

February 26, 2006

## **RIKEN BSI 7<sup>th</sup> ADVISORY COUNCIL REPORT**

**January 24-26, 2006**

### **Introduction.:**

RIKEN BSI continues to be among the first rank of internationally-recognized brain sciences research institutes in the world with many features that make it unique. The rapid rise of the BSI to the top echelon represents a remarkable accomplishment for which RIKEN and Japanese government should be very proud. The founding and visionary leadership of Dr. Masao Ito has been ably continued under Dr. Shun-chi Amari, who deserve great credit for establishing a high scientific standard and attracting talented neuroscientists from all over the world to BSI.

The emergence of the BSI to world status is very timely as many see the 21<sup>st</sup> century as one in which brain sciences will have a prominent position, with influence far beyond the scientific arena. As noted in the initial draft of the BSI strategic plan, brain sciences are expected to have three major impacts:

*ECONOMIC:* In developed countries, brain diseases collectively have more economic impact than any other area of medicine. A report carried out by the World Health Organization to assess quantitatively the burden of disease found that in developed countries, eight of the top ten diseases in terms of loss of productivity due to disability and death were diseases of the brain. Because age is a risk factor for many brain diseases including neurodegenerative disease, psychiatric illness and stroke, brain diseases become more prominent as the population ages. As health care costs continue to rise, the economic burden of these diseases becomes substantial. In Europe and

North America, they currently represent no less than one third of the total costs for health care.

*SOCIAL*: One of the most exciting developments in modern neuroscience is the merger of neurobiology, cognitive sciences, psychology and social science with the goal of developing a biologically-based understanding of human behavior. The BSI is positioning itself to be one of the world leaders in catalyzing this new synthesis. Understanding the biological basis of human behavior will help us deal more effectively with social problems such as addiction and aggression, and lead us to a better understanding of economic behavior. This new field will have impact on education, law, economics and engineering among others. In this sense, brain sciences will be one of major disciplines at center of the intellectual enterprise in the 21<sup>st</sup> century.

*PERSONAL*: The third impact of brain sciences will be on our understanding of who we are as human beings and how we as individuals can maximize our capacities. Our personalities, our creativity, our rational abilities and our empathy for others all arise from our brains. Better understanding of the biological bases of these properties will improve our quality of life at all stages of life, from the young child to the aging adult. Understanding brain development will facilitate our ability to maximize our individual potential as children and adults. The amazing ability of the human brain to continue to change through learning will be enhanced. And, as we grow older, methods to preserve cognitive function and general well-being will help us age gracefully.

Through the BSI, the Japanese Government has made a major investment in brain sciences that has been spectacularly successful. The investment should not be jeopardized by decreasing financial support for the brain sciences. Because of large societal impact of brain sciences and because the BSI is poised to play a world-wide leadership role in advancing the new understanding of the biology of behavior, strong investment by Japan in neurosciences must be continued and increased. Our visit is very timely in that it comes at a time when the Japanese Government is formulating the Third Basic Plan that will guide the development of Japanese science over the next five years. We trust and strongly urge that promotion and nourishment of brain sciences will be a central feature in that planning.

## **Background:**

The BSI Advisory Council made a three day visit to the Institute on January 24-26, 2006. We met with the BSI Director, Dr. Shun-ichi Amari, the Deputy Director of BSI, Dr. Keiji Tanaka, Dr. Doi, the Executive Director of RIKEN and Dr. Kaya, the Director of the RIKEN Wako campus to hear of general issues with respect to RIKEN and, from Dr. Amari, an overview of the general status of the BSI, including progress since our last meeting and the response to our last report. We also met with RIKEN President Ryoji Noyori at lunch to hear of his visionary plans for RIKEN. We then met with BSI scientists, junior researchers, we visited the labs, and we discussed the outline of the BSI Strategic Plan with Dr. Tanaka and the BSI researchers on the committee that drafted it.

## **General Comments:**

First and foremost, we were impressed by the overall quality of the BSI, which continues to improve in scientific excellence. The quality of the Institute is increasingly recognized internationally. The rising international standing of the BSI is exemplified by the Young Investigator Award given to Dr. Takao Hensch by the Society for Neuroscience, the pre-eminent scientific society for neuroscience, with some 30,000 members world-wide. Dr. Hensch is the first scientist from a non-American institution to receive this award.

In addition to its high quality, the BSI has several features that make it distinctive in comparison to other leading neuroscience research institutions world-wide. Among these are the breadth of research interests, ranging from molecular to human cognitive function; the excellent facilities; a strong and successful commitment to methodological development, as exemplified by the Group for Advanced Development; and its international orientation.

With respect to its international activity, we commend the BSI on its leadership in promoting international scientific exchange, including the summer courses which have an international faculty and students, colloquia, workshops, and its leadership role in the

Pacific consortium. These activities give the BSI a strong international presence, help establish it as a research center that attracts the best scientists and trainees from all over the world; and allows it to be an agent of change and development in the world neuroscience community.

We were very impressed with the quality of the new scientists who have been hired since the last AC meeting. We note particularly that Dr. Ikiri is the recipient of the prestigious Golden Brain award. It is clear that the BSI continues to compete for talent at a very high level.

The AC commends the BSI for its willingness to encourage leadership by younger scientists as shown by their appointment as Group Directors. The success of this policy is demonstrated by the fact that several of these groups are among the most vigorous at the BSI.

The Advisory Council was very gratified by the strong response of the BSI leadership to the report of the 6<sup>th</sup> Advisory Council. We recognize and appreciate the leadership and efforts of Drs. Amari and Tanaka to implement the suggestions of the council. Among the positive responses that we noted:

- Increased efforts to promote collaboration at the BSI through the Director's fund, the Cerebellum Colloquium, journal clubs, and recognition of the importance of synergistic interactions in evaluation criteria.
- Assistance to non-Japanese scientists at the BSI.
- Science communications support.
- Continuing efforts to increase number of women and international scientists.
- A thorough-going review of Creating the Brain with plans for restructuring
- Development of a draft of the BSI Strategic Plan
- Continuing efforts to bridge genetics and systems neuroscience
- Appointment of new Group Directors.
- Annual meeting of the Director with each of the laboratory and unit directors.

We believe that all of these actions and changes are very constructive and will result in a stronger BSI.

## **Recommendations and Concerns:**

### 1) Budgetary Challenges:

The Advisory Council appreciates the challenges of the recent and unfortunate decline in the budget of the BSI. We hope that this is a temporary difficulty and will not continue as further decreases could compromise the mission and current success of the BSI. Director Amari has been very creative and resourceful in his response to the budgetary challenge. We believe the system of basal support with supplementation is a good one. It allows implementation of institutional priorities (e.g. promoting collaboration, encouraging application for outside funds), allows excellence to be rewarded and recognizes that different groups have different budgetary needs.

We make several suggestions for augmenting the direct funding that the BSI receives that could help insulate the BSI from the uncertainty caused by variations in direct funding. First, we suggest that all investigators be encouraged to apply for outside funding, both as individuals and as groups. To facilitate the applications, BSI should actively promote the formation of groups of scientists within the BSI or between BSI scientists and those from outside to qualify for group funding.

Not surprisingly, the system of supplementation instituted by the Director has caused some anxiety and uncertainty. To alleviate this situation, we urge the Director to be as transparent as possible in explaining to BSI scientists the basis for his decisions.

We also suggest that the BSI also more actively investigate the possibility of forming collaborations with industry. With the recent recovery of Japan's economy, private companies may be more open to collaborations with academia, which they may see as a cost-effective way to have access to basic research.

### 2) Evaluations of scientific excellence

We urge the Director and BSI leadership to continue rigorous evaluation of research excellence and productivity, tempered by an understanding that long-term, high risk projects may not pay off immediately and that some may even fail. The Advisory

Council would like to understand the evaluation process better and suggest that it be one of the topics for our next meeting. Many members of the Advisory Council expressed willingness as individuals to help provide outside assessments and advice, where requested.

### 3) Turnover

We were asked by the Director to comment on the issue of laboratory turnover. The BSI was started with the revolutionary idea that BSI scientists should not be tenured in the conventional sense, but should work on a rolling 5 year contract system. Such a system can ensure continued productivity and excellence and has been, we believe, one of the attractive and successful features of the BSI experiment.

The question of how the system will operate at steady-state, however, has not been adequately faced. As BSI reaches maturity with the expectation that resources will not continue to expand, the time is appropriate to consider whether BSI will have a more-or-less permanent staff employed on a rolling five year plan or whether turnover will be built into the system, i.e. that scientists at BSI will understand that most will not spend their entire careers at the BSI, but will ultimately move to other positions. The latter strategy envisages that as scientists move from BSI to other institutions, they will actively spread “the BSI philosophy”, thus becoming important agents of change throughout Japanese science.

The Council strongly believes that to remain at the forefront, the BSI must continue to receive fresh infusions of talent, energy and innovation from newly recruited scientists, particularly younger scientists, and that to achieve this goal an expectation of turnover must be built into the system. It is important that everyone who comes to the BSI understands this expectation and, moreover, that there be a planning and mentoring process that will help and prepare scientists as they leave to find positions elsewhere.

Although this policy may occasionally have an adverse effect on recruiting, we believe that the disadvantage will be offset by the strong appeal of strengthening a career trajectory by time spent at the BSI with the superb opportunities for achievement in research that it offers. Such a system has operated very successfully, for example, at Cold Spring Harbor in the United States, at the European Molecular Biology Laboratory

in Heidelberg, Germany, and by the fellowship programs of the Wellcome Trust.

Although we did not discuss this extensively, the Council believes that a period of five years with a single renewal, based on continuing success, should be the normal expectation. This limit should be administered with flexibility and judgement, and should be applied primarily to the four research division, and not to ATDG and the Research Resource Center in which continuity is important.

#### 4) Permanent positions.

A related, but separate, question is whether or not there should be a small number of tenured positions at the BSI which would allow stability and continuity in BSI leadership. The Council was somewhat divided on the advisability of this change and we do not wish to make a direct and strong recommendation at this time. We believe that it is an important question, however, and we urge the BSI to consider it seriously. If the change is to be implemented, we are agreed about several recommendations.

- The criteria for award of tenured positions should be both scientific excellence and the potential for contributing broadly to the leadership of BSI.

- The total number of positions should be relatively small, i.e. no more than 20%

- To maintain flexibility, the positions should be filled gradually over a period of years and not all at once.

- There should be an age limit, perhaps 60 years of age, after which scientists should switch to a system of rolling contract based on performance.

#### 5. Groups, Laboratories and Units

The Advisory Council was pleased to see further strengthening of the groups and units within BSI. The quality of the newly established groups, laboratories and units is very high and we believe that they offer a strong resource for the Institute. The energy and leadership of the new group leaders is especially impressive.

We note with particular interest the emergence of a new kind of group whose members come from diverse backgrounds, but who share common scientific interests that are fostered by the group leader. These groups are typically relatively small, but have a strong focus and sense of shared purpose that maximizes the creativity and productivity of the members through synergistic interactions. These groups also offer the

possibility of strong mentoring of younger scientists which we believe is highly desirable. While the Advisory Council recognizes that this style may not be suitable for all groups, we believe that these “new style groups” will be an important component of future success.

A difficult challenge is the problem of recruiting group leaders from abroad. We are pleased to see and strongly support BSI’s persistence and continued efforts in this area in spite of the difficulties. One suggestion is BSI might use its flexibility in hiring to target young couples who often have difficulty finding jobs in the same institution.

Finally, the increased emphasis on units is an encouraging development which BSI has used to its advantage to recruit outstanding young scientists at the earliest stage of their independent careers. As the use of resources becomes more limited, however, BSI will need to engage in strategic thinking about the optimal number of units within the Institute and to have a well-thought out plan for career advancement of the unit leaders.

#### 6. Trainees

A new and very valuable aspect of our visit was the chance to meet with BSI trainees. Our general impression, based on these discussions, is that they appreciate the excellence of the BSI and feel themselves fortunate to be here. Perhaps unusually for trainees at this stage of development, they offered no strong complaints, which speaks well for the BSI. Several specific suggestions and comments are as follows:

- a. The course which has been instituted appears to be very successful. We suggest that course offerings be expanded. Several post-doctoral fellows independently told us that they would welcome an opportunity to teach. Their participation would be a positive aspect of their training and would offer a venue for improving their presentation skills.
  
- b. We encourage trainees to take full advantage of the rich environment that BSI offers and suggest that they continue be encouraged in this direction. Because interdisciplinary collaborations develop through personal interactions, it is important to foster an environment at BSI in which junior scientists can communicate and learn from each other. We urge BSI to encourage junior



scientists to participate in, and organize themselves, activities such as mini-courses, journal clubs, small-group workshops by providing administrative support and modest funding.

c. Some post-doctoral fellows may remain at the BSI for a protracted period. We suggest that BSI examine whether a policy and career planning for trainees would be helpful.

d. We foresee many opportunities for exchange visits between junior researchers and postdocs at BSI and premier neuroscience departments and institutes around the world. In addition to the RIKEN-MIT Center, we recommend the establishment of a program of travel fellowships for funding travel and living expenses for short- and medium-term visits for purposes of research collaboration.

## 7. Strategic Plan

The 6<sup>th</sup> Advisory Council of RIKEN BSI noted that as the Institute approaches a mature state, in which continued rapid expansion is not possible, an increasingly high premium will be set on its ability to set priorities and strategic goals that guide its use of resources. Accordingly the 6<sup>th</sup> Advisory Council recommended that the Institute engage in formulation of a strategic plan within which decisions about personnel and resource allocation could be made. We also suggested that the planning involve scientists at several levels of the BSI.

We are very pleased to see that under the leadership of Deputy Director K. Tanaka, a committee representing junior, mid-level and senior scientists has undertaken this project and, after many months work, has developed an initial draft of such a plan. Because of limitations of time, the AC was not able to consider the plan in detail. We are willing to help the Institute in any way that we can in further development of the plan and look forward to seeing and discussing future drafts.

## **Thematic Areas:**

## UNDERSTANDING THE BRAIN

**Understanding the Brain** is the largest theme at the BSI. It continues to be a particularly visible aspect of BSI's contributions to brain science with continuing contributions to our contemporary understanding of cerebellar learning and plasticity, the role of the inferotemporal and prefrontal cortices in cognitive function, and of hippocampal function using state-of-the-art molecular engineering and ensemble single-unit recording techniques. This research is organised into three groups - the Neuronal Circuit Mechanisms Research Group (*Masao Ito*), the Cognitive Brain Science Group (*Keiji Tanaka*) and the RIKEN-MIT Center (*Susumu Tonegawa*).

**Neuronal Circuit Mechanisms Research Group.** The wide-ranging work of this very active group includes a new Laboratory and three new Units that have been added since 2004. These offer novel concepts and techniques to the studies of neuronal circuitry that is the essential bridge from molecules to mind and behaviour. We heard about new work on cerebellar plasticity (first discovered by the group leader), neuron-glia interactions, novel world-class imaging technologies and the use of genetic animals. Some examples of exciting new findings include a deeper understanding of the complex network of signal-transduction pathways at parallel fiber/climbing fiber synapses mediating the expression of LTD, distinct sites for short- and long-term VOR adaptation in cerebellum, studies of glial-derived L-serine in development, the functional role of GAD67, and the discovery that BDNF released from a single pyramidal neuron is essential for the formation of GABAergic synapses.

Dr Ito's group has instituted a number of changes in its management structure including the introduction of a regular 'cerebellum discussion club' that is attended by a large number of scientists across all of BSI. This excellent innovation has stimulated inter-laboratory discussion and collaboration.

**The Cognitive Brain Science Group.** This group continues its outstanding research program into the physiology and anatomy of the cerebral cortex. The group is among the world leaders in the study of the neural mechanisms underlying visual object recognition, in the development of optical techniques for the investigation of neural systems, and in the application of new virally-mediated anatomical tracers for

investigating cortical microcircuitry. The quality of research within each laboratory is excellent. A particular strength of the Group is the combination of human brain imaging, primate physiology, and modern neuroanatomical expertise - all within in a single research group. Each of these technical approaches can be unusually powerful when it is coordinated with one of the other approaches.

In our laboratory visits, we paid particular attention to human brain imaging. We believe that the fMRI facility is unique in the world in terms of its technical accomplishments and capabilities, particularly in its application of the high-field-strength magnet to high-resolution imaging of human cortex. We are pleased that a series of significant and important results from this lab have been reported in recent years, and that the group has established successful collaborations with five other laboratories at RIKEN. These accomplishments are all the more impressive given the relatively small number of personnel of the fMRI group in comparison to other major fMRI labs around the world. The impact of this group would, therefore, be amplified with the addition of research personnel. We understand that this recommendation is a substantial challenge at a time of limited resources, but it would be a wise investment for the BSI. There are substantial fixed costs to operating a fMRI facility, and the scientific return on this investment could be enhanced substantially by the addition of new postdoctoral fellows or unit leaders to the fMRI team. The planned reorganization of the fMRI facility under the Research Resources Center with the addition of technical staff is a positive step that will further enable collaborations with other groups at the BSI. Given the excellence of the fMRI facility and the very large number of excellent young students in laboratories around the world, there is an excellent opportunity to recruit young cognitive neuroscientists to lead new laboratories or units.

The MEG laboratory has focused intensively on the development and application of high-resolution magnetoencephalography (MEG) to the study of a remarkably diverse set of brain functions ranging from vision and motor performance to music listening and sleep. Fine temporal resolution has long been recognized as the primary strength of MEG, but the laboratory has worked hard over a number of years to develop the spatial resolution of MEG as well. We are impressed with the recent achievements of the laboratory in this respect that have emerged from tomographic approaches to MEG.

The technical capability of the laboratory is impressive and recent research publications validating the MEG techniques are encouraging. This laboratory could make an unusually important contribution by providing the world brain imaging community with practical, widely available methods for high spatial resolution MEG studies. We hope to see the potential of these MEG technical achievements realized during the next few years such that they will have a highly visible impact at the international level. The established collaborations between the MEG group, the fMRI group, and EEG labs (in the Creating the Brain section) are mutually beneficial and we encourage these interactions to continue to grow.

**MIT-RIKEN Research Center.** The Group Director S. Tonegawa summarized the achievements of the five different laboratories of the RIKEN-MIT Research Center. The work of all the laboratories is very impressive and it adds importantly to the overall research contribution of RIKEN-MIT Research Center.

Progress in the RIKEN-MIT Research Center over the past two years includes exciting new studies using unit recording and cell-biological techniques and publication in high profile journals. Of note are studies that have revealed, using monkeys and rats respectively, more rapid learning in the basal ganglia than in prefrontal cortex in a task requiring their interaction and reverse replay of place cell sequences during sharp waves. Both observations challenge current dogma. Exciting molecular studies are also underway revealing a presynaptic effect of postsynaptic overexpression of PSD-95 and exploiting region-specific transgenic manipulations. There has been some movement of scientific personnel between Wako and Cambridge, which could perhaps be developed further, and a series of joint retreats and seminars that have been enjoyed by all who have participated in them. A concern we had was whether the RIKEN-MIT Research Center had any identity separate from that of the Picower Center with which it is closely allied. We suspect that the two Centers gain from each other, but the visibility of the RIKEN-MIT Research Center is important.

A high priority for the BSI is the interaction with foreign scientists and institutions, to foster an international and creative scientific environment. This is achieved partially by an important contribution of the non-Japanese scientific staff hired in different capacities at BSI -Wako. In this context the RIKEN-MIT Research Center also plays a

significant role. The scientific interaction between the two consists of common retreats, symposia in common areas and a limited number of collaborative projects, involving postdocs and other staff.. This exchange already includes MIT neuroscience laboratories that currently are not part of the RIKEN-MIT Research Center. A number of BSI laboratories work on problems that are not central to those of the current RIKEN-MIT Research Center, and can therefore profit from a collaboration with other MIT laboratories.

We encourage the leadership at BSI and at the RIKEN—MIT Research Center to particularly explore formal programs and mechanisms to increase the exchange of personnel by a variety of means, including short-term (several weeks or months), medium-length (sabbatical- style, 3 months to a year) and longer term (six months to several years) exchanges. These exchanges would help address the challenge problem noted by the Council, and by the leadership at the two centers – namely the difficulty of attracting foreign scientist to the RIKEN BSI in fulfillment of its international role.

Summary: The section **Understanding the Brain** has had outstanding leadership over many years. We are confident that the BSI will maintain this excellence and thereby ensure that the excellent science of this section is sustained at the same high level.

## **PROTECTING THE BRAIN**

The Section of Protecting the Brain has made excellent progress during the past two years. Four team leaders were recruited within the last two years. We are very impressed that two new laboratories established in 2003 already have active research programs and published several high quality papers. The presentations by the group directors were excellent, reflecting nicely the wide-ranging research topics covered by the three groups, from basic mechanisms of neuronal fate specification by transcription factors to mechanisms of axon-dendrite polarity formation, axon guidance, and circuit formation, to molecular and genetic basis of neurodegenerative and neuropsychiatric diseases.

We noted that the complementary nature of the research expertise and the wide range of

*in vitro* and *in vivo* preparations used by various laboratories offer unique opportunities for crosstalk and collaborations within and across the groups within the Section of Protecting the Brain. For example, there is common interest among all three laboratories with Neural Growth and Regeneration Research Group on the signaling mechanisms underlying various developmental processes, collaboration based on studies of the same signaling mechanisms (e.g., sonic hedgehog signaling) shared by different developmental processes (from fate determination and axon-dendrite polarity formation to axon guidance and neuronal migration) appears to be highly attractive.

The unique feature of the Section of Protecting the Brain is to bring together investigators working in basic neurobiological research and in disease-oriented research, in order to produce fruitful interactions. The creation of many groups within the section potentially may create artificial boundaries that are counter-productive. For example, there are clearly overlapping interests among laboratories of the three groups, in particular those in the Molecular Neuropathology Group and Neural Growth and Regeneration research Group. We would like to stress that enhanced communications among the laboratories are critical for Lab Heads and Unit Leaders to keep abreast the research progress in BSI laboratories of similar interests. The regular joint lab meetings, journal clubs and seminars should be established within the Protecting the Brain Section. Furthermore, the overlapping interests in various developmental processes of various laboratories in the sections of Protecting the Brain and Nurturing the Brain also that suggest more extensive interactions will be fruitful.

That the interaction among laboratories needs to be strengthened is evidenced by the fact that many trainees from the Protecting the Brain section attending the meeting with the council members with young investigators apparently did not even know one another! Interactions among lab members of different laboratories not only form the critical part of learning experience for the trainees, but also facilitate the research progress in respective labs by the exchange of ideas, expertise, and reagents for investigators at the lab bench.

**General Concerns of the Lab Heads and Unit Leaders.** A recurrent worry among the team leaders is the anticipated decrease in their budget. They are prepared to apply for outside funding. Most grants are allocated to groups of researchers. They fear the

others will still consider that the RIKEN scientists are wealthy and thus only need a tiny piece of the cake. There is also the worry that too many laboratories have been created, which may limit the expansion of more successful laboratories and for them to fruitfully pursue their research towards the goal of protecting the brain by curing neurological diseases.

The appointment of young scientists as Unit Leaders is an important feature in BSI. It helps to foster independent research by young investigators, a feature lacking in many Japanese research institutions. However, many units are relatively small, consisting of 6 or 7 people, collaboration with other groups may be essential for accomplishing their research goal. We noted that some unit leaders do not have their own office. This may hinder their management of the laboratory, e.g., having private talks with lab members. With increasing number of independent laboratories, there is also the concern for the lack of space in the animal facilities.

## **NURTURING THE BRAIN**

The creation of this section several years ago was viewed positively by the 2004 Advisory Council as it brought together a talented group of researchers with interests in brain development that ranged from basic molecular and cellular mechanisms of neurogenesis (The Brain Development Research Group) to the formation of complex circuits that require precisely timed environmental signals (The Critical Period Mechanisms Research Group). The overall quality of research from these groups has been high. The Brain Development Research Group has made a number of significant contributions on molecular aspects of neural development and is to be complimented for the successful completion of the cerebellar data base, which will be useful resource for scientists worldwide.

The quality and impact of the research from the Critical Period Mechanisms Research Group has been especially impressive. The elucidation of mechanisms that control the timing of critical periods, during which visual circuits are sensitive to modification by external stimuli, will now allow such critical periods to be manipulated in different ways in different sensory systems. The information obtained should be relevant to

human brain development with respect to potential environmental insults and to educational practices, and thus fits nicely with the national goal of utilizing the knowledge of brain science to create an environment of life-long learning. The diverse expertise and technical skills represented within this highly interactive group of scientists should enable them to effectively elucidate the development of complex circuits involved in vision, olfaction, and bird song.

We also applaud the decision of the BSI to add three new laboratories that specifically address the development of higher cognitive function. The two laboratories in the Cognitive Development Research Group utilize animals and humans to study Biolinguistics and the development of Symbolic Cognitive Function respectively, while the Language Development Laboratory in the Human Learning Research Group studies human language development. It is exciting to see the BSI taking these concrete steps, with strong collaborative scientists, toward realizing its goal in pursuing neuroscience at all levels, from the molecular to the highest human cognitive activities. We noted that these laboratories are already effectively collaborating and were impressed with the multiple levels of analysis. However we strongly encourage additional interactions with other scientists in the Critical Period Mechanisms Research Group to benefit from their complimentary expertise. We understand that consideration is being given to reorganizing these three “cognitive” laboratories under one group leader. We see the value of this, especially given the emerging synergies between the labs, but would not recommend this step if it comes at the expense of increasing the focus on human learning.

## **CREATING THE BRAIN**

RIKEN BSI, with its abundance of excellent neuroscientists addressing a wide range of neuroscience questions, offers a unique opportunity for research in computational and mathematical neuroscience, brain style computing and neuroinformatics. Progress in these fields is essential for the success of BSI as a whole and we are very pleased to note BSI’s continued commitment to these important activities.

The 7<sup>th</sup> Advisory Council meeting took place just over a year after the Review of Creating the Brain (CtB) in October 2004. The Review had identified three major factors which could speed



progress at CtB, namely an optimal concentration of intellectual resources, improved coordination of the activities of the various groups within CtB and across BSI, and increased collaboration with Japanese industry.

The Review recommended that a new CtB Director be appointed who would be a senior person who could integrate the various strands represented in CtB and have strong links with industry. The new CtB Director would engage existing Lab Heads and Unit Leaders in using the opportunity arising through the planned closure of labs to refocus CtB, reorganise existing Labs and Units and establish new ones.

We are very pleased that many of the recommendations of the Review have been implemented.

1. The structure of CtB is now more transparent and focused, with one Group working on Computational Neuroscience and one Group working on Brain-style Computing. Development of a shared vision of CtB activity would be very helpful in increasing further the symbiosis between individual projects.
2. As recommended, fewer resources within CtB are being devoted to empirical studies and more resources to partnerships between CtB and experimental groups elsewhere in BSI. In particular, one Lab has been transferred to an environment more suitable to the Lab's extensive experimental program. It should be considered whether increased benefit can be gained by taking this process further.
3. Mechanisms are in place (such as the Director's Fund) to facilitate collaboration and CtB members particularly should be encouraged to take further advantage of these. We also note the desirability of encouraging informal interactions at the post-doctoral level both within CtB and between CtB and other BSI Labs and Units. Computer and mathematical modeling is being carried out also by BSI researchers who are not members of CtB. This will provide another source of inspiration and collaboration for CtB members.
4. We are very pleased that one lab has been transferred to an environment more suitable to the lab's extensive experimental program. One new Lab Head has been appointed and it is anticipated that two new Unit Leaders will join BSI in the near future. We are gratified that, following a recommendation in the Review, an international Search Committee was involved in this process, which is essential in this area, where competition for highly qualified researchers is intense.
5. We understand that discussions are ongoing and it may be possible to establish a

RIKEN-industry collaborative program. Such a collaboration will strengthen the development within CtB labs of brain-style computing methods and technology. One possibility is for BSI to provide additional basic research input to the Human-Robot project involving Sony and Honda.

6. The Laboratory for Neuroinformatics was part of the 2004 Review although it is in ATDG rather than CtB. Progress has been made in developing computational tools and in hosting BSI neuroscience data for the benefit of the BSI. In addition, the new Neuroinformatics Japan Center at BSI is to serve as the Japanese 'node' for the recently established International Neuroinformatics Coordinating Facility. This will host and support a number of different neuroscience databases originating throughout Japan, including databases at BSI. Although the Neuroinformatics Lab is within ATDG, we continue to stress the importance of coordinating the neuroinformatics effort with work within CtB.

## RECOMMENDATIONS

- A. The Creating the Brain grouping is unique amongst the four scientific groupings at BSI in that it embraces a set of methodologies that potentially are applicable at many different levels, from molecular through neural to behavioural and cognitive. Managing a group of scientists with such a widely spread set of scientific interests requires active and careful management. Currently the responsibility of leadership within CtB falls on the shoulders of Professor Amari, who executes this function together with that of Director of RIKEN BSI as well as the Brain-Style Computing Group, the Mathematical Neuroscience Lab (shortly to be a Unit) and, a recent addition, the Japan Center for Neuroinformatics. One strong recommendation from the Review was that a new appointment at the Group Director level be made who could provide the inspirational leadership that CtB deserves, integrate the various strands of research in CtB and develop strong links with industry. He or she could engage existing Lab Heads and Unit Leaders in using the opportunity arising through the planned closure of labs to refocus CtB, reorganise existing Labs and Units and establish new ones.

We are very pleased to learn that significant effort has been expended to appointing a person with strong industrial connections and that the search will continue. We appreciate that finding such a person will be difficult but nonetheless we wish to

re-emphasize the importance of this new senior appointment. The original criterion of requiring significant industrial involvement, whilst desirable, could be relaxed. In collaboration with the BSI Director, Lab Heads and Unit Leaders, this person will establish and implement in a collaborative manner the vision for CtB, and will be instrumental in planning and achieving new appointments.

*B.* We strongly recommend that at least one and preferably two of the five senior appointments originally envisaged in the planned reorganisation of CtB be delayed until the leadership of CtB is in place. There are a number of areas in which new Labs or Units could be established that will complement the activity already present, or planned, within BSI.

Achievement of these two measures will enable the Creating the Brain activity to achieve a very high quality concentration of computational neuroscience and brain-inspired computing expertise that will enable BSI to place itself at the forefront of this very important activity worldwide.

### **Advanced Technology Developmental Group (ATDG)**

The subdivision into ATDG and the Research Resource Center (RRC), implemented a few years ago, has provided a logical and efficient organization. The purpose of ATDG is to develop new technologies and infrastructure of importance for BSI and neuroscience in general. This is now an important part of BSI. The Group director, Dr Miyawaki, presented the activity of the five different laboratories. His own laboratory, the Laboratory for Cell Function Dynamics (start 1999), has made remarkable progress in developing new compounds and strategies for cellular imaging that has led not only to a series of articles in high impact journals, but also to patents and commercial progress.

The Laboratories of Neural Architecture (start 1997), Behavioral Genetics (start 1997), and Cell Culture Development (start 1999) are productive and contribute also importantly through collaboration with laboratories in other sections of BSI and outside BSI.

The comparatively new laboratory of Neuroinformatics (start 2002) is focused on the development of advanced technology for database platforms in neuroinformatics, software development and computational methodology. This section is developing the Neuroinformatics Japan Center (NIJC) under the Japanese government that will form the Japanese node within the International Neuroinformatics Coordinating Facility (INCF). The Japanese node will be inaugurated in late February 2006. This Japanese node is chaired by the BSI Director professor S. Amari and the Laboratory Director S. Usui contributes to running the node. It has already created an efficient organization.

## **Research Resource Center**

The Research Resource Center was presented by the Group Director, Professor C. Itakura. This section appears to be run in a very efficient way, and provides important services to the different research laboratories of BSI. It has two divisions, one of Animal Experiments and one of Common Instrumentation.

### *The Animal Experiments Division*

This division runs the animal facilities. Although BSI has a total space of nearly 8000 m<sup>2</sup> with a total of 25 000 cages and 123 000 mice, there is a shortage of resources for transgenic animals. BSI needs more space for animals. This problem is common to other RIKEN institutions and as we understand under common exploration within RIKEN. This section also provides assistance with extensive services with mouse embryo manipulation, generation of transgenic mice, as well as antibody production, histology, electron microscopy, and analyses of behaviour in for instance transgenic animals.

### *The Division of Common Instrumentation*

This division provides services with DNA sequencing, plasmid purification, gene chips, mass spectrometry, peptide synthesis, flow cytometry and protein purification. The possibility for the different laboratories of BSI to have this service is obviously a great competitive advantage.

*In conclusion:* The ATDG and the Research Resource Center together provide a very

impressive infrastructure for BSI that is very difficult to match by any research environment anywhere in the world.

### **Members of the BSI Advisory Council**

Prof. Sten Grillner (Chair)

Professor, Nobel Institute for Neurophysiology, Department of Neuroscience,  
Karolinska Institutet

Prof. Michael A. Arbib

USC Brain Project Director  
University of Southern California

Prof. Heinrich Betz

Director, Department of Neurochemistry  
Max-Planck Institute for Brain Research

Prof. Zach W. Hall

President, California Institute for Regenerative Medicine  
Keck school of Medicine  
University of Southern California

Prof. David J. Heeger

Professor of Psychology and Center for Neural Science  
Department of Psychology and Neural Science  
New York University

Prof. Nobutaka Hirokawa

Professor and Chairman, Department of Cell Biology and Anatomy  
Graduate School of Medicine and faculty of Medicine  
The University of Tokyo

Prof. Ichiro Kanazawa

President  
National Center of Neurology and Psychiatry

Prof. Lynn T.Landmesser  
Garvin Professor & Chair, Department of Neurosciences  
Case Western Reserve University School of Medicine

Prof. Joseph E. LeDoux  
Professor, Center for Neural Science  
New York University

Prof. Jacques Mallet  
Director  
Laboratoire de Genetique Moleculaire de la Neurotransmission et des Processus  
Neurodegeneratifs  
Centre National de la Recherche Scientifique.

Prof. James L.McClelland  
Walter Van Dyke Bingham Professor of Psychology and Cognitive Neuroscience  
Co-Director, Center for the Neural Basis of Cognition  
Carnegie Mellon University

Prof. Richard Morris  
Professor, Laboratory for Cognitive Neuroscience  
College of Medicine and Veterinary Medicine  
The University of Edinburgh

Prof. Takashi Muramatsu  
Professor, Faculty of Psychological and Physical Science  
Aichi Gakuin University

Prof. William Thomas Newsome  
Investigator, Howard Hughes Medical Institute and Professor  
Department of Neurobiology  
Stanford University School of Medicine

Prof. Tsuneko Okazaki

Guest Professor, Institute for Comprehensive Medical Science  
Fujita Health University

Prof. Mu-ming Poo

Professor, Department of Molecular and Cell Biology  
University of California, Berkeley

Prof. Yoh-ichi Tohkura

Professor and Deputy Director General  
National Institute of Informatics

Prof. David Willshaw

Honorary Professor, University of Edinburgh Institute for Adaptive and Neural  
Computation School of Informatics  
The University of Edinburgh

Prof. Janet Werker

Director, Ph.D, F.R.S.C, Professor, Department of Psychology  
Canada Research Chair  
University of British Columbia

Prof. Ken-ichi Yamamura

Vice President, Institute of Molecular Embryology and Genetics  
Kumamoto University