EMBL Australia

Scientific Program February 2009

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Introduction

EMBL Associate Membership for Australia, activated in March 2008, affords Australia the capacity to develop the next generation of leaders in bioscience research through the establishment of an Australian EMBL Partner Laboratory Network. Through an active partnership with Europe's premier collaborative research institute, the EMBL Australia Partner Laboratory Network will seed a cross-disciplinary, highly collaborative culture across Australia, conducting research of the highest international standing and establishing collaborations, reviewing and mentoring by the world's leading bioscience researchers. The Network will attract state-of-the-art infrastructure, developing and maintaining national Core Facilities operating at the leading edge of technology development, as well as providing access to technologies, expertise and networks across Europe.

Of specific relevance to the scientific themes of the Partner Laboratory Network are Australia's strengths in the involvement and therapeutic potential of stem cells in tissue regeneration, human genetic epidemiology, the power of small molecular screens in elucidating disease mechanisms, generation of animal models of human physiology both in the mouse and other vertebrates, and plant biological research. Great potential synergy can be achieved by bringing together the unique strengths of EMBL/European laboratories in mouse biology, functional genomics, structural biology and bioinformatics with valuable regional Australian resources in biodiversity, neurobiology and chemical biology, and national research initiatives in stem cell research, human genetics, and proteomics.

Australia's track record in clinical trials will ensure effective incorporation of new discoveries from the Partner Laboratories into medical application. Additional collaboration with international partners from the commercial sector in the areas of therapeutics, drug discovery and diagnosis will benefit from the emphasis placed by the Australian government on biotechnological innovation and form the basis of active collaborations with EMBL groups in Europe. Establishment of a Partner Laboratory Network in Australia will therefore have the following clear and lasting benefits:

Utilising a unique Partner Laboratory Network structure: The structure of the EMBL Australia Partner Laboratory Network has been based on the highly successful EMBL model, with distributed, tightly integrated research centres focused on complementary aspects of biological research. Current research partners in the Partner Laboratory Network include Monash University, the Universities of Western Australia, Sydney and Queensland and the CSIRO. All of these universities have specific interests in life sciences research and extensive networks with other universities and research institutes. The Network will adopt the EMBL hub and spoke structure, headquartered at Monash University with potential nodes developed at the collaborating Universities. The size and management of Australian Partner Laboratory Network are currently being determined in discussions within EMBL Australia Working Group. Currently a staggered recruitment of Partner Laboratory Group Leaders is envisioned, with an initial goal of six groups at the hubs, and four groups at each node.

Supporting the world's best: As at EMBL, Partner Laboratory Group Leaders will provided with generous support (approx $1 million pa) for a limited period of time (5 years with possible renewal for a further 4 years upon review). International selection of Partner Laboratory Group Leaders will be based on scientific excellence and promise. At EMBL, approximately one in 30 applicants for Group Leader positions is successful; only the best in the world are appointed to these highly sought posts and it is anticipated that there will be a similar level of competition for the EMBL Australia Partner Laboratory positions, serving to increase awareness of Australia's numerous research strengths, and bringing international attention to the benefits of conducting life sciences research in Australia.

Ability to attract high calibre international scientists to Australia: In its 35 years, the five European campuses of EMBL have hosted thousands of international students and fellows, Group Leaders, staff and visiting scientists from around the world. More than 1400 people from 60 nations currently work at EMBL, generating more than 3000 alumni who form an international network of connections. EMBL is a world-renowned international centre for advanced training and has had the right to award its own PhD degrees since 1997, collaborating closely with 23 partner universities in 16 countries. It is anticipated that by establishing Partner Laboratory Network, EMBL Australia will become a complementary international research hub, drawing

from Australia's own talent pool and engaging overseas members, attracted by the unique strengths of Australian life sciences. Successfully implemented, the EMBL Australia Partner Laboratory initiative will enhance the quality and influence of Australia's biological research, particularly in stem cell biology, comparative genetics and regenerative biology structural biology and bioinformatics. This will have long term effects in strengthening Australia's international competitiveness in many areas of the life sciences.

Producing outstanding young career researchers in Australia: Australia currently suffers from a dearth of early career opportunities for its young scientists, resulting in a "brain drain" that is reminiscent of the 1970s in Europe, when the majority of talented young researchers immigrated to the US to launch their careers in molecular biology. Recognition of this crisis galvanized the establishment of EMBL, which was instrumental in reversing the trend to leave Europe, and ultimately resulted in the ascendance of Europe to a position of strength and innovation in the molecular sciences. A similar crisis is imminent in Australia: there is an urgent need to allocate more resources into science training if Australia is to build long-term capability in the biomedical and biotechnology industries. Australia has the talent and the will in its youth to compete successfully, but to realise this potential Australia needs an infrastructure that prepares young scientists well in their formative years. Establishment of an EMBL Australia Partner Laboratory Network will serve as a paradigm for education and training, providing the leaders of tomorrow an unprecedented opportunity to develop their careers in Australia.

Developing sustainable links with research centres in Europe: EMBL and Australian research cultures are both highly collaborative and the synergies created from the alliance stemming from the establishment of Partner Laboratories are expected to be significant. This will build on already strong relationships between Australia and the European Union in key domains of biomedical research. Many Australian organisations are already engaged in the EMBL network in a variety of ways and are looking at the benefits that a more formal relationship will bring. Establishing Partner Laboratories addresses a key feature of the current Commonwealth Ministry's mandate, to internationalise research in Australia.

Amplifying research quality and outputs: EMBL's current Scientific Program will seek to emphasize emerging research initiatives that reflect the convergence between basic biology and medicine. A number of EMBL faculty members already study fundamental aspects of human biology and pathology, towards understanding mechanisms of disease, however this new focus for EMBL will require a deeper involvement in molecular medicine. The establishment of EMBL Australia Partner Laboratories will foster collaborative partnerships with Australian institutions that regard human biology and medicine as essential for the effective integration of basic and clinical research. Strategic collaborations such as those envisioned with Australian biomedical research institutions will encourage new approaches to molecular medicine through basic research, providing a critical amplifier of national talent. In summary, the EMBL Australia Partner Laboratory Network represents a highly effective, relatively inexpensive avenue for leveraging Commonwealth investment in the future of Australian life sciences and biotechnological research.

Six Key Features of the EMBL Australia Scientific Program

Fostering scientific excellence:

Like its European counterpart, EMBL Australia aims to become an international flagship of scientific excellence. The most valuable resource EMBL provides to its member states is highly trained scientists. In Europe, EMBL's turnover system means that it produces world-class researchers at a much higher rate than any other research institute, and has served as a model for numerous academic institutes around the world. EMBL alumni emerge trained in excellence and schooled in collaborative, cross-disciplinary research, enriching the scientific communities that they join and forging links between scientists around the world.

The similar missions that EMBL Australia Partner Laboratory Network will carry out on behalf of the nation, and the added value to Australia, will depend upon the excellence of its research performance. The EMBL model – freedom to pursue adventurous, discovery-based science by outstanding young international talent with guaranteed research packages, and state-of-the-art support facilities and services – is a proven recipe for innovation at the highest level. In providing this opportunity nationally through the Partner Laboratory Network, the EMBL Australia Scientific Program will strengthen the country's "brain gain and retention." This will occur through the development of a critical mass of expertise to support an active and world-leading research community. The Faculty Development Program, in which qualified young Groups Leaders spend five years at EMBL, with a further four years at a sponsoring Australian University, will provide additional opportunities for qualified young scientists to gain experience at EMBL overseas, returning to pursue their research in Australia.

EMBL has a very strong record of developing star scientists, providing young researchers the freedom to ask and address major innovative scientific questions in a supportive environment, with access to state of the art core facilities, thereby removing the constant distractions of writing frequent reports on short-term, incremental steps. An important feature of the EMBL Australia Partner Laboratory structure is the ensuring of dynamic turnover in the laboratory, guaranteed by fixed term contracts (five years extendable to a maximum of nine years) during which highly qualified Group Leaders can pursue high-risk, innovative research projects that often require years to realise. It is therefore imperative that Groups at EMBL Australia Partner Laboratory nodes are allowed the maximum time to work in the supportive collaborative environment of an EMBL Partner Laboratory Node.

An alternative distributive scheme discussed in some of the workshops, in which Groups would spend five years within a Partner Laboratory Node, then transfer to another sponsoring institution within Australia, was not deemed feasible by the EMBL Director General, since it did not provide a sufficient amount of protected time for a young research to conduct the high risk, collaborative research that has made the EMBL model successful. This scheme was therefore not pursued further as an option for the EMBL Australia Partner Laboratory Network.

Training Programs, Courses and Conferences:

Equally important for the success of EMBL Australia are the mechanisms set in place for ensuring the widest dissemination of expertise and benefits to the Australian scientific communities and beyond. In Europe, one of EMBL's core missions has been the provision of advanced training. EICAT, the EMBL International Centre for Advanced Training, coordinates integrated training activities for scientists at different levels. EICAT pursues a dual mission: to provide first-rate training for the scientists who work at EMBL, and to serve as a European hub of advanced training for those who primarily work elsewhere. Headquartered at the main EMBL laboratory in Heidelberg, Germany, EICAT promotes joint advanced training activities between the five EMBL sites, integrating their respective experience and know-how, creating synergies between EMBL and its sister institution EMBO, and between the Laboratory and research organizations and networks in the EMBL member states, including Australia.

EICAT coordinates activities amongst the EMBL training branches including the EMBL International PhD Program, and a recently initiated Postdoctoral Program that gives future independent researchers the leadership and other management skills they need for careers in science. Using similar models, the EMBL Australia Scientific Program will ensure the training of young scientists at all levels from PhD students to independent Group Leaders.

EICAT also runs the highly successful EMBL Courses, Conferences and Workshops Program and collaborates with the EMBL Science and Society Program. Due to the dedicated involvement of the scientist-organisers, EICAT's dissemination activities are of very high scientific quality, and will be exploited to spearhead similar, complementary activities within the EMBL Australia Scientific Program.

EICAT hosts the European Learning Laboratory for the Life Sciences [ELLS], an education facility for high school teachers, whose mission is to bridge the gap between research and classrooms. There is a worrying current trend throughout Australia for school children not to choose a science curriculum. To help reverse this tendency and to secure the educated manpower required for a knowledge-based economy, children need to be exposed to the most interesting aspects of science at an early age. EMBL has organised a series of "Life Science Learning Laboratories" that can be readily exported to Australia to help teachers find out what is new in the life sciences, and help them design practicals that can work in a school environment in order to illuminate these advances in an interesting way for children.

Networking and Collaboration:

At EMBL, an active Visitor's Program attracts thousands of international scientists each year, affording new opportunities for collaborative research. Careful planning of the EMBL Australia scientific Programmatic themes within the Partner Laboratory Network can achieve an equivalent level of connectedness and interdependency amongst Australian and international scientists. To this end, EMBL Australia will adopt the EICAT Scholars' Program and the Visiting Scientists' Program, which are open to scientists who need training in one of the specialised groups of the Partner Laboratory Network, who wish to evaluate possibilities for their own institutions, or to perform a specific project or to benefit from EMBL Australia technologies and methods for specific parts of their thesis. These programs will offer visiting principal investigators as well as postdocs and students from other institutions the opportunity to associate with a specific group or unit of the Laboratory for a period of study, reflection, writing, and exposure to ongoing research. EMBL Australia will serve as a node in international collaborations that ensure access to data collected throughout the world for Australian scientists.

Services to the Australian scientific community:

As in Europe, the services and facilities developed within the EMBL Australia Scientific Program will be designed to serve a very broad community that includes basic biology researchers, clinicians, and researchers from the pharmaceutical industry, agriculture and ecology. The Core Facilities at EMBL are internationally renown for providing a number of high-level support teams that help the scientific community by providing easy access to well-equipped facilities, both in terms of human resources and state of the art equipment. The support activities need to be tailored to the demands of the community and the staff members hired for such activities need to clearly understand their role. The support activities also need to evolve with the science carried out in the units of the laboratory. Having functioning Core Facilities proves to be advantageous not only in terms of workload and efficiency aspects but also in terms of cost of projects. The continuous investment in state-of-the-art technologies will allow EMBL-Australia scientists and external visitors from our member states to have access to a set of advanced technology platforms.

Leveraging National investment:

EMBL's infrastructural excellence is a critical component of its success. Today's EMBL Group Leaders have full access to in-house Advanced Light Microscopy, Genomics, Proteomics, Protein Expression and Purification, Electron Microscopy, Flow Cytometry, Monoclonal Antibody production, Chemical Biology and Mouse Transgenic Services. Given the fractured nature of European science over the past three decades, these infrastructural features had to be built from within EMBL, at great expense. Conversely in the EMBL Australia Scientific Program, capitalisation on existing national research infrastructural assets, established largely through recent NCRIS initiatives, constitutes an enormous advantage and is a tribute to the foresight of Australian research funding policy. To cite several examples, the availability of high throughput sequencing and analysis through AGRF, nanoscale characterisation and analysis at the Australian Microscopy and Microanalysis Research facility (AMMRF), state-of-the-art synchrotron science at the Australia Synchrotron and supercomputing services through the proposed Victorian Life Sciences Computation Initiative at the University of

Melbourne the proposed and supercomputing in Melbourne, and stem cell resources at the Australian Stem Cell Centre in Melbourne and Queensland – all leverage national investment, minimize risk and avoid unnecessary redundancy in setting up the EMBL Australia Partner Laboratory Network. More locally, national and State governmental programs have provided ample accommodation for EMBL Australia Headquarters at the Australian Regenerative Medicine Institute. Thus the EMBL Australia Scientific Program takes full advantage of national investment in life science.

Growing innovation in Australian life science:

EMBL Australia will avail itself of a highly successful model for commercial outreach, driven by the EMBL Enterprise Management Technology Transfer GmbH (EMBLEM), an affiliate and the commercial arm of the European Molecular Biology Laboratory (EMBL). EMBLEM, established in 1999 identifies, protects and commercialises the intellectual property developed in the EMBL-world, from EMBL-alumni and from third parties. EMBLEM facilitates and accelerates the transfer of innovative technology from basic research to industry by working closely with industrial partners spanning the biotech, ITC and mechanical/electrical engineering markets to develop new diagnostics, drugs, therapies and machines and devices. EMBLEM currently manages a portfolio of more than 170 patent families/copyrights and over 200 license contracts. Their technology portfolio spans the Life Sciences in the broadest sense involving identification and commercial development of life science technologies and includes enabling technologies, molecular tools and techniques, instruments, as well as software programs and databases. EMBLEM also assists in marketing and contracting of scientific consultancy services; advising and structuring EMBL spin-off companies; and is active in training and education. EMBLEM has already liaised with EMBL Australia participating institutions, to consult and offer assistance in capturing EMBL Australia's potential for innovation and commercial opportunities.

The Scientific Program

Process

The formulation of an initial Scientific Program for EMBL Australia will be an iterative process following the scheme employed by EMBL in Europe. Every five years, the EMBL Director General, in close consultation with his Directorate, Scientific Advisory Committee and Heads of Units, prepares an extensive proposal outlining the general research directions, support structures and specific initiatives in service and training that will be undertaken in the laboratory in the next five year funding period.

In 2001, the EMBL Council charged the Laboratory to perform a detailed analysis of the prospects for molecular biology in the coming decade. This analysis, the "Strategic Forward Look: 2006–2015" (SFL) was published at the end of 2003 (http://www.embl.org/aboutus/news/publications/forwardlook.html). Its conclusions formed the basis of EMBL's scientific strategy for the following five years. This is an extensive project of critical importance: last year's 120 page document for the EMBL Scientific Program 2007–2011 took approximately two years to prepare.

The major conclusion was that developments in molecular biology over the past decade, including the sequencing of entire genomes, the broad advent of high-throughput technologies and a few excellent examples of the power of combining experimental analysis with computational modelling and simulation methods in biology, had paved the way for the advent of systems analysis in biology, or systems biology. Biological functions rely on the combinatorial use of multiple components, whose interactions modify each others' properties in non-intuitive ways. This dictates a requirement for interdisciplinary approaches to the understanding of biological phenomena, including the close integration of computational and experimental approaches.

EMBL Australia Working Group agreed to a similar process for developing an indicative Scientific Program for EMBL Australia Partner Laboratory Network. Over the past three months, workshops in Brisbane, Melbourne, Perth and Sydney were convened to discuss and develop a set of broad research themes that are designed to be predictive and inclusive rather than proscriptive or restrictive. These workshops were attended by representatives of the local scientific community as well as by Prof Nadia Rosenthal and representatives from the CSIRO (see Appendix 1 for list of attendees to the workshops).

The Scientific Program for the EMBL Australia Partner Laboratory Network will build upon the strategic alliance with EMBL and its activities in systems biology, whilst capitalising on the specific strengths of Australian life and health sciences. In preparing the Program, the following characteristic features of EMBL research should be specifically considered:

Interdisciplinarity: In the current EMBL Scientific Program, particular emphasis has been directed towards interdisciplinary themes. EMBL strives to foster joint activities amongst its five sites through cross-disciplinary centres, sponsoring faculty and student-run symposia and interdisciplinary postdoctoral programs. Similarly, the EMBL Australia Scientific Program should seek to integrate Australian research strengths through interdisciplinary approaches.

Interdependence: Since the Australia Partner Laboratory Network will be made up of nodes there will be a need to develop strong interactions between these nodes for a unified strategy to be developed. Systems approaches should be encouraged that link the entire research sector rather than replicating the current foci within individual institutions.

Complementarity: EMBL is keen to see EMBL Australia explore research and technological themes that complement their own Scientific Program, as well as include areas of common interest with EMBL activities in Europe. A key issue for EMBL Australia's partners is to identify the major infrastructural requirements to attract the next generation of young researchers in the chosen themes, including infrastructure that complements that at EMBL.

A final consultation draft of the EMBL Australia Indicative Research Themes, developed through consultations at the Scientific Program workshops, is presented below for inclusion in the EMBL Australia working Business Case that is being prepared separately. The draft will be further discussed and finalised at a single topic meeting of the EMBL Australia Working Group. The initial Program will necessarily take the form of a strategic forward look that will be developed over the next year by the EMBL Australia Council, in consultation with the EMBL Australia Scientific Advisory Committee

(EASAC). The resulting indicative Scientific Program will be widely circulated in the Australian scientific community and will be a critical component of requests for support of the Network at the Commonwealth and State levels.

Indicative Research Themes for EMBL Australia

Research themes in the EMBL Australia Partner Laboratory Network will focus on complementary activities that will integrate the proposed Partner Laboratory nodes with sponsoring Universities and surrounding Institutes, to develop and expand existing strengths of Australian life and health sciences in the following six general areas. At each node, the areas of research conducted by the Group Leaders will determine the facilities/instrumentation that will form part of the node, and be made available to other members of the Partner Laboratory Network and to scientists through the various Visitors Programs. Although excellence must be the primary determinant in selecting Group Leaders in each of the EMBL Australia Partner Laboratory nodes, defining research themes prior to establishment of the nodes, by selecting the best established research groups in the broad area indentified, and building Core facilities around them, will be necessary to put a strong scientific case to the Minister as part of the request for EMBL Partner Laboratory funding.

Theme 1: Regenerative Medicine and Stem Cell Biology

We are constantly undergoing structural renewal by replacing molecular components of our tissues, yet the human body gradually loses effective regenerative capacity as we age. What common set of problems must we solve to understand and manipulate the mechanisms of regeneration in different organs? Do non-regenerating tissues have the latent capacity for regeneration? What are the mechanisms of regeneration in embryos, or in organisms where it occurs more effectively, and what are the intrinsic and extrinsic factors that determine the regenerative versus the cancer-causing capacity of a cell to self-renew?

These are some of the questions addressed by regenerative medicine, which aims to restore damaged human tissues and organs using genes, cells, or other biological agents along with bioengineered materials and technologies. Research in the newly formed **Australian Regenerative Medicine Institute** at **Monash University**, combined with Australian advances in stem cell research within the national laboratories supported by the **Australian Stem Cell Centre**, as well as specific strengths in stem cell technologies at **University of Queensland** and tissue engineering at **CSIRO** and elsewhere in Australia, provide an excellent base to pursue promising avenues in regenerative medicine within the EMBL Australia Scientific Program.

- uncovering basic mechanisms in regeneration by systems comparison of regenerative capacities amongst diverse animal species
- regeneration of tissues by injecting or implanting regeneration-competent cells (usually derived from adult or embryonic stem cells);
- protecting cells and tissue from damage due to disease or injury (e.g. by preventing cell death);
- inducing regeneration in the tissues themselves by recruitment of a patient's own cells to the tissue or using proteins or gene delivery to stimulate cell division and tissue reconstitution;
- prevention of inflammation and scarring in tissues to better enable the regenerative process.

Theme 2: Human Genetics and Disease

Those countries with the highest chances of success in applying genomic knowledge and tools in clinical and public health settings have total population data and family record linkage, so that all those with and without disease can be studied in an unbiased way throughout the whole life span. Such linkages and resources already exist at the **University of Western Australia**, where a national and international resource for genetic epidemiology is being developed that will build on the unique Western Australia population health data that has been collected and managed over the last three decades. These linkages mean that the entire Western Australia population can be monitored for all major diseases/conditions, their risk and predictive factors, and the use and role of health services studied.

The Western Australia Genome Project will capture biospecimens on all consenting members of the living population of Western Australia (of approximately 2 million people). The core datasets now include all birth cohorts since 1980 (including prospective antenatal and perinatal data on all live births in the state); the linkage of hospitalisations and disease registers commenced in the 1970s.

Through research activities at the **Western Australian Institute of Medical Research** and **University of Sydney** as well as **affiliated Hospitals**, additional linkages to national Medicare and pharmaceutical benefits and aged care data from the Health Insurance Commission and the Commonwealth Department of Health and Aged Care will enable the study of all hospital and medical service contacts for particular diseases and conditions. Very few countries internationally have this capacity.

The linkage of the core population-based datasets to a large number of longitudinal cohort studies with extensive exposure data and biospecimens provides the potential to investigate the changing roles of genes and gene-environment interactions over the entire life span in population-based samples representative of the general Australian population. These population databases, genetic epidemiology and associated biospecimens can be harnessed in the EMBL Australia Scientific Program to:

- stratify population according to increased health span/lifespan;
- sequence the genomes of individuals in these categories;
- identify candidate gene sets (ROS, telomerase, mitochondrial, hormonal/systemic, regenerative, environmental response);
- develop tools to define molecular mechanisms leading to increased longevity and genetic origins of disease.

Theme 3: Cancer and Clinical Research

Improving our understanding of the fundamental aspects of cell biology is specifically relevant to cancer research to gain information about the transformation of normal cellular functions into a cancerous state, and to identify specific genetic defects in cancer cells and environmental factors which cause cancers. Of specific interest is the emerging relationship between stem cell and cancer cell biology, both exceptionally strong fields in Australian research.

Given the world-renowned reputation of Australian clinical trials, the scope of cancer research themes in the EMBL Australia Scientific Program can therefore be particularly broad. Particular strengths in the Network include **The University of Sydney Cancer Research Network**, which fosters communication with and among members to facilitate research collaboration with an emphasis on research translation and clinical trials; and strong cancer genetics (with focus on paediatric cancers) at the **Western Australian Medical Research**. Additional strengths derive from databases such as **Western Australian Cancer Registry which** recognises the critical importance of reliable population-based cancer data in the planning of services and in the prevention and treatment of cancer. These resources facilitate the following themes that can be incorporated into the EMBL Australia Scientific Program:

- genes involved in development, aging and neoplasia;
- mechanisms of pluripotency vs. malignancy;
- alterations in chromosomes and epigenetic mechanisms;
- hormones and growth factors;
- cell-cell interactions and the extracellular matrix; and
- molecular basis of cancer progression and metastasis.

Theme 4: Chemical Biology

Defining the temporal and spatial context in which biological processes function is critical for their systematic analysis. Chemical biology is an essential part of this aspect of life sciences research. An understanding of the interaction of small molecules and proteins is expected to enable controlled and time-sensitive perturbation of biological networks. Complementing aspects of systems research at EMBL, Australian science is particularly strong in many areas of biological, medicinal and pharmaceutical chemistry. The **University of Sydney's** strengths in chemical biology with an emphasis on the development of tools for imaging biological processes at the sub cellular and whole animal levels. Integrating chemistry into structural biology will also be an important aspect of synchrotron science in Australia, which is being pursued at **Monash University**. These collective strengths of sponsoring Universities in the Network can be exploited to address:

- small molecule analysis: metabolomics, mass spectrometry, in situ detection of trace elements and reactive metabolites in living tissues;
- design and pharmacology of new drugs;
- improved formulations for drug delivery;
- live cell imaging and chemical probes of biological tissues;
- proteomics and other protein detection and analysis techniques;

- mechanisms of chemical causes for some diseases;
- interaction of small molecules and metals with proteins, DNA and other biomaterials;
- design and improvement of pesticides and herbicides; and
- biosensors.

Theme 5: Plant Biology

Australia has a proud history of world-class research into plant science and has important centres of excellence in several universities in this discipline. As with many biological systems, the study of plants is entering a new genomic era. In plant genomics, new DNA markers will provide faster and easier ways to discover and manipulate important disease resistance traits in commercially important grass varieties such as wheat. Australian plant biology leads the world in the genetic and molecular analysis of metabolic networks, energy metabolism, nutrient acquisition, and the response to environmental stress.

In plant development, analysis of important developmental decisions, affecting cell division and cell fate determination, are elucidating the processes that give rise to adult structures such as shoots and roots. Through the integration of cell division with plant development, important plant-specific aspects have been revealed, including novel regulatory proteins and modes of regulation that link expression of cell cycle genes to cell type-specific developmental control.

Other areas of plant research seek to connect the cell cycle control of stem cell activity with tissue level growth and differentiation of the vascular system, hormonal control mechanisms and natural genetic variation. Future research will focus on marrying these important new discoveries in model plants such as Arabidopsis with Australia's traditional strength in plant breeding, to develop crops with enhanced growth and resistance to environmental conditions, taking advantage of superlative plant research through ARC Centres of Excellence. Members include **CSIRO** Plant Industry which conducts research to promote agrifood, fibre and horticultural industries, develop new plant products and improve natural resource management as well as conservation genetics, and **The University of Western Australia**, establishing an International Centre for Plant Breeding Education and Research, and **The University of Sydney's** increased emphasis on plant biology. Collectively these Network partners can support research into:

- genetic and molecular analysis of metabolic networks
- energy metabolism
- nutrient acquisition
- response to environmental stress

Theme 6: Systems Biology

Bioinformatics emerged out of the need to develop computer databases and algorithms that would accelerate and enhance biological research, involving the integration of mathematical, statistical and computer methods. Bioinformatics also encompasses the research and development of new techniques in computation, database management, emerging industrial and information technologies such as automation and robotics. Progress in bioinformatics parallels high-throughput data generation technologies including genomics, microarrays, proteomics and imaging, yielding datasets of unprecedented size and complexity. Bioinformatics provides the methods and tools by which these datasets can be managed and analysed to yield outcomes in bioscience, biotechnology, agriculture and medicine.

Genome sequencing and other high-throughput biomolecular technologies have transformed all areas of bioscience: not only fundamental research, but also health care, biotechnology, agriculture, forestry, fisheries, aquaculture and natural resource management – areas that collectively contribute more than half of Australia's GDP. These new technologies are generating such volumes of data that complex questions, for example involving multi-gene diseases, are becoming impossible to analyse remotely.

To conduct competitive research in bioinformatics and computational biology, Australia requires a local copy of data and tools, integrated into national advanced networks, data grid and high-performance computing. Through EMBL Associate Membership, Australia has a unique opportunity to build a national bioinformatics service facility in collaboration with the European Bioinformatics Institute (EBI). EBI is one of only two major international facilities that organises the world's biomolecular data and makes them freely available, together with unique analysis software, to the world's life science, medical and

research communities. This new facility, proposed to be hosted by **University of Queensland** but involving **all the Network nodes**, will provide up-to-date copies of key data sets and advanced analytical software, in some cases customising them for local problems such as drought-resistant grain crops or tropical diseases.

Such a bioinformatics centre will serve to:

- focus national and regional advanced training in genome-scale bioinformatics;
- leverage existing and future investment in national collaborative research infrastructure extend national capacity in life sciences and information technology;
- enable Australian participation in large international data-intensive projects in bioscience, consolidate scientific links with the European Community; and
- significantly enhance Australia's scientific reputation in the region and globally.

Appendix: Report and attendees at the EMBL Australia Scientific Program Workshops:

Sydney Workshop: 29th July 2008
organised by Prof Trevor Hambley
Attendees:

Dr John Allen	Centenary Institute
Dr Filip Braet	University of Sydney
David Cook	University of Sydney
Prof Merlin Crossley	University of Sydney
Mark Dawson	University of Sydney
Prof Trevor Hambley	University of Sydney
Prof David Day	University of Sydney
Dr David Lovell	CSIRO
Dr Peter Molloy	CSIRO
Dr Mark Morrison	CSIRO
Prof Nadia Rosenthal	Australian Regenerative Medicine Institute/EMBL
Mr Silvio Tiziani	Australian Regenerative Medicine Institute, Monash
Prof Jill Trewhella	University of Sydney
Prof Matthew Vadas	Centenary Institute

The meeting was held at the University of Sydney, who reaffirmed a strong commitment to establishing a node of EMBL Australia's partner laboratory and indicated its intention to incorporate the node into a new building dedicated to the interface between science and medicine.

A number of research areas were discussed, predominately around chemical biology, structural biology, and the interface with translation and clinical application. At a follow up meeting it was decided to draft a proposal around chemical biology with an emphasis on the development of tools for imaging biological processes at the sub cellular and whole animal levels. Access to clinical trials facilities was considered to be important and is something that Sydney can offer. However, the capacity and the areas available will be largely beyond the control of the EMBL node.

Melbourne Workshop: 1st August 2008
organised by Silvio Tiziani
Attendees:

Prof Bill Charman	Institute of Pharmaceutical Sciences, Monash
Dr Marcus Heisler	European Molecular Biology Laboratory
Prof Doug Hilton	WEHI
Dr David Lovell	CSIRO
Dr Keith McLean	CSIRO
Prof Colin Pouton	Institute of Pharmaceutical Sciences, Monash
Prof Peter Rathjen	University of Melbourne
Prof Nadia Rosenthal	Australian Regenerative Medicine Institute/EMBL
Dr Heather St John	Australian Regenerative Medicine Institute, Monash
Silvio Tiziani	Australian Regenerative Medicine Institute, Monash

The meeting was held at Monash Institute for Pharmaceutical Sciences in Parkville. Monash University reaffirmed their commitment to establishing the EMBL Australia Partner Laboratory Network Headquarters at the Australian Regenerative Medicine Institute, which has already established strong collaborative projects with neighbouring CSIRO laboratories in cardiac regeneration and tissue engineering. Dedicated Core Facilities to support EMBL Australia made possible by University, State and Federal funding are already under construction, including flow cytometry (in collaboration with the Australian Stem Cell Centre), advanced light microscopy, gene recombineering and deep sequencing, automated protein crystallization and protein structural analysis, zebra fish genetic facility, and an expanded mouse genetic facility in collaboration with University of Melbourne.

This was the only one of the four Workshops including EMBL Australia non-stakeholder attendees (WEHI, Uni Melbourne) and therefore the conversation concentrated more heavily on the overall structure and strategy of the EMBL Australia Partner Laboratory Network Initiative. Questions were raised about lack of critical mass at the various nodes should funding be in sufficient to build the requisite minimal 4–6 Group core. Additional concerns were raised about the lack of inclusivity in the current proposed structure, and a proposal was tabled for modifying the Group Leader packages to resemble more closely that of the Faculty Development Program, where Group Leaders spend 5 years in a Partner Lab node and an additional 4 years in an Australian institution of their choice.

In consultation with EMBL after the meeting, it was clear that this model is to be discouraged, since it has the undesirable effect of forcing early timelines for conventional benchmarks of success, and discourages innovative, risky projects that might take longer than the five year program to come to fruition. The EMBL Director General in particular emphasised that this model has already been unsuccessful and even destructive when introduced

in Europe, where 5 year fellowships invariably curtail the risky projects of young investigators, who soon focus prematurely on short term outcomes in order to garner the "best deal" after their initial five years and often lose precious momentum.

Perth Workshop: 4th August 2008

organised by Prof Peter Leedman

Attendees:

Prof Doug McEachern,	University of Western Australia
Prof Peter Klinken	WAIMR
Peter Leedman	WAIMR
Dr David Lovell	CSIRO
Ian Puddey	University of Western Australia
George Yeoh	University of Western Australia
Harvey Millar	ARC
Prof Barry Marshall	University of Western Australia, Nobel Prize Laureate
Owain Edwards	CSIRO
Wayne Thomas	Telethon Institute for Child Health Research
Miranda Grounds	University of Western Australia
Ian Constable	University of Western Australia
Kristen Nowak	WAIMR
Julia De Jong (for Joe Ostojich	Western Australia government
Lyn Beazley	former Chief Scientist, Western Australia
Ian Small	ARC
Mariapla Degli-Esposti	Lions Eye Institute
Mike Garlepp	Telethon Institute for Child Health Research)
Neil Lynch	Western Australia government
David Sampson	University of Western Australia

The meeting was held at Western Australia Institute for Medical Research, which is committed to establishing a Partner Laboratory Node upon completion of the new building. A consensus was reached that the top three strengths in the WA research community were: Population databases/ comparative genetics/epidemiology (including long term cohort studies, bioinformatics, datasets), genetic origins of disease and plant biology.

Other related strengths that were cited included: Imaging (AMMRF); Medical mathematics, including biostatistics; molecular characterisation of asthma; cancer genetics – childhood leukaemia, paediatric cancer; Vaccine trials; strong translation into plants/ ag; animal science, specific large animal studies, neuromuscular research; biotherapeutics; and biodiversity.

Brisbane Workshop: 27th August 2008

organised by Prof Mark Ragan

Attendees:

Dr Mark Morrison	CSIRO
Prof Mark Ragan	University of Queensland
Prof Nadia Rosenthal	Australian Regenerative Medicine Institute/EMBL
Prof David Siddle	University of Queensland
Silvio Tiziani	Australian Regenerative Medicine Institute, Monash
Prof Brandon Wainwright	University of Queensland

The meeting was held at the Institute for Molecular Bioscience, which is dedicated to the establishment of a Partner Lab Node, centred on a database "mirror" to the European Bioinformatics Institute. This node will ensure that bioinformatics in EMBL Australia can take on genome-wide and system-scale challenges, with a strong connection to experimental biology. Queensland is exceptionally strong in the bioinformatics space, housing the Queensland Facility for Advanced Bioinformatics (QFAB) providing advanced bioinformatics solutions to the biotechnology, pharmaceutical, clinical and research communities, including secure access to very large databases, specialist software, high-performance computing, data storage and integration technologies and expert services. IBM is involved with the consortium, as is the University of Queensland, whose new Queensland Bioscience Precinct is predicted to become one of the largest employers of specialists in computational biology.