assembled Executive Directors.

ASSESSING THE RESPONSE OF RIKEN TO THE RECOMMENDATIONS OF THE 6TH RAC

General Assessment

The response of RIKEN to the recommendations of the 6th RAC has been very positive overall. We commend President Noyori, the executive directors, and the research and administrative staff for their collective efforts in making changes that strengthen RIKEN, both internally and externally. We highlight several that we think are of special importance.

- We appreciate the attention that RIKEN has paid to the organization of individual laboratory science (“small science”) by merging the Discovery Research Institute and the Frontier Research System into the new Advanced Science Institute (ASI) so as to encourage and facilitate interdisciplinary interaction. This is an important example of RIKEN’s ability to adapt the organization of its scientific activities to achieve greater interaction and synergism between its investigators and to better integrate discovery activities with the development of new fields of investigation. The ASI has great potential, we believe, for scientific achievement and development. Continued strong and visionary leadership by the ASI Director will be necessary to realize the full potential of this new structure.

- We applaud RIKEN’s efforts to expand its scientific relations beyond RIKEN by making its infrastructure available to scientists from other institutions and by including them in its governance. In particular, we highlight the Radioactive Isotope Beam Factory (RIBF) of the Nishina Center, in which scientific priorities are set by an international committee,

which is chaired by a non-Japanese scientist, as a sterling example of international scientific cooperation under the leadership of RIKEN. The scientific administration of this facility, which advances world-wide science and enhances the reputation of RIKEN, provides a model many of whose elements can be incorporated into the management of other large-scale RIKEN infrastructures.

- We note RIKEN's success in recruiting Nobel Laureate Susumu Tonegawa to head the Brain Science Institute (BSI) as evidence of RIKEN's ability to attract scientific talent at the highest international levels. The reorganization of the BSI into new core research areas and the changes in administration and career structure planned by Dr. Tonegawa should further enhance the quality of an already highly successful institute.
- RIKEN has taken important steps to strengthen bioinformatics, as suggested by the 6th RAC, with the establishment of a new Bioinformatics And Systems Engineering Division, under the direction of Dr. Tetsuro Toyoda. The establishment of a comprehensive, integrated, user-friendly database for life sciences research at RIKEN is also an important step that will increase its use by the international scientific community and thereby increase the international visibility of RIKEN.
- The promotion of the Molecular Imaging Research Program to center status (Center for Molecular Imaging Science (CMIS)) is an important step. Its strong coordination with industry partners will expand clinical research activities at RIKEN and offer an important precedent for cooperation with industry in the life sciences.
- We are pleased with the progress made by the Center for Intellectual Property Strategies. After a long lag phase, technology transfer activities

at RIKEN have now made a substantial and promising beginning. We look forward to the expansion of these activities.

- The BioResource Center has expanded its role as an international repository for multiple types of biological materials and as an international training center for technologies related to the storage and use of biological resources. The BioResource Center has developed several important new technologies and has become one of the world leaders in bioresource management.
- We commend the use of the President's Discretionary Fund to stimulate and facilitate the interaction of RIKEN scientists in disparate fields and to explore emerging areas of scientific investigation. We hope that these and similar RIKEN-wide workshops will continue. Perhaps some of them could be undertaken in conjunction with Japanese universities.

RIKEN has also made other important responses to the 6th RAC recommendations as noted below.

Maintain RIKEN's outstanding history of achievements in science and technology.

RIKEN made a number of changes in both in scientific organization and governance that will strengthen its ongoing activities. These include:

- The Genome Sciences Center was reorganized into three smaller centers for infrastructure and research: the Omics Science Center(OSC), the Systems and Structural Biology Center(SSBC), and the Bioinformatics And Systems Engineering Division (BASE).

- The SNP Research Center was given an increased biomedical focus and re-designated as the Center for Genomic Medicine (CGM).
- The NMR facilities have been made widely available to scientists within and outside of RIKEN.
- Additional senior scientists were added to the Research Priority Committee
- The RIKEN Advisory Board was expanded to increase the representation of academia and of the private sector.

Enhance the scientific personnel and culture of RIKEN.

Three major issues were raised in the 6th RAC report that are important in enhancing the scientific personnel and culture of RIKEN: the recruitment of more women scientists; the recruitment of non-Japanese personnel at junior and senior levels; and increasing the number of graduate students at RIKEN. A fourth recommendation, increased use of English, was viewed as essential to strengthening the “internationalization” of RIKEN and improving its participation in and recruitment from the outside world. All of these are long-term goals, whose realization will require many years, and each of them is addressed again in the body of this report. Nevertheless, RIKEN is making progress and has instituted a number of programs that make the culture of RIKEN more congenial to women scientists and to foreigners, including students.

- RIKEN has established programs to provide maternal and childcare support for RIKEN scientists at several of its locations (Wako; Yokohama; arrangements are in progress for childcare at Kobe).
- RIKEN has developed a Foreign Postdoctoral Researchers program and an Initiative Research Scientists program, which will aid in the recruitment of foreign scientists.

- A recently-established International Program Associate (IPA) stipend program will help attract and support graduate students from outside Japan.
- RIKEN has established multiple Joint Graduate School Programs to promote closer ties with Japanese universities and to provide a route for more graduate students to conduct research at RIKEN.
- The number of Asia Program Associates has been expanded to include six graduate schools across Asia, allowing an increased number of graduate students from Asia to conduct research at RIKEN.

Increase RIKEN's contributions to society.

Through expanded clinical studies, the expansion of technology transfer activities and outreach, RIKEN has increased its contributions to society.

- The Research Center for Allergy and Immunology (RCAI), the CGM, and the CMIS have pursued significant translational research collaborations with clinical research institutions and industry. The program on the development of a cedar pollen vaccine is an excellent example of RIKEN taking the initiative to bridge the gap between basic research and the private sector in an active and imaginative way.
- The Center for Intellectual Property Strategies has intensified its interactions with industry, and a Collaboration Centers Program was launched and now operates three centers.
- A total of 28 venture businesses and three RIKEN-industry collaborative projects have been established to convey the benefits of RIKEN research achievements to society.
- RIKEN has expanded its domestic public understanding and outreach activities

Enhance RIKEN's visibility and international standing.

RIKEN has made excellent progress in expanding its international activities, particularly those in Asia, as suggested by the 6th RAC.

- The Global Relations Office was established to coordinate overseas affiliations and to enhance the international environment within RIKEN
- RIKEN began the publication of an excellent monthly newsletter of research highlights (RIKEN Research) and an Annual Report, both in English.
- President Noyori has served as RIKEN's ambassador, giving talks at numerous scientific meetings and ceremonies around the world, particularly in Asia
- Closer relationships with research institutions in other countries have been established, including numerous new ties to institutions in Asia (Korea, China, India, Taiwan)

PLANNING FOR THE FUTURE: RECOMMENDATIONS OF THE 7TH RAC

Striving for dramatic advances in science and technology

RIKEN's central mission is to advance science and technology through research for the benefit of society. RIKEN stands apart from other research institutions in Japan in the breadth of its scientific disciplines, its support for both curiosity-driven research and highly organized goal-directed research, and in the large-scale infrastructure that it develops and makes available to Japanese researchers and others. RIKEN is also committed to full participation in the global world of science. RIKEN is thus in a unique position to foster the creativity of individual scientists and to initiate new scientific directions in rapidly developing scientific areas. To maintain and enhance its position and to achieve the dramatic advances in science and technology that it seeks, RIKEN must continue to support and enhance each of the unique elements that underlie its success.

Enhancing Individual Scientific Creativity

"...creativity that is truly new and fresh" -President Noyori

Science advances in unpredictable ways. The discovery of a new technology or the formulation of a new idea can suddenly transform the way in which research is performed and can lead thereby to a quantum increase in new knowledge. Discoveries made in apparently obscure areas can sometimes have enormous impact. Seemingly arcane research on the sex lives of bacteria and on host restriction in bacterial viruses, for example, formed the basis of recombinant DNA technology which revolutionized the study of modern biology. Although there have been exceptions (e.g. the Human Genome Project), the most important advances are often unplanned and unanticipated. Thus there is no formula for scientific management that will guarantee dramatic scientific and technological advances. Institutions can, however, adopt policies that encourage and promote

creativity, thus making it more likely that significant and transformative discoveries will be made and developed.

One important aspect of institutional policy is the selection and support of individual scientists. Professor Kurokawa in his editorial in *Science* notes that “the insular, hierarchical, and male-dominated system that still prevails in every sector of Japanese society, including academic institutions” is one reason that government funding often fails to “nurture the potential of ...individuals”. Although RIKEN has been a leader in overcoming many of these obstacles, much remains to be done. Many of the recommendations in this section are aimed at encouraging RIKEN to continue to develop new ways of selecting and supporting scientists in a way that will maximize their creative potential.

Recommendation 1. Foster and support early and mid-career scientists.

Although there are many exceptions, the RAC believes that truly innovative discoveries are most often made by early and mid-career scientists. Wherever possible, RIKEN must make it a high institutional priority to encourage the independence of these scientists and to support them, both materially (e.g. with space and money) and also by mentoring them and by engaging their ideas and energy in developing a collaborative research community at RIKEN.

RIKEN has already made significant strides in the support of young scientists, making it an excellent place to start an independent scientific career. In fact, one of the major contributions of RIKEN to other Japanese and world research institutions is that many of the scientists who begin their careers at RIKEN go on to significant research positions elsewhere. We support and encourage this continuing role for RIKEN as an incubator for beginning scientists to establish their independent careers. We also suggest that RIKEN develop means of retaining the most talented of these individuals for longer-term careers at RIKEN.

To help maximize the productivity of younger researchers, we suggest that RIKEN consider using part of the President's discretionary funds (with possible matching funds from the relevant Institute or Center) to identify and support risky projects of high potential impact that are initiated by early or mid-career scientists.

Recommendation 2. Continue to support curiosity-driven, "bottom-up" research.

Historically, RIKEN has built its strength and international reputation largely on the freedom that it has given both to its leaders and its individual scientists to organize and pursue research in directions that they see as most productive. RAC is concerned that the budget for such "bottom-up" research has decreased significantly over the past few years, while that for large-scale infrastructure projects has increased significantly. RIKEN must not lose sight of the proven importance of investigator-directed, curiosity-driven research. RIKEN's strength has been in basic research. Such research projects, initiated because of their intrinsic scientific interest, have often been those that unexpectedly offer the most social benefit. The RAC recommends that budgetary support for "bottom-up" research be maintained and, if possible, increased and that a balance be maintained between basic and translational/applied research.

Recommendation 3. Increase the number and quality of graduate students at RIKEN.

As past RACs have noted, vibrant scientific research communities have almost always been associated with the education of young scientists. Students bring enthusiasm and fresh ideas, are less encumbered by conventional wisdom and often form valuable connections between laboratories. Students are generally the backbone of the laboratory workforce, particularly in the laboratories of early career investigators who have yet to build reputations that would attract post-

doctoral fellows. Students are often drawn to the labs of early career scientists whom they see as “on the cutting edge”.

The importance of graduate students to creative research is emphasized by the efforts of independent research institutes all over the world (EMBL, Max-Planck, Wellcome Trust Sanger Centre, Salk Institute) to form alliances with universities so that graduate students can work in their labs. Indeed, several Institute Directors at RIKEN told us that a major concern of their scientists was to have more graduate students of high quality.

RIKEN has previously made efforts to increase the number of graduate students, through alliances with universities throughout Asia. Although the RAC understands that there have been some difficulties in forming such alliances in Japan, the RIKEN central administration must make a more substantial and comprehensive effort to solve this problem. We urge RIKEN to investigate the arrangements made by other international research institutions (see above) so that it can devise a comprehensive and successful strategy to increase the graduate presence at RIKEN. We note that the collaboration of RIKEN investigators with Japanese universities in graduate education is much more successful in the physical sciences than in the life sciences, suggesting that solutions can be found to this problem. One possibility is the formation of joint graduate programs in specific areas. It is important that such programs include scientists at all levels as participating members of the programs, particularly early career scientists. Because they both benefit from, and contribute to, graduate training programs, whatever arrangements are made with local universities must include early-career scientists.

In addition to satisfying RIKEN’s needs, expansion of graduate training at RIKEN serves the nation’s needs as well. A highly distinguished member of our panel stated that it was “a national crime” that the scientific resources and excellence of

RIKEN were not more fully employed in training the next generation of scientists in Japan and abroad.

Recommendation 4. Increase the number of women scientists and scientific leaders at RIKEN.

As part of its effort to optimize the creative potential of its young scientists, RIKEN must take advantage of a pool of talent that is still relatively untapped in Japan – women scientists. Anecdotal evidence suggests that many Japanese women scientists work abroad because of lack of opportunity at home. With a declining population and decreasing interest among youth in scientific careers, increased opportunities for women becomes not only a scientific necessity, but an economic and demographic one as well.

Although RIKEN has long been committed to the goal of hiring women scientists and has made child-care and other provisions to ease their situation, the current goals for increasing the number of women scientists from the current 8% to 10% over four years seems to the RAC to be much too modest. We suggest that a more appropriate goal would be that 25% of all new hires of Principal Investigators at RIKEN over the same period be women.

One element in the successful hiring of women is to have a strategy for hiring two-career couples. As the number of women in graduate school, and correspondingly the number of two-career couples, has increased, many institutions have found that hiring a highly sought-after young scientist often means being able to offer an appropriate scientific position to a spouse who may be judged to be slightly less strong. RAC members learned of anecdotal cases involving two excellent individuals (one female, one male) who were offered jobs by RIKEN, but took positions elsewhere because of lack of equivalent opportunity for their respective spouses.

The RAC recommends that RIKEN also seek to increase the number of women in leadership positions, both scientific and administrative. In several other countries, a number of university presidents are women, many of them scientists (e.g. MIT, Harvard, Princeton, University of Cambridge, University of Pennsylvania, the Institut Pasteur, the recently named Chancellor of UCSF). RIKEN, along with other Japanese institutions, should nurture talented women who can increase the talent pool of scientific and administrative leaders for RIKEN and other Japanese institutions, and who can serve as role models for their younger colleagues.

In order to increase the visibility of successful women scientists, we suggest that RIKEN adopt a policy of consciously selecting women as members of its evaluation committees, as seminar speakers and in other public roles.

Recommendation 5. Establish a clinical fellowship program that will enhance the research potential of clinical scientists.

Physicians who are trained in research and are also knowledgeable about clinical aspects of disease are in short supply worldwide. The problem is further exacerbated in Japan by the difficulty of doing research in clinical departments of Japanese medical schools. Thus many young academic clinicians who are interested in following a research career have no supportive outlet for their ambitions. We believe that a fellowship program that would bring young and mid-career physician-scientists at the faculty level to RIKEN for research experience for one to three years could help alleviate this problem. Physician scientists with strong clinical ties would bring valuable disease expertise and clinical connections to RIKEN; they would also gain valuable experience in modern research technology to enable them to pursue a research career.

Institutional Initiatives to Promote Scientific Success

Merging individual wisdom into 'RIKEN Wisdom

Scientific success depends not only on the creativity of individuals, but also on the strategic decisions that research institutions make. Some of these decisions are scientific in nature. What are the new opportunities in research that are likely to yield the largest scientific and technological dividends over the next few years? Taking advantage of new opportunities may mean expanding current programs or developing new ones. It may mean bringing current RIKEN scientists together in new combinations to encourage collaboration, or it may mean hiring new scientific leaders to develop new programs. Although decisions about priorities are made by the RIKEN leadership, relevant RIKEN scientists must have input into the decisions and must become invested in the new programs or they will not succeed.

Much innovation takes place at the boundaries of traditional disciplines or in new, emerging fields. The third Science and Technology Basic Plan for Japan calls for research in “emerging and interdisciplinary fields,” which is likely to promote innovation. RIKEN has already taken steps in response to the 6th RAC report to encourage collaboration across disciplines and we were pleased to see in the RAC 2009 White Paper that this emphasis will continue.

The 7th RAC suggests that RIKEN consider several specific scientific opportunities that it believes would benefit RIKEN research and maximize the possibility for scientific advances.

Recommendation 1: Increase operational support for the Radioactive Isotope Beam Factory (RIBF).

The RIKEN cyclotron is the largest and best instrument that has ever been built for the exploration of nuclear structure, helping us to understand the nature and origin of our material universe. As a consequence, RIKEN is now the leading center for research in nuclear structure physics. The tremendous potential of this new instrument for discovery is illustrated by the fact that within months of its first operation, Japanese scientists discovered, and proposed to name, a new element [the suggested name is Japonium], bringing prestige and new distinction to Japanese science. For nuclear physics, RIKEN is a name known around the world. RIKEN will sustain its current competitive advantage for a period of 5-7 years, until the next generation of facilities is built in France, Germany and the United States. It is extremely important that RIKEN obtain maximal benefit from this instrument while it is a unique resource. We strongly recommend that funds be found to allow fuller use of this instrument (the Nishina Center AC recommends 8 months per year) to allow more complete access by physicists who seek to use it from all over the world. We further strongly support the construction of a cyclotron storage ring, as recommended by the Nishina Center AC, for mass measurement of short-lived nuclei and for neutrino mass studies.

Recommendation 2: Consider initiating new programs in environmental studies and in bioengineering/quantitative biology.

In his opening remarks, President Noyori identified a number of related environmental issues that have emerged as critical challenges for our time, including energy, water, health, agriculture and biodiversity. One might add global warming and the related question of greenhouse gas emissions to that list. RIKEN has a number of excellent scientists and scientific resources, including

those of plant sciences, chemistry and genomics that could be applied to these important and global problems. The RAC was pleased to hear the President's concern for these issues and heartily endorse his plan for RIKEN to fully engage in this area of research and development. The RAC proposes that RIKEN investigate the feasibility of initiating a coordinated and comprehensive program in environmental sciences that would cut across RIKEN, involving scientists from a variety of Institutes and Centers, as appropriate. If the results are promising, a small group of new and existing investigators might be brought together in ASI or in one of the other relevant Institutes as the nucleus of a new program.

The second new initiative that we suggest RIKEN consider is bioengineering or "quantitative biology". Universities and research institutions in many countries are aware of the potential benefit that can come from the application of physics, chemistry, engineering and mathematics – the quantitative sciences – to biology. Whether through nanotechnology, materials science, mathematical biology, or new instrumentation, physical scientists and engineers are eager to apply their skills to biological problems. Within engineering departments in the United States, for example, the most vital and attractive area for students and young faculty is now bioengineering. In fact, the current ferment in this area is also signaled by the new National Institute of Biomedical Images and Bioengineering at NIH.

Many research institutions (Harvard, Stanford, the University of California, a joint program at Emory and Georgia Tech, SystemsX.ch in Switzerland) have established new programs or Institutes to take advantage of these new opportunities. KAIST in South Korea has even undertaken to merge its Departments of Engineering and Life Sciences. One barrier to the successful collaboration of engineers and physical scientists with biologists is that they have different intellectual traditions and speak different languages. The new programs are aimed at bringing the two types of scientists together to remove those barriers through mutual education and through training a new generation of scientists who are fluent in both biological and physical (mathematical)

languages. RIKEN would seem to be an ideal place to incubate this new interdisciplinary science, as it has world-class programs in both physical and biological sciences, together with very powerful large-scale facilities such as SPring-8, XFEL and (soon) the 10-Petaflop Supercomputer. We suggest that the RIKEN leadership, in conjunction with appropriate RIKEN scientists, and perhaps others from outside, explore the possibility of establishing such a program. Meanwhile, continued appointments in the physical sciences, particularly chemistry, should not be ignored.

Recommendation 3. Expand support for the Bioinformatics And Systems Engineering Division and for new bioinformatics efforts.

The RAC urges that additional funding be dedicated to bioinformatics, which has become “the backbone of the life sciences.” The rate of generation of nucleotide sequence data increased by several orders of magnitude in 2008 alone and will continue to increase, with perhaps 100,000 human genomes being sequenced in the next few years. Cancer genome sequencing will also produce a large amount of data, requiring bioinformatics. The opportunities for medically important discoveries from computational analysis of this data are enormous. With the development of the supercomputer facility, RIKEN should consider leading an international effort with such centers as The National Center for Biotechnology Information (NCBI) and The European Bioinformatics Institute (EBI) to analyze this data.

Recommendation 4. Further strengthen scientific input for making decisions on scientific priority.

RIKEN faces the challenge of maintaining the flexibility that it needs to initiate new programs or expand old ones in spite of a limited budget. To meet this challenge, RIKEN thus must have a rigorous process of setting scientific priorities

that will form the basis for making hard decisions, not only about which programs to initiate or expand, but also – *the most difficult decision for all institutions* – about which programs to scale back or discontinue. Such decisions rightly involve many considerations, but critical, unbiased and independent scientific judgment must be an essential component to any decision that is made. For this difficult but important task, it will be beneficial for each Institute or Center to have regular occasions when its ongoing research activities and future plans are assessed through purely scientific discussions with colleagues, both Japanese and abroad.

The President has made great strides in setting up an advisory structure to help him make decisions about scientific priorities. The RAC remains concerned, however, that the President and the Executive Directors receive the strongest possible scientific input to aid them in decision-making. First, we suggest that the President engage several Senior Advisors whom he could consult either individually or as a group about the wisdom of proposed decisions. Such Senior Advisors should be internationally experienced scientific “statesmen” or “stateswomen” of great distinction. Second, we suggest that the President consider having at least two Executive Directors who have scientific backgrounds, perhaps one in the Life Sciences and one in the Physical Sciences.

Recommendation 5 Make clear to the government the need for adequate and predictable funding.

RIKEN must continue to make the case to the government of the necessity of adequate funding and funding mechanisms if it is to achieve its goals. RIKEN cannot maintain its international excellence without appropriate funding, particularly in “Fund A” that supports operational expenses. We urge RIKEN to make strong and concerted proposals to the government to address these critical issues.

Recommendation 6. Establish a business plan for the support of large-scale infrastructure.

The RAC remains concerned that excess operational expenses for large-scale infrastructure at RIKEN will erode the funds available for supporting research. RIKEN, in partnership with other agencies that may be involved, should develop a business plan for the support of the large-scale facilities. The plan should include a fair and transparent system of recharge to users for operational expenses.

Recommendation 7. Reform the administration of RIKEN to make it more effective and efficient and to gain maximum advantage from personnel.

World-class science needs world-class administration. The RAC believes that changes in RIKEN's administration have not kept pace with the growth in size and complexity of its scientific enterprise, and that fundamental changes will be needed to bring it up to date. We were highly pleased with the ambitious plans that we heard during the first day of our meeting for administrative reform at RIKEN. Reform will not only improve the quality of administrative support for research, but also will increase efficiency.

We believe, in particular, that a system of obligatory job rotation is, in most cases, an inefficient mechanism. The constant job transitions result in far too much wasted time and productivity and do not allow the long-term development of skills and knowledge – often highly specialized in a research institution – that are essential to job performance at the highest level. We recommend that a system be instituted in which job transfers are not routine or obligatory, but occur only when they are tailored to specific individual career development needs or to fulfill a specific short-term need for RIKEN. We further recommend that vacant

positions be advertised openly, both within and outside RIKEN, and that they be filled by search procedures that result in employment of the most qualified person. Finally, we urge RIKEN to encourage career development, particularly among its middle managers, through course work to develop skills, and through peer groups that provide a forum for sharing problems and best practices.

Recommendation 8. Appoint an Administrative Advisory Council, similar to the Research Advisory Council, that will periodically evaluate RIKEN administration and make recommendations to the RIKEN leadership.

An Administrative Advisory Council (AAC), composed of those with expertise and experience in modern management, should review practices and procedures and make formal recommendations. The AAC should include those with experience or knowledge relevant to research institutes as well as those with general knowledge in areas that are critical for RIKEN (e.g. accounting, procurement, human resources, communications, international relations, research ethics, compliance, etc.). Although not essential, the RAC hopes that the AAC will ultimately include international members with useful expertise in management and research administration.

Recommendation 9. Establish RIKEN standards for research on human subjects.

As RIKEN's engagement with clinical medicine expands, the establishment of RIKEN standards for human subjects research becomes more and more important. We urge RIKEN to organize a working group that will consult with the relevant constituencies, address these issues, and make recommendations to the leadership for such a policy as soon as possible.

Collaboration within RIKEN

“To achieve its mission....., RIKEN must further increase its interdisciplinary strength..... [by] strengthening internal and external collaboration”. – RAC 2009 White Paper.

For RIKEN to be a vibrant research institution that is more than a collection of outstanding individual scientists, it must promote a culture of collaboration across disciplinary and institutional lines. Within RIKEN, the barriers to effective collaboration include its organization into separate Institutes and Centers and its geographical dispersion. Cultural attitudes emphasizing self-sufficiency and introversion may also play a role. RIKEN leadership thus is rightly concerned with promoting increased communication, cooperation and collaboration through institutional initiatives.

Because Institutes and Centers are relatively stable structures that are difficult to form and dissolve, the challenge is to provide more fluid and flexible structures for organizing scientists in new ways as new fields emerge. This problem is similar to that faced by universities in the United States, which have stable departments, often organized along traditional disciplinary lines. A common solution is to superimpose on the departmental structure other ways of organizing scientists. One way is through graduate education. Graduate programs in neuroscience, for example, may bring together scientists from a number of different departments with a common interest in the nervous system to teach and train graduate students. Another is through the creation of Research Centers, groups of scientists from different departments that cooperate in the pursuit of particular kinds of research, such as bioengineering, nanotechnology or systems biology. It is important to note that such affiliations are not mutually exclusive. A scientist may be a member of a particular department, with a joint

appointment in another department, participate in one or more interdepartmental graduate programs, and be a member of a research center.

The RAC suggests that RIKEN explore the possibility of bringing scientists together across the Institutes and Centers around cross-cutting themes as a way of increasing collaboration. The Institute and Centers themselves can contribute to this effort through joint retreats (which are already being conducted by several Institutes), joint seminars, the co-hosting of foreign visitors, as well as in other ways.

Technology is also a means by which science is united. The formation of an integrated, comprehensive life sciences database is an important step in improving the accessibility of specialized data to all interested scientists.

Recommendation 1. Consider the possibility of offering joint appointments in different Institutes or Centers of RIKEN where appropriate.

One way to increase contact between scientists across Institute/Center boundaries is to offer, where appropriate, a primary appointment in one Institute or Center, with a secondary appointment in another. Although research space and budget would be in the primary Institute/Center (other arrangements are also possible), a scientist with a joint appointment would be included in faculty meetings, seminars, journal clubs, retreats and other activities in both Institutes.

Recommendation 2. Consider establishing one or more trans-Institute programs in interdisciplinary areas.

RIKEN's strength, compared to traditional Japanese universities, is in the flexibility in its structure and organization. The newly-organized ASI may be able to serve as a fulcrum for the organization of trans-Institute programs in interdisciplinary areas.

Recommendation 3. Establish RIKEN-wide workshops for the promotion of interdisciplinary discussions within RIKEN.

Workshops devoted to specific topics that would feature the exchange of ideas and information between those with different expertise and technology would promote interaction and foster the development of unplanned, innovative, interdisciplinary research projects. Although the workshops should primarily involve RIKEN scientists, participation by colleagues from other Japanese and international institutions, as appropriate, would also be beneficial. Such workshops might be supported by matching funds between the President's Discretionary Fund and funds from several relevant Institutes and Centers and should be planned by an interdisciplinary group, possibly including one or more scientists from other Japanese institutions. These workshops could be implemented by building on the existing President's workshops program.

RIKEN and Society

Striving to contribute to society and to win society's trust

Recommendation 1. Strengthen ties to academia, through a circulation system.

One of the most effective ways for RIKEN to impact society and earn its trust is through continued strengthening of RIKEN ties to, and interactions with, academia at all levels. RIKEN must continue to seek mutually beneficial relationships with Japan's universities, in opening up its research infrastructure, in training of young scientists and as invaluable partners in research collaboration. RIKEN's reputation for excellence within the Japanese scientific and academic community is important, particularly as a site for graduate and postdoctoral training. RIKEN should look to build significant capacity for

partnership by developing a “circulatory system” with the universities that will maximize benefit while maintaining the distinctive identity and purpose of RIKEN.

Recommendation 2. Continue to develop Intellectual Property Strategies.

The Center for Intellectual Property Strategies is doing extremely important work in developing avenues for utilization of RIKEN’s inventions in commercial and social applications. This is important not only as a means of ensuring RIKEN’s contribution to society, but, if properly managed, may represent an important source of revenue that can be channeled back into the funding of new research discoveries. As noted earlier, the RAC is pleased to see the recent progress in this office. We urge that staff and resources be increased as needed for further development of the Center and that continuity of leadership be assured during this crucial time of development.

Recommendation 3. Establish a Science Policy Office.

The remarkable range of expertise in RIKEN is an asset that could substantially aid the Japanese government and people in addressing present and future challenges. To this end, RAC recommends the establishment of a ‘Science Policy Unit’ or ‘Science Foresight Unit’, to engage RIKEN scientists and experts from elsewhere (Japanese universities, overseas institutions, relevant public and private bodies) in horizon-scanning exercises on selected topics of potential national significance (e.g. climate change, food supply, water, consequences of increasing longevity, etc). Reports and conferences sponsored by this office could be used by the government and other policy organization, helping RIKEN to engage with government, the media, and many other stakeholder groups. Such activities could help to promote evidence-based policy in Japan, and greatly enhance RIKEN’s contribution to Japanese society and hence its reputation.

Recommendation 4. Engage the public in outreach efforts.

We commend RIKEN for its continuing efforts to make contributions to Japanese and global society, not only through benefits derived from its research achievements, but also through its promotion of public outreach. The high attendance at annual open house events is a testament to public interest in RIKEN's scientific activities. This could be enhanced even further, we believe, by efforts to involve the public, including students, in dialogues on the issues and implications of areas of RIKEN research, such as stem cells and genetic modification, that have broad public interest. Providing forums for public engagement is an excellent means of fostering a relationship between RIKEN and the Japanese public based on mutual trust and understanding.

Recommendation 5: Through public relations, promote a positive image of RIKEN.

RIKEN rightly recognizes the importance of cultivating a reputation for excellence in science, not only within the scientific community, but also in the community at large. The RAC recommends that RIKEN consider engaging a public relations firm to carry out a campaign of advertising that will build a public image of RIKEN as a beneficent institution, contributing positively to the health, economic prosperity and quality of life in Japan. The starting point for these efforts may be to acquire a proper understanding of RIKEN's present reputation. RAC recommends that RIKEN commission a 'Reputation Audit', with a small-scale public opinion poll and targeted interviews with key representatives of major stakeholder groups (government ministries, universities, industry, the media etc). An understanding of the present views of RIKEN will be necessary to inform any subsequent efforts to build the institute's brand, and to provide a recognizable single logo and mission for public awareness and support.

RIKEN and the International World of Science

Making a strong global brand for RIKEN

Although RIKEN is one of the top research institutions in the world, it is not yet fully integrated into the global research community. In some areas, such as high-energy and nuclear physics, RIKEN is well-recognized internationally and there is extensive exchange of personnel, ideas and collaborative projects between RIKEN scientists and those outside of Japan. In other areas, RIKEN is not as well-recognized internationally and its scientific community remains relatively insular, with little exchange of personnel and ideas with the broader scientific community.

To maintain its vitality and to compete most effectively, RIKEN must have the international diversity of talent and collaborative atmosphere that are essential for innovation and scientific success. As noted in the RAC 2009 White Paper, RIKEN must become part of the global career path of scientists at all levels, both recruiting top scientific talent from all over the world and contributing top-level scientists to other world-class institutions.

As part of this effort, RIKEN as an institution must reach a higher level of visibility within the international scientific community. Particularly outside Asia, the RAC believes that RIKEN does not receive the recognition that is commensurate with its achievements. As RIKEN becomes more known for the breadth and quality of its science, and as a source of exciting scientific advances, its attraction as a desirable place to be for the trainees, scientists and scientific leaders around the world will grow.

RIKEN should seek to be a good partner in the international scientific community by adhering to policies and standards that are widely used elsewhere.

Recommendation 1. Review RIKEN policies with respect to release of human genetic data.

RIKEN should review its policies on releasing human genetic data and associated phenotype information to insure that they meet international standards for exchange of information that advances scientific and medical research while safeguarding the privacy of study participants. The policies could be modeled on those adopted by the NIH in the United States or the Wellcome Trust in the UK.

Recommendation 2. Continue to recruit outstanding international talent to scientific and administrative positions at RIKEN.

The RAC strongly supports the continued efforts to recruit the best scientists from all over the world to RIKEN. As noted above, we applaud the recruitment of Dr. Tonegawa as the Director of the BSI and believe that this will send a strong signal of RIKEN's ability to recruit scientists of international stature as scientific leaders. We hope that this will be but the first of many such recruitments.

In addition, we urge RIKEN to also consider recruiting administrative personnel from abroad where feasible. In addition to other Asian institutions with administrative personnel from abroad, we note that the Okinawa Institute for Science and Technology now has an American executive director.

Recommendation 3. Continue to cultivate an English-speaking culture at RIKEN.

RIKEN's ability to be successful in international recruitments at all levels will depend on its success in creating an atmosphere that is hospitable to an international scientific community. The most important element in such a community at present is the use of the English language, which continues to be the international language of science. RIKEN must redouble its efforts not only to become bilingual but to make English its primary operational language. All administrative documents should be in English, or available in English, all scientific meetings, particularly those with a non-Japanese speaker present, should be conducted in English, and all administrative staff should be able to communicate in English with reasonable proficiency. Although foreign personnel should be encouraged to learn Japanese so as to enhance their experience during their time in Japan, full participation in the scientific culture of RIKEN should not require knowledge of Japanese. An emphasis on English proficiency will help Japanese scientists as well, since fluent communication of research results in English, both written and spoken, will increase their own career success.

Recommendation 4. Continue to serve as an international hub for scientific activities, both within Asia and world-wide.

RIKEN should continue to host meetings and global networking activities at its campuses and should continue to increase the number of summer courses that bring international staff and students to RIKEN. RIKEN should also expand Visiting Scholar programs that bring senior scientists from other countries to RIKEN for short periods. One item of concern to RAC is the lack of suitable housing for such programs at the Yokohama campus. We urge RIKEN to find a solution to this problem.

RIKEN should consider sponsoring visits by distinguished scientists (one or more each year) under the personal sponsorship of the President (RIKEN Presidential

Scholars or Fellows), who would remain at RIKEN for a period of one week or more, and who would visit several Institutes or Centers to give talks and to meet, both formally and informally, with scientific colleagues. Those distinguished scientists chosen as Senior Advisors for the President might be among those invited. Individuals might also be selected as Scholars or Fellows on the basis of their contribution to interdisciplinary areas of research. Hence they could help RIKEN to develop new cross-cutting initiatives, as recommended by the RAC. Special effort might be made to attract women to these positions, as role models for young female researchers at RIKEN.

We also urge that the President and other scientific leaders continue to act as ambassadors for RIKEN, by participating in international scientific conferences, by meeting with scientific leaders in other countries. The RIKEN leadership should also take advantage of RAC members, who would be happy to arrange introductions to relevant leaders and to facilitate meetings and publicity for visits to foreign countries.