Recommendations
8th Meeting of the RIKEN Advisory Council (RAC)

October 25 – 28, 2011

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EXECUTIVE SUMMARY

The 8th meeting of the RIKEN Advisory Council (RAC) convened on October 25 - 28, 2011 at the InterContinental Tokyo Bay Hotel.

In his opening presentation, RIKEN President Ryoji Noyori outlined his vision for the future of the institute in the face of dramatic changes brought on by economic contraction and budgetary constraints, political uncertainty, and the aftermath of the Great East Japan Earthquake and tsunami that struck on March 11, 2011. He further provided the following Terms of Reference to guide the 8th RAC in making its recommendations:

1. Evaluate RIKEN's responses to the recommendations made in the 7th RAC report, "RIKEN: Laying the Foundation for Creative Advancement".

2. Under its third 5-Year plan from April 2013 to March 2018, RIKEN will continue to pursue its current mission and also use its full resources as a comprehensive scientific research institute to contribute to the gathering of knowledge essential for humanity's continued existence. The 8th RAC is asked to advise on the governance, strategies, research systems, and management policies necessary to achieve this goal.

3. The 8th RAC is asked to evaluate RIKEN's cross-departmental research activities among its centers and institutes, as well as its domestic and international collaborative activities with universities, industry, and other external institutions. It is also asked to advise on how to maximize RIKEN's collective strengths.

SUMMARY OF FINDINGS

The 8th RAC commends RIKEN in its efforts to "adapt to the changing times" by taking the initiative in supporting the crucial role of science and technology in the recovery of Japan in a turbulent age. We strongly endorse President Noyori's vision for the next 5-Year Plan (2013-2018), with its focus on complementing fundamental scientific research with innovative and translational development, and its emphasis on problem-oriented, cross-disciplinary collaborations. This will undoubtedly help to demonstrate how basic research can make real contributions to social benefit. RIKEN's rapid deployment of trained physicists to monitor affected areas in the immediate post-tsunami period this spring is an excellent example of how scientists can provide invaluable support to emergency response and mitigation effort, in clear alignment with the efforts of the next 5-Year Plan.

From the electric motor and the laser to transistors and monoclonal antibody therapies, the history of technical innovation provides a multitude of examples of totally unexpected practical benefits arising from unconstrained, fundamental research. Going forward, it will be critical to introduce new translational objectives in a way that does not erode the ability of RIKEN's scientists to continue the tradition of excellence in the basic sciences for which the institute is so rightly known, and which will be essential for the transforming technologies of the future.

We are pleased to recognize the concerted efforts on the part of the RIKEN organization as whole in its thorough and effective responses to the recommendations of the 7th RAC (2009). It is gratifying to witness the many new developments in both the scientific and administrative arms of the institute that have been undertaken in the 18-month interval since the previous RAC. We encourage the institute to redouble its efforts in increasing employment and opportunities for female and foreign scientists, both important and under-utilized human resources in Japan. This is another area in which we are confident RIKEN will (and must) find ways to lead the Japanese scientific and academic communities by example.

Indeed, its continuing efforts to create a work environment for its scientists and administrators that embodies the international standards of communication, transparency and diversity are commendable. Support for foreign staff and their families, and the ongoing development of a truly bilingual system need to be maintained and enhanced if RIKEN is to achieve its goals of a multicultural research and administrative staff with a shared

commitment to openness and excellence. The recent growth of international meetings, exchanges and affiliations programs is welcome sign.

We find that the overall levels of scientific achievement and technical support for facilities continue to be superlative, and are among the definitive hallmarks of the RIKEN organization. The broad scope of research across fields of physics, chemistry and the life sciences, and the deep coverage of specific areas at the many strategic research centers, coupled with state-of-the-art infrastructure in such diverse areas as imaging, computation, structural biology, and high-energy physics, provide a truly remarkable environment for a broad spectrum of research activities and interdisciplinary science. The recent first-in-the-world accomplishments of the SACLA X-ray Free Electron Laser in Harima and the K computer in Kobe stand in testament to RIKEN's ability to harness and coordinate the resources of the Japanese scientific and engineering communities in pioneering breakthrough achievements.

As RIKEN seeks to broaden its focus from fundamental science and technology, to science, technology and innovation (and hence a contribution to reconstruction/reform), it will need to be steady in its commitments not only to its new goals of utility and social relevance, but also to its proud tradition of excellence in basic science. This new course will also require keen-eyed and discriminating target selection and priority-setting; there are more than enough real-world problems to go around, RIKEN must focus on those where its strengths and capabilities can most effectively be applied. An emphasis on interdisciplinary and team-based approaches will be a necessity, bringing broad-based scientific expertise and expertise together with advanced technologies to bear on problems of resources, energy, health, and wellbeing. Fortunately, RIKEN has such resources in abundance.

This new approach will almost certainly involve a rethinking of the framework in which RIKEN science takes place. Strong consideration should be given to consolidating and coordinating the facilities and foci of the many research centers in the biological sciences, both to eliminate redundancies and inefficiencies, and to open up possibilities for cooperation. By reducing vertical structures, new pathways to innovation may become clear. Similarly, a shift in the balance or integration between biological and physical sciences may be in order. The innovation focus will require greater concentrations of talent in engineering, chemistry, and physics to enable breakthrough applications in areas such as imaging, nanotechnology and physics. The co-existence of all these diverse elements in a borderless environment will help to encourage inter-disciplinary efforts and cross-pollination of ideas. The efforts led by Executive Director Kawai to achieve this new paradigm should be strongly supported.

With the combined goals of scientific excellence and practical application, RIKEN will not only continue to be a source of pride to the people of Japan, but will become a symbol of hope as well.

Of course, both science and technology of the highest caliber cannot happen in a vacuum. RIKEN will need to cultivate and build on relationships with a wide range of partners in academia, industry and medicine if the seeds it discovers and nurtures are to reach fruition. It will also need to continue to develop its most precious resource – people. From providing opportunities for graduate students to study and train, to developing a work environment conducive to the success of a diverse research community, to supporting administrators in their careers so that they can contribute more effectively, RIKEN must foster excellence in all members of the organization, and engender in them a shared sense of purpose and common cause to provide the benefits of science and innovation for humanity.

KEY RECOMMENDATIONS

1. Reorganization: Balancing tradition with transformation

The 8th RAC endorses the next 5-year Plan proposed by President Noyori. Its emphasis on problem-solving, cross-disciplinary research and on increased efforts to focus basic science on developing seeds for innovation is a necessary evolutionary step for the institute in response to a rapidly changing Japan. This new paradigm, in which fundamental investigations and innovation-driven research are integrated and inseparable, and in which the whole endeavor is supported and enabled by RIKEN's world-class infrastructure, is a formula for adaptation to the exigencies of the times. We are convinced that its success will rest on its ability to demonstrate that the very best of fundamental science can contribute to the solution of real-world problems. For this reason, the reorganization must be careful to recognize and sustain RIKEN's tradition of excellence in science, which is the heart and soul of the institute. Basic scientists and those engaged in more translational research must all be ensured that their roles are valued and appreciated, and all must be given the tools and pathways they need to succeed. Care must also be taken not to overreach. Efforts to develop innovative solutions must be driven by realism and recognition of the core advantages and competencies that RIKEN offers. Skill in passing on the baton of innovation to the commercial sector, clinicians or other agencies, will be as important as brilliance and efficiency in the processes of discovery and translation, in which RIKEN can excel.

The recent appointment of Dr. Maki Kawai as Executive Director will help in the challenging task of maintaining the confidence and commitment of the scientific staff of RIKEN as it implements its new 5-Year Plan. We recommend that RIKEN puts in place an appropriate, small group, including representation of young researchers, to advise and support her through this period of change.

2. Research Cluster for Innovation

The establishment and increasingly important role of the Research Cluster for Innovation, designed to provide a system for knowledge and technology transfer to industry and healthcare, is an exciting development. New major initiatives in Biomass Engineering and the Drug Discovery and Medical Technology Platform (DMP) will seek to help meet obvious societal needs, through cultivating seeds prior to commercial or clinical development, and working in partnership with industry to bring them to fruition. We further voice our support for the proposal of adding a new focus in the areas of stratified or preemptive medicine, for which RIKEN is uniquely well-suited to make real contributions. The earlier success of the Computational Science

Research Program, which will reach completion next year, is a promising sign of the potential power of this approach.

The DMP program will be particularly challenging. RIKEN must choose carefully how it is best able to support modern drug development, diagnostics and preventive medicine. Rather than investing in conventional and expensive approaches to the clinical trials pipeline of drug development, its strongest contributions might be in target validation, and on research on such topics as biomarkers and new approaches to studies of pathogenesis. RIKEN is also well placed to work on sophisticated molecular and imaging-based diagnostics and patient classification, and on the development of new platforms for the application of "omics", imaging and cell-based phenotypic screening, which could be of enormous value to clinical scientists and the pharmaceutical industry. Perhaps most importantly, the RCI will need to choose its targets strategically, whatever the area. Given its comparatively limited resources, intelligent and selective priority setting will be key. Consideration should be given to the appointment of an Advisory Committee with expertise in experimental and investigative medicine, molecular medicine and phenotypic screening, to help the Director with the crucial task of choosing priorities for the DMP.

3. Research infrastructure

RIKEN boasts some of the most advanced scientific infrastructure and facilities in the world. The recent achievements in performance of the K computer and the SACLA X-ray free electron laser are just the latest in a long line of best-in-class, large-scale systems. This is a record of accomplishment, of which RIKEN can be proud. The concentration of such a wide array of facilities, including the Nishina Center cyclotron and two accelerator facilities overseas, the SPring-8 synchrotron, and the many collections at the BioResources Center, are a tremendous advantage for RIKEN's scientists, and a unique opportunity for research collaborations. Given the central importance of these national treasures, RIKEN and the Japanese government must ensure that they are adequately and sustainably funded and resourced to achieve their full potential. Many of these facilities are furthermore intended as international resources, to be shared with the scientific community worldwide. In such cases, it is vitally important for user interfaces and technical support to be available for all potential users. This contributes not only to the advancement of science, but also to RIKEN's global reputation as a hub of scientific excellence.

4. New directions in science, technology, and innovation

RIKEN has undertaken a number of new and noteworthy scientific initiatives since the 7th RAC. The new Quantitative Biology Center (QBiC) will focus on a

number of fundamentally important aspects of the life sciences, including simulation and modeling, synthetic biology, and computational and quantitative approaches. This should integrate well with existing research programs in neuroscience, "omics," immunology, development, and of course systems biology. It remains to be seen whether the lack of a single physical home for the center will be a stimulus or an impediment to interactions between its scientists and others throughout the RIKEN system.

In the future, additional initiatives in epigenetics, proteomics, and chemical biology might be valuable, particularly in light of the goal of the Drug Discovery and Medical Technology Platform to contribute to the prevention and treatment of disease.

The continuing strong emphasis on biological over physical sciences in RIKEN's research portfolio also remains an issue. Strategic initiatives in areas of physical, chemical and engineering research would diversify the mix, and open up new avenues for truly multi-disciplinary investigation. Programs focused on the development of new methods and technologies might also be a fruitful investment, as these are the tools that drive innovation and enable breakthroughs in other fields. Along these lines, it may be useful to study the possibility of breaking down barriers between the individual biological research centers to encourage greater interactivity and synergy, both within the life sciences and across disciplines.

5. Increasing opportunities for female scientists

The underrepresentation of female scientists across all fields and at all stages of the career pathway at RIKEN continues to be an important issue. The appointment of Dr. Maki Kawai as RIKEN's first female Executive Director is an important step, but there does not appear to have been a significant rise in the percentage of women in positions of scientific leadership since the recommendations of 7th RAC. We recognize that a combination of historical and cultural factors make it difficult to achieve rapid hiring increases in the short-term, but this remains a crucially important problem, on which RIKEN must intensify its efforts. Priority should be given to the identification, encouragement and appointment of female candidates of the highest ability, and the leadership should explore ways of proactively recruiting talented women both from within Japan and abroad, particularly in the life sciences, in which many countries have made significant strides toward parity. Exchange programs for women scientists, such as the existing one between Japan and Canada, may also represent a means of encouraging more visits by female researchers of diverse backgrounds and experiences to visit and learn more about RIKEN.

6. Programs for graduate students

While legal and political issues appear to prevent RIKEN from conferring postgraduate degrees, measures must be taken to ensure that graduate students have full opportunity to gain from the opportunities to conduct research and study in diverse, inter-disciplinary teams at RIKEN. Increasing the numbers of graduate students working in RIKEN will not only help to nurture the next generation of researchers but will provide current RIKEN investigators with the enormous stimulus of having excellent students working in their labs. It is the young generation that tends to lead progress in discovery and technical innovation. RIKEN must continue to develop and promote programs such as the Junior Research Associate (JRA) and International Program Associate (IPA) programs to cultivate young scientists and the creativity, energy and enthusiasm that they bring. The institute should investigate novel approaches to forging closer ties with graduate and medical schools around the country, and around the world, as well as to provide real incentives to attract the best and brightest to RIKEN labs. One strength of the RIKEN environment is the many opportunities it affords for multi-disciplinary work, which is certain to increase under the organizational reform. A second is its world-class infrastructure in nuclear and particle physics, imaging, and computer science. These might be a powerful draw for many students, and should be presented as a unique opportunity for them to involve themselves in leading-edge research.

Other aspects of training and education must also be supported, and it may be worthwhile to pursue summer school, intensive lecture, and other curricular programs to complement laboratory investigations, or simply to serve as a first introduction to RIKEN for the curious.

7. Scientific advisory system

In response to recommendations by the 7th RAC, RIKEN has taken valuable steps toward ensuring that its leadership, including President Noyori, has access to the highest quality, independent scientific advice as a resource for use in strategic decision-making. The rapid proliferation of such advisory bodies, however, now makes it worth investigating whether it might not be possible to consolidate these into a more streamlined system. It was not fully clear to the RAC what the roles and responsibilities of the Committee for Research Strategy and the RIKEN Science Council were, or what their achievements have been in the interim since the 7th RAC. It was also noted that the Committee for Research Strategy does not include any scientists from a physics background, while the life sciences appear to be over-represented. Given the rapidly evolving priorities of the institution, and the shift toward greater work in the physical sciences and engineering, the composition of this committee may need to be revisited.

8. Cultivating RIKEN identity and visibility

Despite its long record of excellence in fundamental scientific research, and its impressive infrastructure facilities, the functions and importance of RIKEN are insufficiently recognized by the public at large, and even by some members of the scientific community in other countries. Fledgling efforts have been made in response to recommendations from previous RACs to build a RIKEN "brand" to promote awareness of the institute commensurate with its achievements. However, we suggest that the first step to building an identifiable image, RIKEN must first create a corporate identity by cultivating a shared sense of purpose and goals among its scientific and administrative staff. The institute needs to craft a compelling mission statement that conveys a sense of its core values and aims in a concise and memorable fashion, one that serves as an identifier of RIKEN's values not only to the outside world, but to its employees as well. All subsequent branding exercises must take place under this rubric, and must be conducted in a professional manner that is unlikely to be achievable by generalist administrative staff on rotating appointments. RIKEN should strongly consider outsourcing its brand development to a firm with proven experience.

9. Intellectual property and industry collaboration

RIKEN has devoted an extraordinary amount of resources to develop its technology transfer and business partnering efforts. The rapidly increasing number of industry partnerships, for example, is truly impressive and is a testimony to RIKEN's reputation for scientific excellence. These business functions will clearly play an important role as RIKEN expands its focus on innovation and translational research. Its intellectual property strategies, however, must be informed by realism and keen selectivity to prevent wastage of time, effort and money. We were concerned to note that at present, expenses in maintaining IP staff are more than triple RIKEN's income from its patent holdings. The size of the administrative support for these functions should be more proportionate to present-day needs and revenues, and scaled up only when justified by circumstances. We would also like to see a more strategically thought-out approach to RIKEN's cultivation of relationships with industry, looking ahead. The reorganization now under way will require that RIKEN familiarize itself more thoroughly with the needs and demands of potential corporate partners.

10. Administrative reform

The RAC was encouraged by the proposal to diversify the administrative employment system by strengthening parallel tracks for "generalist" and "specialist" administrative staff. Many administrative functions, such as scientific coordination, communications, intellectual property, and finance

require a depth of expertise and experience that must be cultivated by a longer-term commitment than is possible under the traditional staff rotation scheme. The proposed introduction of merit-based compensation would also be a welcome change from the current salary system with its emphasis on seniority. One area of concern with regard to the administrative system is the recent trend that has seen administrative positions maintained or even increased, in the face of budget cutbacks leading to reductions in scientific staff. Directors of research programs should have some discretionary power in balancing staff changes across both scientific and administrative divisions. We were also concerned to learn of recent changes in the purchasing and contracts systems that have made them less responsive to the needs of research staff for flexibility and speed. High priority should be given to automating the accounting system and making it usable by foreign staff. (In this vein, the work of the Translation Office, which has translated thousands of pages of documents and regulations into English, is to be commended.) Modernization of the purchasing and contracts divisions may be a useful area for discussion by the next Administrative Advisory Council.

Annex 1: Research institutes, facilities, centers and programs

1. RIKEN Advanced Science Institute (ASI)

The three-layer structure of ASI has served it well historically over the past fifty years; however, the most interesting problems in science today require and reward approaches based on diverse and inter-disciplinary teams. While it appears that the research departments are formed in line with both bottom-up and top-down direction, these can be somewhat vague, lacking specific milestones or targets that would allow for coordinated efforts toward specific research goals. BSIP appears to be a system for highlighting the importance of cross-disciplinary basic research, which is a praiseworthy framework.

2. RIKEN Nishina Center for Accelerator Based Science (RNC)

It is the view of the 8th RAC that eight months of operation per year are an absolute minimum requirement for success for the RNC facility. Technical support for external users (especially foreign users) of experimental facilities continues to be a problem, but this is a critical feature that distinguishes a purely research institution from a shared-use facility; it seems wasteful to create this excellent resource and not adequately support its operations. The RNC leadership will need to make hard decisions when setting priorities for future plans, including interaction with J-PARC; it does not seem possible from a financial perspective to undertake all proposals currently under consideration. Management needs to carefully review from a budgetary perspective where it stands in enhancement of technical support, and that the importance of human resources should be kept in perspective for any future plans to build such large-scale facilities

3. RIKEN SPring-8 Center (RSC)

The RSC and SACLA team are to be congratulated on achieving the shortest XFEL wavelength. The governance of the SPring-8 (and other major science infrastructure in Japan) needs to be streamlined and rationalized; the current arrangement is burdensome and complex. A continued focus on research output will enhance both quality and quantity at SPring-8. Similarly, increased support for external users will further enhance research output and the standing of the center within the international community.

4. RIKEN K computer Project and Advanced Institute for Computational Science (AICS)

The development of the world's fastest supercomputer is a noteworthy achievement; from now, the facility will benefit by increased focus on the development of specific applications for addressing real-world problems. We also suggest that the group must work quickly, in collaboration with the

national consortium and other stakeholders, to develop an effective interface for the external user community.

5. RIKEN Brain Science Institute (BSI)

Under the leadership of its current director, Susumu Tonegawa, there has been a comprehensive cultural change in BSI, with more freedom for young researchers within the "flat" organizational structure. The institute has made real efforts to integrate behavioral and cognitive studies with modern neuroscience, in both non-human primates and humans, which promises to yield important insights. Likewise, the future plans to build on existing strength and to emphasize 'neural circuit genetics' represent an exciting new direction. In the interests of fair and equal consideration, support services currently provided for young researchers from overseas, such as international schools, should be made available to young Japanese researchers as well (and should be extended to other parts of the RIKEN organization).

6. RIKEN BioResource Center (BRC)

The BRC is an important international resource for plant, animal, and human cells as well as micro-organisms, and for the maintenance of genetically modified animals. It serves as an open repository of resources for academic research and collects material from many sources, including universities, hospitals, other RIKEN institutes and industry. The center was fortunate to survive the Great Eastern Japan earthquake with minimal damage, but should take a lesson in developing plans for future contingencies and a robust backup system to protect its valuable resources. Its worldwide distribution efforts further have the effect of contributing to the increased international visibility of RIKEN as a whole.

7. RIKEN Plant Science Center (PSC)

The center has maintained highly-cited research output in the face of a declining core budget, and has introduced a flat organization to encourage its younger scientists. The PSC has invested considerable effort in national and international collaborations and appears keen to exploit their potential role in work on Green Biotechnology and Efficient Photosynthesis. They are expected to take a leading role in the translational Biomass Engineering Program, although the RAC group was uncertain about the depth of expertise in this important area. The Center is also collaborating with the paper industry on high-yield 'super-plants' and also on bio-plastics.

8. RIKEN Cluster for Life Science Platforms (CLP)

The CLP brings together the powerful resources of the Omics Science Center (OSC), the Systems and Structural Biology Center (SSBC), and the Bioinformatics and Systems Engineering program (BASE). These centers have

been successful in leveraging their cutting-edge technologies into high-impact publications and have made a number of important scientific advances, especially in single cell RNA analysis, structural analysis of RNA 'racheting', and in functional gene annotation. The OSC has been notably successful in attracting foreign scientists, with more than half of its research staff from overseas. The establishment of the RIKEN SciNetS database integration platform might usefully serve as a trigger for RIKEN to develop a clear policy on the storage of original data and the contribution to open and international databases.

9. RIKEN Quantitative Biology Center (QBiC)

Despite having only been launched this spring, QBiC is already involved in pioneering work in single molecule imaging and embryonic live imaging. Members of its research staff, including PIs, are quite young on average, and include encouraging numbers of female and foreign lab heads. This should become one of the key new institutes to drive interdisciplinary research in the life sciences across programs both within and outside of RIKEN.

10. RIKEN Research Center for Allergy and Immunology (RCAI)

The scientific achievements of the center are ranked highly. The use of humanized mice in this endeavor is significant but it is recommended that the Center should focus further on human immunology. We recommend the cultivation of a network of researchers outside the center to further spur clinical development.

11. RIKEN Center for Genomic Medicine (CGM)

The new leadership is doing well in promoting the completion of genome-wide association studies, which were originally pioneered by the center. New strategies, including the introduction of recent technologies and methodologies for genomic, epigenomic and phenotype analysis will be necessary to maintain international leadership in this rapidly evolving field.

12. RIKEN Center of Research Network for Infectious Diseases (CRNID)

This 10-year program, which was launched in response to a government initiative, has achieved interesting results in its work to date, but the current budget is due to expire in 2014. We recommend that this type of research coordination in the area of infectious disease be maintained in some form after that time, but only if provisions are made by the government for an operating budget sustained for the duration of the program.

13. RIKEN Center for Developmental Biology (CDB)

The CDB has an excellent record of scientific achievement under the leadership of its current director, Masatoshi Takeichi, including recent work in self-organized generation of three-dimensional optic cup-like tissue from embryonic stem cells, and work seeking to develop regenerative medicine approaches to the treatment of age-related macular degeneration. Given the success of the center under his leadership, we encourage Director Takeichi to reconsider his planned retirement.

14. RIKEN Center for Molecular Imaging Science (CMIS)

This research center has made significant progress since its establishment several years ago. Its achievements include the production of ligands for studying animal physiology, with possible applications in human as well. More effort should be devoted to optimizing these for the study of the human system, as well as to supporting diagnostic and drug discovery efforts.