**Report on the 1st Meeting of the RIKEN Centre for Life Science Technologies Advisory Council**

**Chair: Allan Bradley, Director Emeritus, Wellcome Trust Sanger Institute**
**RIKEN, Yokohama Campus June 15–16 and Kobe Campus June 17-18, 2014**

## Executive Summary

The formation of the Centre for Life Technologies presents significant challenges. These arise from the geographical separation, the distinct technology platforms and the desire to maintain the international reputation of the individual units while at the same time distilling a cohesive scientific programme that opens new field(s) of life sciences.

CLST have outlined a research road map that envisages development of novel methodologies for analyses of whole molecular events from normal physiological function to diseased state via pre-diseased state. The roadmap appears to be appropriate for building up a base of human "Live" Science, a new concept proposed by CLST. However, for this to be realized strong integration of the elaborate structural/synthetic biology, functional genomics, and multi-level molecular/functional imaging must occur and some unifying biological themes should be adopted supported by a network of strong clinical collaborations.

While the CLST-AC was very impressed with the leadership of the Centre and Divisions and mechanisms being deployed to achieve cohesion and enhance interactions, we felt more could be done. Our principal advice is for the centre's leadership to jointly decide on the profile of new PIs and establish an appointments committee with strong external membership and rigorous application of academic standards to guide this process.

Since the number of full-time PI appointments that can be made will be limited, CLST should also initiate other mechanisms to appoint "associate" PIs, who could engage with and influence the science conducted with CLST's world leading technology platforms. It is envisaged that the primary appointments of these individuals would be held elsewhere. We further recommend that one profile of these appointments would be clinical scientists who have deep understanding of disease at both the pathophysiological and molecular/mechanistic level and who would be well placed to foster collaborations with academic medical centres.

The CLST-AC supports the laudable concept of the drug discovery programme but advises caution about the potential outcome(s). We further advise that such efforts should be focused on a limited number of diseases and restricted to targets where the mechanism of action of the target is highly validated, ideally supported by strong association with clinicians who are experts in the disease area. We further advise that a focused effort on a few targets may provide a stronger competitive advantage compared to parallel efforts on many targets.

**Summary of the preparation and the 1st meeting**

The first meeting of the RIKEN Centre for Life Science Technologies Advisory Council CLST-AC took place June 15-16 at the RIKEN Yokohama Campus and June 17-18 at the RIKEN Kobe Campus. The site visit committee were provided with a detailed book describing the activities of the Centre's various Divisions and Units before the meeting and the site visit it self consisted of a cascade of presentations beginning with the history of RIKEN and the Centre. The presentations then were mainly focused on the different divisions detailing their different programmes. All of the CLST-AC were present for the high level sessions but were split into three parallel to review each of the three divisions. Drs. Bradley, Juha Kere and Chieko Kai, Division of Genomic Technologies (DGT); Drs. Cheryl Arrowsmith, Lucio Frydman and Masami Hagiya; Division of Structural and Synthetic Biology (DSSB); Shigekazu Nagata, Christer Halldin and Noboru Yumoto, Division of Biofunction Dynamic Imaging (DBDI). The whole site visit committee were also taken on facility tours where they viewed the impressive facilities and met with some of the proud operators of the installations. On the final day to we learnt how the nascent interactions between the divisions were being nurtured at the grass roots level, how the centres were opening up their World class facility to users outside of RIKEN and thereby contributing to the progress of science in the greater Japanese scientific community, we discussed the Centre's role in the national effort to stimulate drug discovery in the academic sector and finally we discussed human resource policies.

The site visit committee asked many questions at the end of each session ranging from high level strategic questions of the Division directors, to probing scientific exchanges with individual principal investigators. Overall, the site visit team were deeply impressed with the level of preparation for the meeting, the extensive documentation provided, energised atmosphere of the staff they encountered during the sessions and on the tours as well as the leadership demonstrated by the Division Directors and particularly the Centre Director, Dr. Yasuyoshi Watanabe.

***Recommendations***

The recommendations of the Advisory Committee provided below are assimilated in the context of the information provided and the interactions described above. They are provided in the spirit to give helpful, constructive guidance, recognizing that there may be local as well as overriding RIKEN and/or national constrains that may prevent their implementation. The Advisory Committee have taken note of President's Noyori's terms of reference in assembling their recommendations and these are provided in the context of the ACs significant Japanese and International experience with the intent to help the Centre not only maintain but grow its substantial international reputation. The committee's recommendations are focused at the macro-level (Centre and Divisional); following the recommendation of the Centre's Director, we have not reviewed individual PIs in this first acquaintance visit.

The Centre for Life Technologies is a new Centre formed in April 2013 under the leadership of Dr. Yasuyoshi Watanabe by the fusion of the activities and facilities of three formerly separate Divisions. This amalgamation is an attempt to encourage cross-

disciplinary research, a laudable concept launched throughout RIKEN by President Noyori in the third Five-Year term. Associated with this reorganisation two new Directors were appointed, Dr. Mikako Shirouzu and Dr. Piero Carninci, heading DSSB and DGT respectively; while Dr. Yasuyoshi Watanabe continued the leadership of his former Division, previously know as the Centre for Molecular Imaging Science in Kobe, as well as assuming overall Directorship of the Centre.

The formation of a new centre under new leadership presents a number of significant challenges as well as opportunities. The challenges are undoubtedly well understood and recognized by RIKEN and the Centre's Directors. They are multifactorial and include the geographical separation of DBDI from DGT and DSSB, the operation of highly technical, world leading but very different platforms in each centre, the significant scientific legacy and continuity of the projects in each division, as well as the eminence (and to some extent the actual presence) of the former directors in two of the divisions. Aside from the already significant challenge associated with maintaining the international stature of these divisions under new leadership and integrating these in a new management structure, the expectation that the fused centre should open new field(s) of life sciences at the interface of the core disciplines presents an enormous additional challenge.

The CLST-AC was very impressed with the leadership of the Centre and the Divisions generally and the appointment of a woman and a non-Japanese person as divisional directors; this sets a tone and indicates that RIKEN is serious about gender balance and internationalisation at the highest level. Dr. Shirouzu probably faces the greatest challenge in her new role, as besides the aforementioned scientific leadership and inter-divisional integration efforts, she needs to distinguish her leadership and vision from that of the former Director. This may not be something that she can achieve alone: high level support may be needed to achieve an agreement on how to disengage her new initiatives and scientific projects from those that originated under the headship of Dr. Yokoyama, and support her to obtain international recognition. One notable difference noted with the new structure was a clear sense among the leadership team of mutual respect and a desire to work together, which has already broken down some of the barriers that were evident between the groups previously on the Yokohama campus.

***Appointments and promotions***.

The most important tool a Director can use to steer the scientific direction of a centre and maintain and/or enhance its international reputation, is through scientific appointments. Systematic approaches to manage departures of PIs are also important, since they seed the external scientific community with new PIs, while providing a Centre with the possibility of incorporating new unique scientific and technical skills. The formation of the Centre has endowed it with a number of excellent PIs, many of whom grew up in the RIKEN system. Some recent departures provide opportunities early in the formation of the CLST to explore new scientific opportunities that deviate from the direction established previously. While it is tempting to immediately fill vacuums left by the departure of highly productive PIs with individuals working in closely related fields,

for instance by internal appointments of undoubtedly excellent senior postdocs from the division, this may not yield the subtle but important directional shift envisioned by President Noyori in bringing these divisions together. Proactive external recruitment of individuals with unique biological and/or medical knowledge who work, or who wish to work at the interface of the Divisions, will yield the highest scientific impact over the long term.

In this context the CLST-AC recommends that the scientific profile of all new positions is discussed and agreed by an appointment committee constituted by directors belonging to the Centre's senior management team, plus two or three external members that have a biological expertise that is not represented in the Centre currently. Such members are available in other centres within RIKEN, and/or from high-ranking Japanese Medical Schools and Universities. To achieve maximum impact one might consider appointments that take advantage of biological insight and knowledge in other RIKEN divisions but can exploit the technological platforms available in the centre. Appointments that bridged RIKEN centres would perhaps have the greatest long-term impact.

Open advertisement, strict adherence to the vision of the position coupled with application of uncompromising standards in the selection process, will assure that strong appointments are made. For immediate impact, established group leaders could be targeted rather than young PIs. In all instances the AC recommends that the Centre incorporates their foremost recruitment choice to their cadre, while avoiding "second-best" compromises.

**Opening New Fields of Life Sciences**

The expectation that the CLST should open new fields of life sciences research is undoubtedly a significant but appropriate challenge for the Centre. The divisional directors have devised various mechanisms to bring personnel together including retreats, periodic meetings and joint seminars, and funding of joint scientific projects proposed by PIs from the different divisions. While these will likely yield interesting scientific developments, these will be rather slow and may not yield the desired results in the time frame envisioned by the RIKEN leadership. Further investment in joint research is warranted.

Although the CLST-AC is confident that new developments will emerge from the bottom up, they can't be forced and they will take some time to develop. To speed up this process, the CLST should consider proactive engagement with individuals in other organisations –with special emphasis on experts with biological expertise and/or clinical insight, who would benefit enormously by working closely with the CLST platforms while providing CLST with a welcome, different perspective on scientific and medical problems. Examples of such initiatives can be found in institutes like the Broad Institute (Cambridge, USA) who have appointed numerous PIs as "Associate members", thereby fostering a very large community of researchers spanning the large academic community in the Boston area. It may be advantageous to develop this as a focused

thematic effort in a limited number of fields in the first instance –for instance, the incorporation of health-oriented experts to boost the DMP drug discovery initiative– while broadening this out later.

**Clinical access**

The expectation that the newly formed CLST should apply their combined platform which extends from the understanding of molecular interactions at the atomic level, through coordinated gene expression, cellular and whole body imaging, is visionary, and if realized will have extraordinary impact. To achieve this aspiration, we recommend from the CLST to foster interactions with clinical scientists who have deep understanding of disease at both the pathophysiological and molecular/mechanistic level. In this respect, the lack of an affiliated hospital is a disadvantage to some of the Centre's initiatives –like the DMP and PMI mandates– but certainly not a unique problem for the CLST. The CLST may wish to consider how to address this deficiency by considering the experience of related organisations in other countries. One simple and rapid solution to achieve collaboration with clinician scientists at every level is to adopt the example of the Broad Institute (as mentioned above). The Sanger Institute has also managed to close this gap by establishing a broad clinical interface by investing in clinical PhD training programmes, appointing clinical scientists as postdoctoral fellows and as PIs, requiring that all of these individuals continue to be active clinically. The AC therefore recommends that such mechanisms be adopted by RIKEN, as the AC believes that CLST should present an extremely attractive research opportunity for physician scientists. There will be numerous opportunities and influence emerging from such appointments, such as focused studies on specific diseases and access to human tissues and cohorts for disease as well as access to healthy volunteers.

**Drug Discovery**

The Drug Discovery and Medical Technology Platforms (DMP) was conceived as a 10-year effort to accelerate drug discovery in Japan by utilizing RIKEN's strengths in basic research. The CLST is undoubtedly well placed to contribute to this national initiative in a number of areas and indeed there are examples of contributions in collaborations with pharmaceutical companies in the each of the divisions.

The time available for the CLST to evaluate the DMP was limited, moreover we are aware that the DMP has its own Advisory Council. Thus the CLSTs observations about this programme should be considered in this context. Although the goals of the drug discovery and medical technologies programs are laudable the AC would advise that it is worth being substantially cautious about the potential outcome of instructing academic laboratories to embark upon drug discovery and development. Moreover, although it was evident that there was enthusiasm for engagement with this type of project, the top-down realignment of basic research initiatives will impact other outcomes in the short and potentially longer term. These concerns are multi faceted and include the target list, which includes many diseases and biological systems worked on by pharmaceutical and biotechnology companies –and thus for which the competitive landscape is likely to be significant.

The AC also discussed the disease choices and felt that greatest impact would be achieved by decisions to focus on a limited number of disease where there was a clear unmet need and pre-clinical and clinical development path that utilized the strengths of the CLST. The AC recommended some consideration of neglected diseases of the developing world though we recognized that orphan diseases of the Japanese population may perhaps have more resonance. The AC advises against any efforts directed against common diseases where the mechanism is unclear. While common diseases where the mechanism is clear are attractive the drug development program should recognize that (i) any effort in these areas will be competitive, and (ii) all efforts would benefit from close association with health-oriented professionals familiar with the pathophysiological challenges of the targeted disease. The AC also considered how the basic science component of the CLST could best be deployed to contribute to this national drug-development effort. One area of CLST's clear competitive advantage is imaging for pre-clinical and clinical studies. The CLST have suggested that they could make the structural biology component more relevant to the drug discovery industry by focusing on traditional target classes such as GPCRs and/or ion channels. While the AC support some effort in this area, it will be tough to compete with established groups such as Ray Stevens (formerly at Scripps, who now has a big Centre in Shanghai) who concentrates solely on GPCR structures and their inhibition and publishes several high impact GPCR structure papers each year. Other target classes are also promising and of interest to pharma such as epigenetic targets, which has nice synergy with DGT as well. Whatever the target choices though, the programs should be partnered with disease experts to choose the targets and to guide testing of the disease hypothesis with lead compounds in clinically relevant disease models.

In addition to these global CLST considerations, the AC focused on overviewing each of the Centre's Divisions global activities and plans. These are summarized as follows:

**Division of Structural and Synthetic Biology**

**Leadership**

Dr. Shirouzu has a strong track record in the core areas of protein synthesis and structural biology and is well positioned to lead this division, but will need some support to clearly distinguish science conducted under her leadership from the substantial but important legacy of Dr. Yokoyama as discussed earlier. The AC is very positive about this appointment and felt this was the natural choice. The AC is also confident that Dr. Shirouzu can achieve the international stature enjoyed by the former Director, though we recognize this will take some time. An important but essential element will be further development of Dr. Shirouzu's conversational English.

The change of leadership opens opportunities for some PIs and may present challenges for other PIs within the division. Undoubtedly some nascent seeds will grow and flourish but others may struggle. The CLST is encouraged to proactively identify and support the development of nascent scientific leaders and monitor weaknesses within the division.

**Vision and Mission**

The division overall comprises an excellent group of scientists at the forefront of structural biology, novel synthetic biology technologies, computational methods for protein and small molecule design and screening, and a world-class NMR facility specializing in solid and solution-state analyses. The division is charged with excelling in basic research in all these areas; at the same time the division is expected to provide a national and RIKEN-wide resource for protein synthesis, structural biology, drug discovery and NMR spectroscopy access. The committee noted the following particular strengths of the division:

- The DSSB incorporates a comprehensive pipeline for structural biology
- DSSB possesses an outstanding instrumental infrastructure, especially in NMR and EM
- DSSB includes world class structural biology teams in several important themes, lead by young and energetic experimental PIs
- The computational groups at DSSB, lead by PIs Honma and Zhang, are very strong
- DSSB has developed over the years a unique resource of nonnatural amino acid and nucleic acid (aptamer) technologies, enabling world-class 'synthetic structural biology'.
- The committee was particularly pleased to see the integration of multiple technologies within the division and across divisions in the epigenetics program of Dr. Umehara.
- DSSB has adopted as one of its flagship projects the development of high-temperature superconducting (HTS) technologies, which are sorely needed to break the GHz NMR barrier. HTS technologies are the focus of an international magnet development program at DSSB; this expertise is also used to develop a new generation of ultrasensitive HTS-based cryogenic NMR probeheads. When taken in unison, these developments may impact Structural Biology at a paradigm-shifting level, as well as other important areas in science ranging from materials science to biology and onto the clinic.

**Challenges**

The committee recognizes that this division is newly formed, and derived from part of a previous Centre. This creates challenges for establishing independence from the legacy of the previous Centre, and poses complex integration challenges when considering its integration with the other two divisions of CLST. An additional challenge may arise from the expectation for DSSB members to participate in RIKEN's drug discovery program –in addition to excelling in their own areas of research and providing a RIKEN-wide research infrastructure resource. It may be a challenge to remain at the forefront of their respective technologies and disciplines while also having to fulfil these additional mandates.

**Recommendations**
With recent acquisition of three state-of-the-art EM instruments the committee strongly recommends the recruitment of a world-class level microscopist to make the most of the instrumentation and potential synergies within the division.

The committee felt that maximum scientific benefit would be realized if more academic users both outside and within RIKEN were able to access the division's World Class infrastructure such as NMR. The committee encourages further proactive development and implementation of policies to achieve this and to monitor their impact.

**The Division of Genomic Technologies (DGT)**

**Leadership**
The AC was impressed with Dr. Carninci's leadership. He is clearly a highly productive internationally recognized scientist who has played a central part in the elaboration of the RNA-world. The challenge Dr. Carninci will face will be to set a direction for the Division in the context of the departure of several of the senior established group leaders, the continued evolution of the technology platforms, the application of RNA sequencing elsewhere in the world making the DGT less unique than it has been in the past, the conclusion of the on-going FANTOM project, and the laying out of an ambitious but achievable roadmap for FANTOM's continuation.

**Vision and Mission**
The mission of DGT is stated as developing and applying new ground-breaking technologies to understand transcription, a fundamental biological process. Specifically, the mission statement mentions transcriptome, epigenome, non-coding RNAs (ncRNA), single-cell technologies, and cell reporogramming as research targets. They also focus on methods standardization, an important aspect for a Research Infrastructure Centre, expected to provide consistent and reproducible data for internal as well as collaborative research and also to function as a reference point for the scientific community at large.

DGT is further organized as two closely interacting and interdependent groups, the Life Science Accelerator Technology Group and the Genome Network Analysis Support Facility (GeNAS). This division is inherited from the former Omics Science Centre (OSC) and continues to be well-motivated and effective. Upon the reorganization, Dr. Carninci has introduced two new units within the Life Science Accelerator Technology Group to further strengthen the development of technologies, raising two former OSC scientists (Drs. Takeya Kasukawa and Charles Plessy) to Principal Investigators. In addition, a new unit was formed with Director's strategic funds by recruiting a PI from outside RIKEN (Dr. Aki Minoda) to start the Epigenome Technology Exploration Unit.

Not only for its organization but also for its scientific directions, DGT stands at crossroads. This year saw the publication of the phase I main papers of the FANTOM5 project, an uncontested and unique cutting-edge international collaboration conceived and

coordinated by OSC (under the leadership of Dr. Yoshihide Hayashizaki). Dr. Carninci is now directing DGT toward the next-generation projects (FANTOM6) that are still in their formative stages. It should be emphasized that phase II of FANTOM5 is still being wrapped up for reporting, and that several tens of satellite research papers are being processed based on FANTOM5 achievements; it was estimated that one more year of part-time activity will be needed to complete these tasks.

Several new ideas and directions were presented during the review sessions that included single-cell transcriptome analysis, techniques for analyzing molecular interactions on the chromatin level (to elucidate functions of ncRNA and understand epigenetic mechanisms), computational analysis of the comprehensive data to establish detailed regulatory molecular networks for improved biological understanding, large-scale cellular perturbation technologies to derive enhanced and conclusive network mechanisms, and cell conversion technology development to be able to engineer any desired target cell types at will. While all these ideas are at the frontline of our knowledge, the AC did not yet get a clear idea about which is going to form the core of the possible new signature FANTOM project. The question was raised whether a disease-centred project, focusing on clinical samples on important diseases, would be useful and provide a good basis for international collaboration. Such a collaborative aspect is one that has helped FANTOM5 reach such broad visibility and attracted a large number of scientists worldwide visit RIKEN and tie contacts with its staff. The decision about the scope and work content for the possible next FANTOM project remains one of the most important for this division and will be crucial for completing the leadership change at DGT.

The reorganization coincides also with the leaving of three DGT PIs to prominent positions at universities in Japan (Dr. Sotaro Uemura) and Australia (Drs. Alistair Forrest and Timo Lassman). This must be viewed as evidence that CLST has managed to nurture within its midst, highly appreciated, internationally prominent scientists. It also creates opportunities for recruiting new talent to an excellent environment. As noted in the overview the AC advises that this is an opportunity to consider how to get maximum impact for the CLST as well as DGT and it may not be appropriate to continue Dr. Uemura's unfinished project given the progress with sequencing provided by off-the-shelf instrumentation.

GeNAS is an essential part of DGK and the AC was given the opportunity to visit its premises and see the actual technology platform. The AC takes notice that GeNAS has continued to evolve as a world-class sequencing centre focusing on transcriptome. There are few if any centres that have been able to evaluate and compare all commercial sequencing technologies and adopting the most purposeful technologies for appropriate uses such as CAGE.

The facility itself was unusual in that it was part museum containing a number of legacy machines that were no longer operational. The AC wondered if there could be substantial operational, budgetary and scientific benefits by combining the sequencing facilities of DGT with those of the Centre for Integrative Medical Science? We were further unsure about the desire to set up a class III facility for influenza, which as felt to be duplicative with other

national facilities. The BSL2 and BSL3 facilities, however, are useful for other infectious diseases, for recombinant virus vectors, or for even gene fragments from high BSL classified infectious microorganisms. Thus, AC encourages CLST to make a good use of them.

The international collaborative nature of DGT is striking and positive for RIKEN. Half of the collaboration is with other countries. AC encourages DGT to have more combined projects with two other divisions to create new fields of science. AC also encourages DGT to have a new system of open collaboration with researchers outside of RIKEN.

One of the technologies developed by DGT, SmartAMP, is potentially very important clinically and thus of benefit to Japanese population. First-to-market is very important for commercial traction, however development of applications for Smart AMP has been on-going for at least 9 years. The CLST-AC is unsure of the reasons for the slow progress, but note that the timelines are too long. With such extended time lines some of the potential will have been eroded. The CLST-AC recommends that the manner in which this technology is being "translated" should be reviewed. In addition, a detailed development plan with appropriate time lines and milestones should be assembled and used as a framework to manage and measure further progress.

**Division of Biofunction and Dynamic Imaging Science**

***Leadership:*** The AC were greatly impressed with Dr. Watanabe's leadership. The challenge he'll face is less focused on the managing of his own Division, than on balancing the support of the science he knows well in his division in Kobe with that of the other divisions. In this respect, it is up to his leadership and vision to rising to the challenge of facilitating a collaborative and open research environment centre which exploits to the utmost the breadth of the technology platforms in his centre.

***In Summary***: The AC thinks that the DBDI division has strong potential to perform *in vivo* imaging analysis at multi level using molecular imaging such as PET and other multimodality techniques. They are developing chemical and biochemical methodologies to insert short-lived radionuclides into key radiolabeled molecules for elucidating the role of these radiotracers under healthy, ahead sick and diseased states.

Since CLST is a newly established centre, and some members just joined the division, we evaluated the DBDI division for the following points.

- Will the division promote creative research leading to world-class results?
- Will the division maximize the Centre's characteristics?

DBDI has in general a world-class potential to image a large series of different potent compounds for highly interested targets with radioisotopes suitable for PET. The imaging chemistry group is developing novel molecular imaging probes with a high efficiency. In particular the Pd-supported $^{11}$C-methylation reaction has been successfully applied for the labelling of a large number of potentially interesting

molecules. The AC has, however, the opinion that in order to be able to label all the future potential novel tracers by taking full advantage of all new compounds that will be supplied by DSSB and the DMP platform an even more advanced radiochemistry platform need to be developed. This can be accomplished by introducing $^{11}$C-CO carbonylation radiochemistry and even further developed by introducing the concept with microfluidic radiochemistry.

DBDI has high level equipment needed to fulfil its tasks such as cyclotrons, hot-cells, radiolabeling synthetic modules and a GMP (Good Manufacturing Practice) lab for clinical production. A variety of PET cameras needed for translational research exist with some of them recently purchased with a world leading performance such as high resolution and sensitivity.

The imaging function group is developing imaging biomarkers and novel molecular imaging methods and has clearly the ability to perform translational research at an international top level. In addition, the existence of an animal facility with animal models for rodents and non-human primates, as well as development of cellular function and architecture imaging is highly appreciated by the AC. As multi-modal imaging is emphasized by DBDI, it may be important to also focus on developing bimodal tracers to be applied for PET-MR or other bimodality imaging techniques.

The imaging application group is certainly performing high-level development of the next-generation molecular imaging technologies. Some examples of its achievement are the innovative development of simultaneous multi-imaging (GREI, P-PET, and MRI) that is of high interest. We realize that DBDI is promoting molecular imaging applications all the way to clinical set-up and is working on neuronal network and neuronal diseases (Parkinson diseases, autism), fatigue, regenerative medicine, cancer stem cells, hepatitis, etc. We are not fully convinced that so many diseases and targets should be studied at the same time. It may be better to focus on a less number of targets.

In summary, we have no doubts that DBDI will promote the creative science on Bio-function dynamic imaging that is needed in a world-class centre such as CLST.

*Will the division help maximize the centre's potential?* The bio-function dynamic imaging is an important technique in life science and central to CLST. In RIKEN, there are a number of strategic research centres such as Quantitative Biology Centre (QBiC) and Brain Science Institute (BSI). Collaborations with these institutes would be mutually advantages for CLST and the mission of RIKEN.