

Conference Report:
Connecting Collections for a New Generation of Interdisciplinary Research
Scientific Collections International (SciColl)
Melbourne Museum, 2-4 February 2011
Melbourne, Victoria, Australia

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Executive Summary

The Melbourne Museum hosted 42 participants from 16 countries for a meeting on 2-4 February 2011 devoted to international and interdisciplinary cooperation among object-based scientific collections¹. The scope of the meeting covered a range of disciplines including: agriculture; anthropology; archaeology; biology; biomedicine; earth, environmental and space sciences; and ethnography. Participants included representatives of institutions and government agencies that share an interest in collections stored in permanent repositories for use as research resources. The meeting included a one and one half-day scientific symposium followed by a one day business meeting. The symposium focused on four research challenges to explore how scientific collections amassed by different disciplines could contribute to interdisciplinary research. The business meeting brought together representatives of countries and institutions that propose to launch [Scientific Collections International](#) (SciColl) as a global coordinating mechanism for collections.

During the symposium, researchers in four major research areas – human migration, climate change, emerging diseases and food security – presented findings based on the analysis of samples in diverse types of collections. Discussions focused on the unanticipated uses that collections can have other than those for which the specimens or material was originally collected. The key to identifying and profiting from these novel uses is to (1) create new, mutually productive interactions among research and collection specialists from different disciplines, and (2) increase the visibility and accessibility of collections over the web. The Natural History Museum, London, has pioneered the “London Collection Protocol”, a structured approach to identifying new uses of their collections for climate change research. Participants agreed that the Protocol could and should be applied to other research topics and collections and preliminary plans for doing so were discussed. The Australian National Insect Collection has created online access to specimen information and images for real-time use for agricultural pest control across many countries in the region.

The first formal SciColl business meeting was held with voting participants -- the representatives of four countries and four institutions that had submitted letters of intent to join SciColl. These representatives constitute SciColl's Interim Executive Board and they selected David Schindel (Smithsonian Institution) as Chair and Suzanne Miller (South Australia Museum) and Michel Guirud (Muséum National d'Histoire Naturelle, Paris) as Vice-chairs. Preliminary commitments by these four countries and four institutions represent approximately 50% of the funds needed to create a Secretariat Office and launch a program of work. Representatives of several other countries and institutions stated their intent to join SciColl in early 2012 when funds in a new fiscal year become available.

The Board agreed to continue the membership initiative and to add members to the Board as letters of commitment are received. The Board also significantly lowered institutional membership fees during the first three years of membership and clarified the basis on which institutions would be assigned to fee categories. OECD's Global Science Forum Secretariat is reviewing applications to host the Secretariat Office from the Smithsonian and the Royal Belgian Institute of Natural Sciences. A revised timeline was approved with a June 2011 deadline for letters of intent followed by formal commitments through a Memorandum of Understanding in August/September 2011 and a formal launch in early 2012.

Discussions resulted in a clarified three-year program of work for SciColl. Four activities will begin immediately as distributed activities: Climate Change (led by Natural History Museum London); Zoonotic Diseases (Fundação Oswaldo Cruz (Fiocruz), Rio de Janeiro), Food Security (Chinese Academy of Sciences), and Human Migration (Australia and New Zealand).

¹ Presentations given at the meeting are available online at <http://barcoding.si.edu/SciColl/scicoll.html>.

Background

SciColl is an initiative that has developed under OECD's Global Science Forum (GSF) with the goal of creating a global interdisciplinary coordinating mechanism for object-based collections. As used here "object-based collections" include specimens and samples in permanent archival repositories that cover the full range of scientific disciplines, including but not limited to anthropology, archaeology, biology, biomedicine, earth and planetary sciences, and applied fields such as agriculture, environmental science, and technology.

A Steering Committee (listed on the cover page of this report) has assembled [Terms of Reference](#) (ToR) that would create SciColl as an organization of member countries and institutions. The [first SciColl conference](#) was held in Brussels in February 2010 to discuss and improve the proposed mission, ToR, and workplan (see [conference report](#)). A proposal to create SciColl as a formal organization through a membership initiative was presented to and approved by GSF in April 2010. As of the time of the Melbourne conference, [letters of intent to join SciColl](#) had been submitted by four countries and four research institutions. Two applications to host a SciColl Secretariat had been submitted for review under GSF's supervision.

As stated in its ToR, SciColl's mission is to increase the return on investment that countries and institutions make in their scientific collections by:

- *Promoting a new generation of research on major challenges that can only be done through the use of scientific collections that are distributed across countries and disciplines; and*
- *Improving the management, operation, documentation, accessibility and use of collections in all disciplines by developing community standards, documenting and disseminating good practices, and catalyzing international and interdisciplinary collaboration.*

The Melbourne Conference brought together 42 representatives of 16 countries (see Appendix 1, participant list). The conference agenda (see Appendices 2 and 3) was designed to examine four complex research challenges with the goal of assessing how SciColl should pursue the first part of its mission – promoting interdisciplinary research that relies on collections. The conference participants were encouraged to contribute their ideas on priorities and strategies that should be embodied in SciColl's program of work for its first three years of operations.

Format and content of the Melbourne Conference

The Melbourne conference consisted of a one and one-half day science symposium (see agenda, Appendix 2) followed by a one day business meeting (Appendix 3). The science symposium included six sessions: four devoted to interdisciplinary research that relied on different types of collections; one session on examples of new ways to connect collections across disciplinary boundaries; and a plenary discussion devoted to identifying priorities and strategies for SciColl's first three years of operations.

The science symposium was followed by a one day business meeting devoted to the first formal interactions among prospective SciColl member countries and organizations. Discussions focused on SciColl's workplan and the process of securing the financial commitments needed to establish a Secretariat Office for SciColl and selecting the Secretariat host organization.

Science Symposium sessions 1-4: Using collections for interdisciplinary research

SciColl's mission is based on the premise that even though scientific collections are created and maintained primarily by and for specific research communities, they can have significant impact on other research areas. They also have considerable potential for application to real world problems

outside research. This cross-disciplinary impact is usually unplanned and can often be serendipitous (see Exhibit 1 for examples). During the symposium, Richard Lane presented a model program that has been piloted at the Natural Museum, London, for systematizing this strategy (see Exhibit 2 on the London Collection Protocol). These four symposium sessions explored the extent to which interdisciplinary use of collections can be planned and purposeful, and can become a standard research strategy.

- **Human Migration.** Lisa Matisoo-Smith (Univ. Otago, New Zealand) summarized research seeking to reconstruct the history of the settlement of Oceania, Melanesia and Polynesia. Researchers have used pottery decorations, linguistic similarities, and clustering of different mitochondrial DNA regions but the patterns found in these different lines of evidence are not concordant and they don't conform with many aspects of human morphology that supposedly have a common origin no more than 50,000 years ago, and less than 5,000 years ago in some cases (e.g., body stature, facial features, pigmentation among Taiwan, Indonesia, Polynesia and New Zealand). This discordance suggests a more complex history than a single eastward wave of migration. Lisa's research has focused on ancient mtDNA in chicken, dog and rat bones found in archeological sites. The assumption has been that these were early domesticated animals that were carried in ocean-going canoes during eastward expansion but haplotype clusters are discordant among the three animal groups, suggesting different histories of introduction.

Alan Cooper (Australian Centre for Ancient DNA, Univ. Adelaide) described the impact that ancient DNA was having beyond anthropological work like Lisa's. Next-generation sequencing technology is now making it possible to recover DNA data from increasing numbers of fossil bone and teeth, even the dental calculus found on fossil teeth. These data are shedding light on the introduction of species, the diet of ancient populations, and even the bacteria to which they were exposed. Thanks to these new gene sequencing technologies, anthropological collections are now relevant to research on agriculture, biomedicine, control of invasive species, and other fields.

Exhibit 1: Unanticipated Uses and Impact of Collections

Objects in scientific collections are preserved for use within that discipline but sometimes their greatest impact can be in another field of research. New and unanticipated uses for collections usually emerge from the application of new analytical techniques applied by specialists in other fields for reasons unrelated to their original purpose, such as:

- Obsidian tools are found in archaeological excavations and they're recollected to study the state of technological development of their users. X-ray fluorescence analysis done by geologists on the obsidian tools unveiled a chemical signature linking them to their volcanic source, providing new information on migration and trade among ancient peoples.
- Biological specimens are collected repeatedly over time in selected areas to monitor changes in species diversity and the composition of ecological communities. These longitudinal surveys now provide historical records of the build-up of ecotoxins that can be analyzed by environmental chemists using techniques such as neutron activation. Lichen collections in herbaria have been used to document increases in air-borne lead and tuna preserved in alcohol have provided data on mercury in the food chain.
- Surgical samples taken more than a century ago are providing DNA that is revealing the presence of bacterial and viral diseases. Researchers are using these samples and specimens in natural history collections to study the origins and spread of infectious diseases.

Exhibit 2: The London Collection Protocol

Specimens and samples are collected by investigators for specific scientific purposes but increasingly, new and unanticipated uses are being found. Ordinarily the discovery of these new uses for collections is a lucky accident, often involving new instrumentation or analytical procedures applied by strangers to the collections (see Exhibit 1). In 2010, the Natural History Museum, London (NHM) undertook the first-ever structured attempt by collection curators to predict and identify new uses by another field for their collections.

NHM researchers had been involved in climate change research by charting changes in the distribution of species over time, but they were interested in identifying possible new uses for the collections to help their climate change research. The NHM staff and administration created what has become known as the London Collection Protocol (LCP) to overcome traditional views on the limited use of collections by identifying new and unanticipated research impact they could have. The LCP conducted on climate change research by NHM was a structured analytical process that could be applied to other types of collections and research areas. The original LCP consisted of:

1. **Establishing the NHM baseline** of climate change research over recent years;
2. **Surveying other major museums** to identify and learn from efforts to redirect the use of existing collections into a new field of research;
3. **Conducting inreach meetings** to discuss LCP with NHM staff;
4. **Holding an external stakeholder meeting** between collection staff and outside researchers in climate change research to identify potential uses of the NHM's collections;
5. **Structured interviews** of NHM curators and researchers that identified parts of the collection that meet the criteria for new uses in climate change research;
6. **Documentation of targeted collections** by scoring quantitative descriptors of each collection and its potential impact on climate change research. These descriptors reflect suitability of each collection for use, such as:
 - a. Completeness of the sampling;
 - b. Completeness of sample data and metadata;
 - c. Degree to which samples have been or can be databased;
 - d. Applicability of modern analytical techniques (e.g., DNA sequencing);
 - e. Availability of comparable modern samples or data;
 - f. Potential for obtaining external funding; and
 - g. Presence of a specialist on NHM staff interested in the project.
7. **A pilot project(s)** on one of the highest-ranked collections to assess potential success;
8. **Expand focused curatorial and collecting efforts** by:
 - a. Prioritizing staff effort on climate change research;
 - b. Increasing online presence of relevant collections and their potential use;
 - c. Building linkages to databases of relevant collections in other museums;
 - d. Developing targeted collecting efforts to extend time-series by resampling;
 - e. Reviewing institutional policies on destructive sampling for research; and
 - f. Improving informatics systems to collect specimen data and deliver through online databases.

Lisa and Alan discussed some of the challenges that accompany these new uses of collections. Demand for access to fossil bone and teeth are increasing rapidly and new policies will be needed to govern destructive sampling and subsequent sharing of limited DNA samples and data. New protocols for specimen preservation will be needed to safeguard ancient DNA but who should support them? The anthropologists with stewardship over the collections or the DNA experts in other fields who want to use them?

- **Climate Change.** This symposium session built on presentations at SciColl's Brussels meeting on the direct physical evidence of paleoclimate provided by diverse collections (e.g., ice cores, ocean and lake sediment cores, tree rings, coral growth rings). The Melbourne symposium session focused on indirect evidence that could be gleaned from biological specimens in natural history museums and herbaria.

Greg Guerin (Univ. Adelaide) described the work of the Australian TRanssect for ENvironmental monitoring and Decision making (TREND). TREND is compiling biodiversity records from collections along terrestrial and marine transects and overlaying them with temperature and rainfall records. Climate change models predict how temperature and rainfall will shift, making it possible to predict changes in biodiversity patterns. These predicted changes have implications for agriculture, land use management, and species conservation. Herbarium records also provide direct evidence of change over the history of field collections by documenting changes in plant morphology, genetics, and flowering time (phenology) which reflects changing climate.

Warwick McDonald (Australian Bureau of Meteorology) discussed the National Plan for Environmental Information (NPEI) which includes observational data along many dimensions (physical, chemical, biological, even electromagnetism in space weather) as well as data drawn from scientific collections. NPEI's goal is to provide universal access to data that increase understanding of whole ecosystems in response to social needs. CSIRO hosts a longitudinal collection of air samples taken at Cape Grim since 1978, before interest in monitoring greenhouse gases arose. The Cape Grim samples illustrate how scientific repositories often have to foresee the needs of long-term research programs. It was noted in discussion that environmental monitoring that mandated by Australia's states can have a 24-30% taxonomic misidentification rate and no requirement to maintain voucher specimens. NPEI's approach parallels that of SciColl in relying on: baseline collections and data; standards to create interoperability across collection types, data mining across databases, and using new technologies on old specimens.

Greg and Warwick noted that the impact of distributional data on climate change research will require: (1) consistent taxonomy, (2) accurate species identifications, (3) consistent use of georeferencing systems, (4) the ability to access and aggregate records from different herbaria and jurisdictions, and (5) reducing the lag time between field collecting and public data release.

- **Emerging Diseases.** Graham Brown (Univ. Melbourne) spoke on the relationship among disease hosts, parasites, and the environment in which these relationships exist. Diseases represent a loss of equilibrium among them and the presentation explored what we might learn about the origins of this disequilibrium from scientific collections. The outbreak of cholera in Haiti provides an example of competing hypotheses concerning the source, route, and contributors to an outbreak. Was it simply an introduction from a foreign aid worker or was it a new host reservoir, or the shift to compromised water sources? Avian flu outbreaks may have come from the creation of open air markets where domesticated chickens were exposed to aquatic birds. The presentation explored different outbreaks of avian flu in human populations and how they support or refute this hypothesis of disease transmission. Historical collections of humans and

domesticated and wild animals can provide direct evidence of pathways. Tissue samples can reveal the presence of a parasite or pathogen, and blood serum samples can be used to document past exposure and immune responses to infectious diseases.

Graham noted the special challenges associated with using human samples for research. Medical care and public health programs produce extraordinary numbers of samples, far more than can be stored and made available for research. The same is true for personal collections amassed by researchers when they retire. Neither physicians nor public health organizations are required by law to retain samples. Which ones should be retained and what resources are available to support their long-term preservation in archival collections? Paraffin-embedded tissue samples may be retained at room temperature because they were fixed in formalin, but DNA is compromised by this preservation method. Permanent ultracold storage is needed to preserve DNA, increasing the costs significantly. Even if preserved, there may be ethical problems that limit their downstream use. Even if informed consent was granted when the sample was taken, use of the sample for other types of research not noted on the consent form may be prohibited.

- **Food Security.** Joanne Daly (CSIRO, Canberra) provided a review of the shifting balance between increasing demand for food (from increasing population, improved nutrition, waste) and our ability to increase supply (through increased use of fertilizers, pesticides, plant breeding and irrigation, and expanding land area used for agriculture). Biodiversity research can contribute in many ways, such as documenting wild relatives of crop species that can be used in plant breeding and identifying pest species and natural predators that can control them. Joanne argued that an ecosystem approach is needed, including more work on understudied taxonomic groups and habitats such as fungi, micro-invertebrates, and soil microbes. Future collecting efforts need to be driven by the demands of applied research rather than hypotheses of curiosity-driven projects. The data associated with these collections then need to be recorded in standardized ways (e.g., through DNA barcoding) and mobilized on a global scale through projects like the Global Biodiversity Information Facility (GBIF). This approach can be applied to the full range of collection types, not just traditional museum specimens. Research using these specimens in the context of other georeferenced data on weather, soil, water, and other factors will support study on optimization of crop yields. For example, Andy Jarvis has studied the distribution of the common bean plant relative to physiographic factors which, combined with climate model predictions, allowed projections of future distribution and the suitability of conditions. Distribution maps of drought-resistant varieties in germplasm collections suggest sources of material for future plant breeding.

Joanne pointed out the increasing diversity of collections that are being established to respond to these needs, such as Australia's national soil collection. Many others are proprietary industrial collections. Frozen soil samples are maintained by pharmaceutical companies that are bioprospecting in soil microbes. Sediment cores held by oil, gas and water companies hold information on natural aquifers. Data access and management can be the principal challenges in such cases.

Science Symposium session 5: Examples of new collection-based initiatives:

- **Climate Change Research.** Richard Lane (Natural History Museum, London) described the Museum's efforts to identify new uses of traditional museum collections that would benefit climate change research (see Exhibit 2, the London Collection Protocol). Participants agreed that LCP is an excellent starting point for SciColl's efforts to promote and facilitate interdisciplinary research use of diverse collections.

- **Biosecurity and Quarantine.** John La Salle (CSIRO) and Ken Walker (Melbourne Museum) described a web-based network of collections and agricultural inspection stations that is protecting countries from the introduction of agricultural pest species. The Remote Microscope system is connecting 45 research collections and agricultural inspection stations using digital cameras costing less than US\$400 each over Skype. This network enables border inspectors to show taxonomic experts images of unidentified specimens they have intercepted. The experts can then examine reference specimens at other participating nodes, allowing them to make identifications very rapidly. The system is self-improving because digital images of newly identified specimens are constantly being added to the [Pests and Diseases Image Library](#) (PADIL), a critical resource for the Remote Microscope network. The PADIL website had 1.4 million visitors in a four month period, of whom 86% were non-Australians.
- **Australian roadmap for collections and data.** Suzanne Miller (South Australia Museum) provided an overview of government funding for scientific collections in the framework of research infrastructure. The National Collaborative Research Infrastructure Strategy (NCRIS) provided AUS\$542 million in funding for major research infrastructure from 2004-2011 but scientific collections were not considered eligible for this support. “Powering Ideas”, a 2009 innovation policy document released by the Australian government led to a \$901million Super Science Initiative for 2009-2013. Australia’s “Strategic Framework for Research Infrastructure Investment” clarified the place of infrastructure in the Super Science Initiative and it included scientific collections under its definition of research infrastructure. Digitization of collections and biodiversity informatics are eligible to compete for support under the eResearch component of the Super Science Investment program.
- **Digitizing and integrating US collections.** David Schindel (Smithsonian) described two US initiatives. An interagency working group has focused on collections held by Federal government agencies and they issued a 2009 report² that argues for the value and impact of collections across the spectrum of scientific disciplines. The report called for the analysis of the costs related to maintaining and using collections; identification and dissemination of best practices in museum policy and management; and improvement in documentation of and access to collections. The report has been endorsed by the President’s Science Advisor and a recent Act of Congress.

The US National Science Foundation commissioned a strategic plan in 2010 for biological collections and created a new funding program designed around this plan in 2011. Advancing the Digitization of Biological Collections (ADBC) will provide \$20 million for the digitization of collections related to high priority research themes in 2011, as well as a central hub that will develop standards and tools for industrial-scale digitization. NSF hopes to continue this investment through annual competitions over ten years.

Recommendations for SciColl’s Program of Work

Suzanne Miller led a discussion that produced the following recommendations for SciColl’s program of work for the coming three years:

- 1) **Interdisciplinary Research.** SciColl should focus on four interdisciplinary research challenges:
 - a) **Climate change** including collections that bear on paleoclimate (e.g., biodiversity collections, tree and coral samples for dendrochronology, ice and sediment cores, samples for isotope

² Scientific Collections: Mission-critical Infrastructure for Federal Science Agencies;
<http://www.whitehouse.gov/sites/default/files/sci-collections-report-2009-rev2.pdf>

- analysis), ocean acidification (sediment cores, sediments, shells and bones for chemical and isotopic analysis), and other phenomena;
- b) **The origins and histories of zoonotic diseases**, which are the sources of the majority of human diseases, can be studied through samples in biomedicine, veterinary medicine, natural history museums, zoos, anthropology and paleontology;
 - c) **Human history and migration** which can draw on collections in anthropology, ethnology, archaeology, biomedicine, paleontology, and biodiversity (natural history museums and herbaria); and
 - d) **Food security** which would draw on resources such as: seedbanks, genebanks and other genetic resource centers; soil, water and other environmental samples; sediment cores, biodiversity, collections in archaeology, anthropology and ethnology; and agricultural, wildlife and livestock collections. Interdisciplinary research on food security would have important connections to social research in economics, geography, business and trade, political science, history and sociology;
- 2) **Organizational Strategy.** SciColl's strategy for promoting interdisciplinary research should follow the model created by the London Collections Protocol for bringing collections-based researchers within fields together with users from other fields. In doing so, SciColl's goals should be to create:
- a) Dialogue about the information content of collections and their databases;
 - b) Shared vocabularies and social networking capabilities, i.e., a Facebook for participants in collections-based research;
 - c) Opportunities for continuing interactions through SciColl workshops and networking activities such as those of the International Quaternary Association, and physical gathering places like 'synthesis centers' funded by NSF in the US;
 - d) Shared online workspaces for data exchange and collaboration similar to ScratchPads (<http://scratchpads.eu/scratchpad-taxonomy>) in the biodiversity community; and
 - e) Addressing obstacles to access to collections across disciplines and promoting collaborative, non-competitive relationships among researchers needing access to the same collections;
- 3) **Approach to Networking.** SciColl should build its interdisciplinary international network in several ways:
- a) SciColl's member countries should identify lead agencies which would pursue their priority interests within the selected four research areas;
 - b) SciColl's member institutions would develop linkages to similar institutions and collections and potential users of collection data within their respective countries and disciplines;
 - c) SciColl's Secretariat would reach out to and coordinate with international organizations such as the World Health Organization (WHO), the Intergovernmental Panel on Climate Change (IPCC) and diverse large-scale research initiatives such as the Integrated Ocean Drilling Program (IODP) and the Global Earth Observing System of Systems (GEOSS); and
 - d) SciColl's Secretariat would organize workshops and symposia that would utilize and expand the London Collection Protocol to bring together collections specialists and potential research users in the three selected research areas.

- 4) **Digital Access.** Facilitating the creation of online collection descriptors, ontologies and locator systems to enable researchers to learn about and find relevant collections across disciplines. These systems would complement online databases of samples and specimens. Creation of higher-level descriptors and locator systems can create a foundation for specimen/sample digitization in fields without traditions of extensive collection databases (e.g., archaeology, ethnology, public health);
- 5) **Links to Social Sciences.** Brokering the involvement of relevant social sciences such as economics, sociology and history;
- 6) **Promoting Best Practices.** SciColl could provide valuable services to its members in addition to promoting new interdisciplinary research by collecting, evaluating, disseminating and promoting discussion on:
 - a) Practical information and best practices on:
 - i) Collection management;
 - ii) New approaches to informatics new technologies, and new types of collections such as frozen DNA banks;
 - iii) Specimen/sample preservation;
 - iv) Documenting and digitizing collections; budgeting, business models and sustainability of collections; and
 - v) Organizational models such as centralized versus distributed collections;
 - b) Procedures for evaluating the research importance, physical condition, and level of documentation of a collection, and approaches to setting priorities for improving collections based on evaluations;
 - c) Policy issues such as:
 - i) Ethical use of collections;
 - ii) Destructive sampling;
 - iii) Regulation of access to collections;
 - iv) Sharing benefits stemming from the use of collections; and
 - v) Repatriation of specimens/samples and their associated data;
 - d) Policy guidelines on how to manage 'orphaned' collections and small valuable collections including orphans; and
 - e) 'Success stories' that illustrate the impact of scientific collections on research and society.

Business meeting, Thursday, 3-4 February 2011

The Science Symposium was followed immediately by a one-day business meeting (see agenda, Appendix 3). The business meeting was attended by representatives of the four countries and four institutions that had submitted letters of intent to join SciColl:

- Australia
- Belgium
- Spain
- United States
- Muséum National d'Histoire Naturelle, Paris
- Fundação Oswaldo Cruz (Fiocruz), Rio de Janeiro
- A consortium of Spanish museums under CSIC led by Museo Nacional de Ciencias Naturales, Madrid
- Biodiversity Research Center, Academia Sinica, Taipei

The meeting was also attended by a representative of OECD's Global Science Forum and observers from countries and institutions that hope to join SciColl within the next year, pending decisions on budgetary allocations (see participant list, Appendix 4).

1. **Status reports.** Members of SciColl's Steering Committee provided reviews of:

- ***SciColl's history*** of development, including Steering Committee meetings, the Brussels international conference, and an initiative to obtain letters of intent to join SciColl. Prior to the Melbourne Conference, all SciColl activities have been organized by the Steering Committee;
- ***Progress toward SciColl's official launch.*** The ToR specifies that the official launch of SciColl as a member organization would take place when financial commitments from prospective member countries and institutions reached €500,000 per year for a three year period, the projected operating budget for an implementation period. OECD's Global Science Forum has received eight letters of intent to join SciColl which represent commitments of approximately €200,000 per year for a three year period. Representatives of several countries and institutions stated their hope to join SciColl in early 2012 contingent on the success of their requests for financial commitments in the new fiscal year;
- ***SciColl's Terms of Reference*** which designated this business meeting as the point at which an Interim Executive Board (IEB) would be created. SciColl is therefore in a transition phase between planning and formal international agreements among its members. Participants agreed that the activities of the Steering Committee should continue, especially the membership initiative, with input from the IEB. Formal decisions would be made by the IEB; and
- ***Selection of the host organization for SciColl's Secretariat Office.*** Frederic Sgard (OECD Global Science Forum, GSF) reported that the Royal Belgian Institute of Natural Sciences (Brussels) and the Smithsonian Institution (USA) had submitted applications to host SciColl's Secretariat Office. GSF will convene an independent panel to review the applications and submit its recommendations to the IEB. Participants noted that since SciColl could probably not be launched formally until 2012, other institutions may be able to submit host applications. Participants agreed that the GSF review panel could decide to re-open the call for applications in order to consider a broader selection of options for the Secretariat host.

2. **Program of Work.** Participants reacted enthusiastically to the proposed focus on four major global research challenges. For each research challenge, a prospective SciColl member stated its desire to organize an international conference and/or lead that component of the program of work.
- Global climate change and ocean acidification: The Natural History Museum London proposed to expand its use of the London Collection Protocol as a process for re-thinking the use of collections and a standard approach for future SciColl meetings. They would include diverse components of global change such as pollutants, nitrogen levels, PCBs, ecotoxins, and other anthropogenic effects. There are programs of sentinel environmental monitoring sites for longitudinal studies and their relationship to collections needs to be established. There will be a Diversitas “Planet Under Pressure” conference in London in March 2012 that could have a SciColl component.
 - Food security: The Chinese Academy of Sciences proposes to use the London Collections Protocol to bring together collection and researchers using an ecosystem approach. They will explore planned conferences on food security sponsored by the World Bank, IMF, UNEP, and private foundations with which SciColl could partner. of user communities such as: plant breeding; climate models; biosecurity and quarantine; sustainable farming practices; soil types; marine pests, fisheries, aquaculture, and the impact of climate change on fisheries; food safety, long-term studies of ecotoxins; genetic diversity of fish stocks and the impact of over-harvesting; and the impact of green agriculture on ecosystems.
 - The causes and effects of human migration: Australia and New Zealand propose to create a social network for information exchange on human migration research with the goal of assembling material on best practices for: sharing samples and data; specimen preservation techniques; policies on ethical research practice, access and benefit sharing; and cooperation with researchers in arts, humanities and social sciences. They propose to engage the Consortium of Australian and New Zealand Museum Directors in this initiative.
 - Zoonotic diseases and human health: Institute Fiocruz, Brazil proposed to organize a SciColl conference on this topic which would integrate diverse types of collections.

The IEB and observers discussed the degree to which SciColl’s program of work should address improvement of collection practices and creation of an information clearinghouse, as recommended by participants in the Science Symposium. There was general agreement that promoting research is a higher priority, especially during the process of attracting more members and establishing the Secretariat office. Creating and maintaining a registry of collections would require long-term sustainability that SciColl will not have for several years. It is possible that a wiki-based system for collecting information can be created on SciColl’s website. This would enable communities to contribute information on collections, best practices and assessment techniques as a side-benefit of SciColl’s conferences and research initiatives. Initial plans include hiring a project officer for management issues starting half-time in year 3. If data accumulate and appear useful to SciColl members this priority can be reassessed and support for this function can be sought.

3. **Next Steps.** Participants agreed that:

- a) The Interim Executive Board should receive and review the recommendations of the GSF panel for the Secretariat host, while considering the possibility of re-opening the call for applications if neither application was considered optimal;
- b) The Steering Committee, in consultation with the IEB, should continue the membership initiative. The IEB should draft a letter to government ministries highlighting the research focus

of the program of work and calling for letters of intent to join SciColl. A new representative would be added to the IEB when a country or institution submits a letter of intent to join SciColl to the Global Science Forum. Participants agreed that SciColl's goals and program of work would be much more focused as result of the Melbourne conference and that this would attract members;

- c) The IEB should refine the ToR to reflect input provided during the Melbourne conference, especially concerning SciColl's emphasis on promoting new interdisciplinary research;
- d) The IEB should develop the Memorandum of Understanding with financial commitments that SciColl's members would sign prior to the formal launch;
- e) The IEB should update the timeline leading to SciColl's formal launch; and
- f) The IEB will decide, based on receipt of letters of intent and associated financial commitments, when to ask prospective member countries and institutions to make formal commitments by signing the MOU.
- g) The IEB, with GSF's assistance, should contact countries and institutions that have submitted letters of intent to determine if the offer of membership contributions are time-limited.

4. **Actions of the Interim Executive Board.** Representatives of the four countries and four institutions that have submitted letters of intent elected the following officers of the IEB:

- Chair: David Schindel (USA), and
- Vice-chairs: Suzanne Miller (Australia) and Michel Guiraud (Muséum National d'Histoire Naturelle)

5. **Membership Categories.** Participants noted that the two criteria in the ToR for different categories of institutional members (operational budget and number of staff members) could give conflicting results. For example, an institution in a developing country or an emerging economy could be assigned to a larger category based on its staff size than its operating budgets. There was general agreement that the ToR should be refined by specifying:

- Only the staff size and operating budget related to collections operations would be considered in choosing an institution's membership category. Its research staff size and budget would not be counted; and
- If staff size and operating budget place an institution in different categories, operating budget will be the deciding factor.

The Steering Committee has received inquiries from potential member consortia of institutions. Some potential consortia include groups of similar institutions with shared interests and others seemed like heterogeneous institutions that want to share the cost of membership. Opinions varied on whether SciColl should analyze and restrict the basis on which consortia formed. There were several suggestions for placing consortia in membership categories based on their operating budgets (their sum, arithmetic mean, and geometric mean) but no consensus emerged. The IEB will consider creating a separate schedule for membership contributions by consortia.

6. **Membership Initiative and Contributions.** Participants agreed that attracting members is the highest priority for the Steering Committee. Participants discussed the strategy to rely on national contributions for the first three years of operation and then transition to reliance on institutional contributions thereafter, assuming that SciColl provided valuable returns to member institutions. Members of the Steering Committee stated that large institutions were not willing to join because

the financial commitment seemed too high for an organization that had not demonstrated its impact yet. Potential country members had not expressed concern about the levels of requested financial commitment. Some countries were delaying submission of their letters of intent to give their budget approval processes time to work.

There was general agreement that the financial commitments being asked of institutions should be reduced significantly, with the understanding that institutions would be asked to pay more after three years if SciColl proved to be valuable to them. The IEB approved reductions of institutional contributions in the ToR to:

- €10,000 per year for large institutions (as defined in the ToR);
- €5,000 per year for medium-size institutions;
- €2,500 per year for medium/small-size institutions; and
- €1,000 per year for small institutions.

7. **Operating Budget.** Participants briefly reviewed the projected operating budget. Some members of the IEB felt that the proposed salary for the Executive Director is too high. Others felt it is appropriate to pay a high salary to attract a senior leader who can produce results during the three year implementation phase and would be willing to relocate without the security of a long-term position. The possibility that the host institution would share the costs of the Executive Director was discussed. Participants agreed that some clarification is needed as to whether the projected budget figures include salary and fringe benefits (e.g., health insurance, contributions to retirement) or just salary. No actions or decisions were proposed.

8. **Timeline.** Participants supported the following milestones for the coming months:

- 1 March 2011: Completion of a draft report of the Melbourne conference and meeting report and a short document to be used in the membership initiative;
- March 15 2011: IEB will begin to develop scenarios for SciColl's start-up with different levels of support below the €500,000 per year needed for a full launch of SciColl. Scenarios will consider phased start-up of Secretariat functions, delayed creation of the Secretariat, launch of program of work using volunteer efforts by members, and other options;
- 1 April 2011: Submission of a progress report to the GSF meeting;
- Mid-April 2011: IEB will receive and consider recommendations of the GSF panel for the Secretariat Office host institution;
- Mid-April 2011: IEB will reassess status of financial commitments by potential members and will select a strategy for starting SciColl activities with less than full funding;
- 1 May 2011: MOU will be ready for signature by member countries and institutions;
- 1 June 2011: New deadline for submission of letters of intent to join SciColl; and
- July and August: MOU available for signature by member countries and organizations

Appendix 1: List of Science Symposium Participants

| | | |
|-------------------------|--|---------------------|
| Bray, Diane | Melbourne Museum | Australia |
| Brown, Graham | Nossal Institute for Global Health | Australia |
| Cooper, Alan | Univ. Adelaide Australian Centre for Ancient DNA | Australia |
| Daly, Joanne | CSIRO | Australia |
| Guerin, Greg | Univ Adelaide, Australian Centre for Evolutionary Biology | Australia |
| Henry, Dermot | Melbourne Museum | Australia |
| Jones, Di | West Australia Museum | Australia |
| La Salle, John | CSIRO | Australia |
| Liau, Lian | Pathology Museum, University of Sydney | Australia |
| McDonald, Warwick | Bureau of Meteorology | Australia |
| Miller, Suzanne | South Australia Museum | Australia |
| Pillman, Stuart | South Australia Museum | Australia |
| Slyater, Cameron | DIISR | Australia |
| Walker, Ken | Melbourne Museum | Australia |
| Wallis, Ely | Melbourne Museum | Australia |
| Grootaert, Patrick | Royal Belgian Institute of Natural Sciences | Belgium |
| da Silva, Manuela | Fundação Oswaldo Cruz (FIOCRUZ) | Brazil |
| Queiroz, Dalva Luiz de | Embrapa Florestas | Brazil |
| Zhu, Chaodong | Chinese Academy of Sciences, Institute of Zoology | China |
| Archambeau, Anne-Sophie | GBIF France | France |
| Guiraud, Michel | Musée National d'Histoire Naturelle | France |
| Sgard, Frédéric | OECD Global Science Forum | France |
| Häuser, Christoph L. | Museum für Naturkunde | Germany |
| Matsuura, Keiichi | National Museum of Nature and Science | Japan |
| Suzuki, Kenji | MEXT | Japan |
| Kim, Dong Hee | Ministry of Education, Science and Technology | Korea (Republic of) |
| Kim, In Hee | Ministry of Education, Science and Technology | Korea (Republic of) |
| Paek, Woon-Kee | Ministry of Education, Science and Technology | Korea (Republic of) |
| y | Naturalis Museum | Netherlands |
| Buchanan, Peter | Landcare Research | New Zealand |
| Matisoo-Smith, Lisa | University of Otago | New Zealand |
| Simes, John | GNS Science | New Zealand |
| Szrek, Piotr | Geological Institute of Poland | Poland |
| Manrique Reol, Esteban | National Museum of Natural Sciences (MNCN) - CSIC (Spanish Research Council) | Spain |
| Peñacoba, Maria Luz | National Museum of Natural Sciences (MNCN) - CSIC (Spanish Research Council) | Spain |
| Uruñuela, Ana | National Museum of Natural Sciences (MNCN) - CSIC (Spanish Research Council) | Spain |
| Rundgren, Linnea | Sewden Museum of Natural History | Sweden |
| Yang, Man-Miao | National Chung Hsing University | Taiwan |
| Lane, Richard | Natural History Museum London | UK |
| Bart, Hank | Tulane University | USA |
| Rios, Nelson | Tulane University | USA |
| Schindel, David | Smithsonian Institution | USA |

Apenpdix 2: Science Symposium Agenda

Connecting Collections for a New Generation of Interdisciplinary Research

Wednesday February 2, 2011

09:00 Coffee and registration

Welcome and introduction

09:30: Welcome by the Australian host and housekeeping issues: Suzanne Miller, South Australian Museum and Conference Co-chair

09:40: Introduction and discussion about the workshop background, aims and expected outcomes: David Schindel, chair of SciColl steering committee

Science symposium session 1: Interdisciplinary use of collections for research on human migrations and environmental change

10:00: Overview: “Identifying the origins of peoples and their commensal plants and animals in order to better understand the settlement, history and prehistory”: Prof. Lisa Matissoo-Smith, Prof. Of Biological Anthropology, University of Otago, New Zealand.

10:20: Presentation of collections-based research: Prof Alan Cooper, Head of the Australian Centre for Ancient DNA

10:40: Discussion and possible impact on SciColl programme of work

11:00: Coffee break

Science symposium session 2: Interdisciplinary use of collections for research on climate change (The need for integrated global data in the role of understanding scales of climate change)

11:30: Presentation of collections-based research: Dr Greg Guerin, Australian Centre for Evolutionary Biology

11:50: Presentation on potential use of additional types of collections: Dr Warwick McDonald, Head of the National Plan for Environmental Information, Australian Bureau of Meteorology

12:10: Discussion and possible impact on SciColl programme of work

12:30: Lunch

Science symposium session 3: Interdisciplinary use of collections for research in emerging diseases

13:30: Presentation on “Host-parasite-environment: What might we learn from the past?”: Prof. Graham V Brown, Nossal Institute for Global Health

14:10: Discussion and possible impact on SciColl programme of work

Science symposium session 4: Interdisciplinary use of collections for research on food security

14:30: Presentation of collections-based research: Dr Joanne Daly, CSIRO, Australia

15:10: Discussion and possible impact on SciColl programme of work

15:30: Coffee/tea break

16:00: Open discussion of interdisciplinary research priorities for SciColl’s Program of Work

17:00: Adjourn

18:00: Conference dinner, Museum Victoria

Thursday February 3, 2011

09:00: Coffee-Registration

Science symposium session 5: Connecting collections

09:30: Connecting biodiversity collections in Australia – new technology: John La Salle, CSIRO and Conference Co-chair, and Ken Walker, Museum Victoria

10:00: Australian Roadmap for data intensive networks: Prof. Suzanne Miller, South Australian Museum

10:20: London Natural History Museum initiative: Prof. Richard Lane, Natural History Museum London

10:40: Connecting collections in the US: Dr. David Schindel, Smithsonian Institution

11:00: Coffee/Tea break

Science symposium session 6: Conclusions

11:30: Open discussion of recommendations and decisions to SciColl Leadership on Research Problems and building them into the SciColl work plan

13:00 Lunch

Appendix 3: Business Meeting Agenda

SciColl Interim Executive Board and prospective SciColl members

Thursday February 3, 2011

Business meeting session 1

| | |
|-------|---|
| 13:45 | <ul style="list-style-type: none">- Introduction of participants (tour de table)- Status of membership initiative and process of launching SciColl: David Schindel, Smithsonian Institution- Discussion of priorities for SciColl programme of work for 2011-2012 |
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15:00 Coffee break

Business meeting session 2

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|-------|---|
| 15:30 | <ul style="list-style-type: none">- Review of proposed SciColl Terms of Reference and governance: Christoph Häuser, Berlin Museum- Discussion of proposed governance model |
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17:00 Adjourn

Friday February 4, 2011

08:30 Coffee

Business meeting session 3

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|-------|---|
| 09:00 | <ul style="list-style-type: none">- Selection of the Chair of the Interim Executive Board - Status of selection of Secretariat host: Frédéric Sgard, OECD Global Science Forum- Discussion of proposals and timeline for Secretariat host- Discussion of financial commitments and operating budget- Elements to be included in the future Memorandum of Understanding |
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10:30 Coffee break

Business meeting session 4

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| 11:00 | <ul style="list-style-type: none">- Review of potential priorities from Business Session 1- Discussion of strategy for launching SciColl- Agreement on next steps, next meeting, communication strategy and timeline leading to launch of SciColl |
|-------|---|

12:30 Conference ends

Appendix 4: Participants and observers, SciColl Business Meeting 3-4 February 2011

The following participants were representing countries and institutions that have submitted to OECD letters of intent to join SciColl:

- Australia: Cameron Slayter (DIISR), Suzanne Miller (South Australia Museum), and John La Salle (CSIRO), Diana Jones, Western Australia Museum);
- Belgium: Patrick Grootaert (Royal Belgian Institute of Natural Sciences);
- Spain and a consortium of institutions under National Research Council CSIC: Esteban Manrique Reol, Ana Uruñuela and, Maria Luz Peñacoba (National Museum Natural Sciences of the National Research Council, CSIC);
- United States: David Schindel (Smithsonian Institution);
- Biodiversity Research Centre of Academia Sinica, Taipei: Man-Miao Yang;
- Institute Fiocruz, Brazil: Manuela da Silva; and
- Muséum National d'Histoire Naturelle, Paris: Michel Guiraud.

Frederic Sgard, OECD Global Science Forum, was present as a resource person and facilitator. Also present were observers from countries and institutions that hope to join SciColl within the next year, pending decisions on budgetary allocations:

- Brazil: Dalva Luiz de Queiroz (Embrapa);
- Germany: Christoph Häuser (Museum für Naturkunde, Berlin);
- Korea: Dong Hee Kim, In Hee Kim, and Woon-Kee Paek (Ministry of Education, Science and Technology);
- New Zealand: Peter Buchanan (Landcare Research) and John Simes (GNS Science)
- Chinese Academy of Sciences: Chaodong Zhu (CAS Institute of Zoology);
- Japan: Ken Suzuki (MEXT) and Keichi Matsuura (National Museum of Nature and Science);
- CollectionsWeb, a consortium of US museums: Hank Bart (Tulane University);
- Museum of Natural History London: Richard Lane;
- Netherlands National Centre for Biodiversity and Naturalis Museum: Christiane Quaiser;
- Geological Institute of Poland: Piotr Szrek
- Swedish Museum of Natural History: Linnea Rundgren