BUILDING THE BIODIVERSITY MACROSCOPE IN BOLIVIA: A COLLABORATIVE RESEARCH NETWORK FOR DNA BARCODING AMONG THE NATIONAL COLLECTION OF FAUNA, THE NATURAL HISTORY MUSEUM ALCIDE D'ORBIGNY AND THE NATIONAL MUSEUM OF NATURAL SCIENCES OF ARGENTINA.

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Administration of the funds: Fundación IBYME[1]

Introduction

DNA barcodes are short sequences from a standardized segment of the mitochondrial genome (typically 648 bp of the COI gene in animals) used for species identification and discovery (Hebert et al. 2003a,b). This technology is enabling the study of biodiversity at a global scale, and has been compared with a "macroscope" for the exploration of large scale patterns of Life on Earth (Ausubel 2009).

The Barcode of Life activities have had a catalytic effect in biodiversity research in Argentina since their inception in 2005. The main reason for this is that the success of the project to barcode the birds of Argentina, which was possible mostly due to two grants from the Lounsbery Foundation, convinced the authorities of the National Research Council (CONICET) about the relevance of DNA barcoding and encouraged them to get involved at a larger scale. As a consequence, Argentina was one of the first countries to confirm its participation in the International Barcode of Life project (iBOL) and the authorities of CONICET decided last year the upgrade of Argentina to a Regional Node of this project. This implies a significant increase in the investment on barcoding activities and an active role in the coordination and facilitation of the development of the project in other countries of the Neotropical region (particularly in the southern Neotropics).

Based on the ongoing collaboration between the National Museum of Natural Sciences of Argentina (MACN) and Bolivian institutions (in the context of the project to barcode the birds of Argentina and neighbouring countries), and taking into consideration this new regional role of Argentina and the immense potential of DNA barcodes for the study of the rich Bolivian biodiversity, we would like to expand the barcode activities in Bolivia and create a strategic network of collaboration among researchers and natural history institutions of both countries, including the participation of colleagues and institutions from abroad. This expansion will continue the successful collaboration around the Birds of Bolivia, and also incorporate new groups of animals.

Bolivia is currently suffering a wave of political unrest because of the policies of the Central government and the resistance of other sectors to their implementation. In fact, the richer southern and eastern departments are claiming more political and economic freedom from the Central government. This situation complicates the organization of the country in relation to diverse aspects and the scientific system is not an exception. In this context, we consider that

[1] **Aclaratory note:** The request and administration of funds is made through the Fundación Instituto de Biología y Medicina Experimental (IBYME), because it allows us to keep the administrative costs of the grant low (like in the two previous R. Lounsbery's grants). The Fundación IBYME belongs to one of the most prestigious research institutes of Argentina (IBYME http://www.ibyme.org.ar/), created by the first Argentine Nobel laureate in Medicine, Dr. Bernardo Houssay. This foundation is authorized by the National Reseach Council of Argentina (CONICET) to manage money from grants of the researchers and Institutes. The Fundación IBYME is very well known in the Argentine research community because of its efficiency and reliability.

the expansion of collaborative barcoding activities in Bolivia will not only boost the Barcode of Life project in this country (and help its advancement in the Neotropics), but will also help the people of the region by building scientific capacity and a regional network for biological research. In relation to this, the expansion of a collaboration between Argentina and Bolivia is facilitated by the fact that both countries share the same culture and a common history, and relationships between them have always been very good. Finally, the governments of both countries have developed similar policies in relation to the possibility of moving specimens through borders, which also facilitates an interaction in the context of the Barcode of Life project.

Achievements based on the two previous Lounsbery Foundation grants

Before depicting the project related to expanding the barcode activities in Bolivia, it is relevant to describe the achievements of the project to barcode the birds of Argentina, which started in 2005 and was possible mostly due to two grants from the Lounsbery Foundation received in 2006 and 2008.

As a result of this project 3200 DNA barcodes from about 700 bird species from the Southern Neotropics have been generated (mostly from Argentina but also some from Bolivia). This set of barcodes represents around 20% of the bird barcodes obtained so far, a figure that clearly shows the importance of this project in the context of the All Birds Barcoding Inititative. Moreover, this dataset constitutes the first large scale set of barcodes from Neotropical vertebrates, and as such also relevant for diverse studies of evolutionary patterns in the region and in the American Continent in general.

In addition, this project allowed us to undertake several collecting trips and generate a collection of fresh bird tissues in the MACN that is unique to the region, both because of its size (more than 5500 specimens from 730 species, the third largest in Latin America, Stoeckle & Winker 2009) and because virtually all of the samples have an associated voucher (a study skin or a skeleton), which is very important because it allows to check the identity of each specimen if it is necessary. Of course, this collection of tissues and vouchers is precious not only in the context of the barcoding project, but also because it generates an extremely valuable resource for future research in the region. In fact, we have published not only the article related to the first 500 barcodes of the birds of Argentina (Kerr et al 2009, PLOS ONE 4(2):e4379), but also articles related to deeper studies of interesting cases flagged by the barcodes (Sanin et al. 2009, Molecular Phylogenetics and Evolution 53:547-555; Campagna et al. 2010, Molecular Ecology Resources 10:449-458). Other manuscripts related to the analyses of species or groups of species that the project highlighted as worthy of deeper study are in preparation or have been recently submitted.

The project also allowed the training of human resources and the building of infrastructure and capacity in the MACN. In relation to the former, we can mention that 1) several PhD theses and postdoc projects are being carried out by students of the Ornithology Division of the MACN in the context of this project; 2) several students were trained in molecular techniques at the BIO-CCDB (one student per year); 3) we organized the First ABBI Neotropical Working Group Meeting in 2007 at MACN, in which more than 50 researchers from around the globe (most of them from Latin America) started to plan how to barcode the birds and fishes of the Neotropics, and 4) we organized two Leading Labs Workshops in 2009 and 2010, which were taught by us and instructors from the BIO-CCDB, and in which around 50-60 students and researchers from Argentina and other Latin American countries were trained in barcoding, including the entire range of activities from collecting tissues to analyzing barcode data (in particular, three researchers from Bolivia attended these workshops). In relation to the building of infrastructure, we were able to assemble a molecular laboratory in the Ornithology Division of the MACN, which is relevant not only for this project, but also for future molecular research (in particular related to the interesting cases flagged by the barcodes).

Finally, and as mentioned above, the project also started a collaboration with Bolivia to barcode its avifauna. Three field trips were already undertaken in collaboration with Isabel Gómez, the curator of birds at the Colección Boliviana de Fauna. As a consequence, she was able to start the first bird fresh tissue collection of the country. These field trips of course also

contributed a few hundreds of barcodes to the project and several new species (some of which are not even present in Argentina), and were an initial successful step towards a large scale project to barcode not only the birds but also other representatives of the fauna of Bolivia. This expansion started to fluorish during the last Leading Labs workshop, which took place in May 2010 and included two researchers from Bolivia (Kazuya Naoki, from the Colección Boliviana de Fauna and Arturo Muñoz Saravia from Museo de Historia Natural Alcide d'Orbigny; Isabel Gómez had already participated in the previous edition of the workshop in 2009), who were not only trained in barcoding activities, but also started to process samples of birds, amphibians and ants to be barcoded. If this expansion of barcoding activities in Bolivia is to become a reality, it is essential to generate a network of researchers and to undertake several field trips in the country, the two key aspects of the present proposal.

The strategic value of Bolivian megadiversity

Bolivia is a Mediterranean country of about 1,098,581km^2 located between the tropic of Capricorn and the Equator. The country has a varied landscape divided in ten different ecorregions that conform a complex mosaic (Herzog et al. 2005, see Fig. 1). Bolivia's biodiversity is astounding and comparatively less well known than those of other countries in the region. It has more than 20,000 species of seed plants, 652 species of freshwater fishes, 254 amphibians (60 endemics), 306 reptiles (29 endemics), 1415 birds (14 endemics) and 389 species of mammals (at least 17 endemics). The number of invertebrate species is still undetermined but certainly very high (e.g. Bolivia is the fourth richest country in terms of the number of butterfly species). It is very important from Bolivia's standpoint to develop new biological collections aimed to identify the species present in the country and their variation, and many new species are waiting to be described. Clearly, this is an ideal situation for the application of DNA barcodes to aid in both the identification of already known species and the discovery of new ones. It is also an ideal situation for the expansion of local collections and the introduction of modern collecting standards that include the preservation of barcode compliant materials (tissues and their associated vouchers).

The development of barcode studies in Bolivia will also be strategic as a complement to barcode studies in Argentina, because these countries share species and this collaboration will allow studying genetic variation over an extended geographical range and attacking interesting taxonomic problems, such as the evolutionary history and taxonomic status of disjunct populations of species present in both countries. In fact, several cases of population structuring were already unveiled by our ongoing collaboration with Bolivian researchers, which is responsible for the generation of barcodes from 120 Bolivian species so far. The most typical situation is that of species with disjunct ranges in Bolivia and Argentina showing deep divergence in their DNA barcodes. Such is the case of the Red-crowned Ant-tanager, *Habia rubica*, which shows more than 7% of divergence in DNA sequence and also variation in other phenotypic characters (e.g. plumage), suggesting that a taxonomic revision is needed. Other interesting cases include: a) the Large-headed Flatbill, *Ramphotrigon megacephalum*, with almost 7% divergence between specimens from Bolivia and Misiones in Argentina; b) The Plain Xenops, *Xenops minutus*, which also shows high differentiation between the birds from Bolivia and Misiones (around 5.5%); and c) the Grayish Saltator, *Saltator coerulescens*, which shows virtually no genetic structure in Argentina but more than 3% divergence between Argentinian and Bolivian populations. Finally, the Bolivian dataset provided a new case of species that share barcodes and therefore cannot be differentiated by the barcode methodology. These species are the Blue-gray Tanager (*Thraupis episcopus*) and the Sayaca Tanager (*T. sayaca*). This is a case that we intend to further analyze in the near future. In addition, the geographic position of Bolivia also allows more comprehensive comparisons about patterns of barcode variation among temperate, subtropical and tropical species, an approach that we have already started by comparing the dataset of the birds of Argentina and North America.

In brief, the implementation of a large scale barcoding project in Bolivia will be beneficial for this country in different ways, including social and scientific aspects, and it will also help considerably to advance with barcoding the Neotropical fauna. In particular, we plan to develop a network of Bolivian and Argentine researchers and institutions, expanding the momentum that DNA barcoding is gaining in Argentina.

The Argentine experience with DNA Barcoding, its current role as a Regional Node of the iBOL project and the participation of Bolivia in the international Barcode of Life community

The involvement of Argentina in DNA barcoding dates back to the creation of the Consortium for the Barcode of Life in 2004. One year later, during the first International Barcode of Life Conference in London, the first two global barcoding campaigns were launched -the All Birds Barcoding Initiative (ABBI) and the Fish Barcode of Life (FISHBOL)- and Argentina became an active participant in both of them. The MACN has taken the leading role in the barcode of the birds of Argentina. More recently, the MACN also got involved in the campaign to barcode the bees of the world (BEEBOL). The success of Argentina's involvement in barcode activities convinced the National Research Council (CONICET) to support the iBOL project. In 2008 CONICET signed the Memorandum of Understanding to became a National Node of the iBOL and created the iBOL Argentina Fund to support the collection of barcode compliant materials (samples and their associated vouchers). Currently, this fund is supporting 40 small projects on vertebrates, invertebrates, plants and fungi and most of the samples and vouchers are being deposited at MACN. The Museum also hosts the Leading Labs Training Workshop for DNA barcoding that is being taught annually to Argentine researchers that are awarded with the iBOL Argentina Fund. In 2009, CONICET's vice-president of technology joined the iBOL Board of Directors and CONICET approved Argentina's change of status to Regional Node of iBOL, which implies a significant increase in the investment on barcoding activities and an active role in the coordination and facilitation of the development of the project in other countries of the Neotropical region (particularly in the southern Neotropics, see below). In addition, Argentina is one of the countries participating in the IDRC grant "Engaging Developing Nations in the International Barcode of Life Project", aimed to develop the barcode reference libraries of species with the greatest socio-economic and environmental importance in a small group of developing countries in Latin America (Argentina as the regional node and Perú and Costa Rica as National Nodes) and Africa (South Africa as Regional Node and Kenya as National Node).

As mentioned above, the support from the Lounsbery Foundation could be reflected in an initial and decisive step towards replicating in Bolivia the catalytic effect that barcoding has had in Argentina. As a consequence, the mission of Argentina as a regional node would be strengthened by the development of collecting activities and training of human resources in its most biodiverse neighbouring country (excluding Brazil). Even more important is the fact that it would allow the active participation of Bolivia as a country, and of Bolivian researchers in particular, in the international Barcode of Life community, generating at the same time a network of scientific research and international collaboration in Southern South America.

International cooperation

The key for success in barcode projects is the international cooperation. We will rely not only on the high throughput barcoding services of BIO/CCDB and on our long lasting collaboration with Paul Hebert (University of Guelph) and Steve Lougheed (Queen's University, Canada), but also on collaborative research with colleagues from USA that worked with us during the first two phases of the Birds of Argentina project. In particular for birds, we will invite Drs. Kevin McCracken (University of Alaska Fairbanks), Muir Eaton (Drake University), Dr. Terry Chesser (National Museum of Natural History, Smithsonian Institution), and Mark Robbins (Kansas University Natural History Museum) to join field expeditions, research and publications. One of our closest collaborators, Dr. Kevin Kerr (who did its PhD Thesis with Paul Hebert) is now a post-doc at Smithsonian Institution and we anticipate a fluid collaboration with him as well. This model of collaborative work will be cloned to other taxa and their corresponding specialists, and it will be expanded as a consequence of the interaction with colleagues from Bolivian institutions.

Activities

-Field work for collecting new barcode material. Field work in Bolivia will be done covering 8 out of 10 Bolivian ecorregions (mainly Yungas, Amazonia and Valles Secos because these areas have higher number of species and endemisms: see Appendix 3 for more details). Vertebrate specimens will be collected using standard techniques (e.g. using mist nets and shotguns in accordance with both national and provincial laws in the case of birds). Invertebrate species will be collected using pit, malaise and light traps, as well as sweep and

aerial insect nets. In vertebrates, tissue samples will be obtained from muscle and heart. We will obtain four samples in each case, two of them will be frozen in liquid nitrogen immediately (this assures the best long term DNA conservation of the tissue) and the other two will be preserved in ethanol (mainly as a back up). In invertebrates tissue samples will be obtained typically from plucked legs, and two samples will be obtained from each specimen. The description above includes duplicated sets of tissue samples because one of them will be deposited in local collections and the other one will be imported to Argentina and deposited at MACN). At MACN, samples will be permanently stored at -86°C in a Thermo Forma Ultrafreezer (we have a second ultrafreezer as a back up and a generator to secure electric power supply) and in the Colección Boliviana de Fauna and the Museo Alcide d' Orbigny samples will be stored at -20ºC. This duplication of tissue samples ensures their long term preservation, particularly taking into account that no ultrafreezer and limited freezing capacities exist in the Bolivian Institutions.

-Voucher preparation and storing. Voucher specimens will be prepared in the field and in the laboratory following gold standards (protocols differ among taxonomic groups). All materials will be georeferenced and photographed. Vouchers will be deposited either at the Colección Boliviana de Fauna, at the Museo de Ciencias Naturales Alcides d´Orbigny or at the National Collections of the MACN, which storage capacity will be increased accordingly with new compact cabinets (50% of the vouchers will be deposited in each country).

-Human resources formation and international cooperation.
Four Bolivian students and researchers per year will be trained in sampling protocols, curatorial activities, collection management, molecular techniques and barcode data analysis at MACN with the funds of the Lounsbery Foundation grant. The training will be given during the Leading Labs Training Workshop for DNA barcoding that we organize every year and during research visits. These students and researchers will be able to curate the tissue and voucher collections in their respective home institutions, open their barcode projects in BOLD, process material for analysis and analyze the data obtained as a result of the project. During the last five years the MACN has been cooperating in ornithological collecting expeditions with several American institutions and researchers. We anticipate that the collecting effort associated with the barcode project in Bolivia will both strengthen these ties and provide new opportunities for collaboration with researchers in other taxonomic groups among our nations.

Budget

Field Work in Bolivia (16 collecting trips, costs of local people)	20,000
Participation of Argentine researchers in field work in Bolivia (2 people participating in 4 collecting trips and training activities)	8,000
Technician services	7,000
Voucher preparation, storing and consumables	8,000
Human resources formation: Attendance to the Leading Labs Training Workshop and research visits (8 Bolivian students and researchers trained at MACN; 4 each year)	10,000
Administration costs (5%)	2,650
Total funds requested from Lounsbery Foundation	55,650

Justification of the funds required and leveraging of the Richard Lounsbery Foundation support.
Field work for building barcode compliant collections and human resources formation are the two key elements of this project. As a consequence, both of them together represent most than 50% of the total funds requested. However, part of the costs related to training students and researchers from Bolivia in Argentina will be covered from other sources (MACN – CONICET - BIO/CCDB – CBOL – Fundación Williams - IDRC) as we estimate they will continue to support the Leadling Labs Training Workshop during 2011 and 2012. MACN and CONICET support for barcoding is increasing because of the iBOL regional node position of Argentina and we therefore expect that CONICET will help to defray some costs related with the activities conducted in Bolivia. Because of Bolivia's economic situation, it is not expected that their institutions could contribute significantly to this project at this stage. However, they will be able to provide some logistic support (e.g. transportation) and to pay the salaries of the Bolivian staff. Salaries of the project leader and members of his team are paid by CONICET. Basic operating costs of the project (telephone, mail, internet, energy, etc.) and technician hours required in voucher preparation for materials processed in Argentina will be covered by MACN. Administration of the Lounsbery funds will be done through the Fundación IByME, because of its low costs and high efficiency.

Expected results. We expect to obtain between 1500 and 3000 new vertebrate specimens (with their respective frozen tissues plus vouchers) and between 10000 and 15000 invertebrate specimens per year as a result of this project. At least 4 students and researchers from Bolivia will be trained in DNA barcoding every year at MACN, and many more will be exposed to barcode activities during the field work and training activities in Bolivia. Although we anticipate that most of the progress will be concentrated at the Colección Boliviana de Fauna and Museo de Historia Natural Alcide d'Orbigny, we also predict the recruitment of other researchers and institutions from Bolivia including the Centro de Biodiversidad y Genética (CBG – Universidad Mayor de San Simón, Cochabamba) and the Museo de Historial Natural Noel Kempff Mercado (Santa Cruz). In two years from now we envision a scenario in which several local groups working with vertebrates and invertebrates will have barcode projects in BOLD and will be actively participating in iBOL. The first results of this progress will be presented during the Fourth International Barcode of Life Conference, which will take place by late 2011. For more details about the results and for a timetable see Appendix 4.

Significance of the project
By 2015 the iBOL set the goal of having 500000 species of the World barcoded. The implementation of a Barcode program in Bolivia will help to meet this ambitious iBOL global target. With the addition of an estimate of at least 1500-3000 new vertebrate specimens (frozen tissues plus vouchers) and 10000-15000 invertebrate specimens per year, the project will create a significant resource for biodiversity research in the region and reinforce the importance of local museum's collections.

In addition, we are confident that the implementation of this project will have also very positive effects on the scientific communities of Bolivia, where multiple political and economic problems obstruct the progress of biodiversity science.

We think that the results of this project will be critical to test the performance of DNA barcodes for species identification not only because of the study of more species from the tropical and subtropical realms, but also because the extended geographic and taxonomic coverage of the samples will provide a more accurate picture of the intra- and interspecific patterns of molecular variation among closely related species.

Finally, because we are going to work in some of the richest and less explored areas of the World in terms of diversity, we expect that DNA barcodes may help to discover many putative new species and the identification of significant units for management and conservation.

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APPENDIX 1. PROJECT LEADER PROFILE

Pablo L. Tubaro is an Independent Researcher at the National Research Council of Argentina (CONICET), Curator of Birds and Vice-director of the National Museum of Natural Sciences of that country (MACN). Since 2005 he is a member of the Scientific Advisory Board and now member of the Implementation Board of the Consortium for the Barcode of Life. He is also Chair of the Steering Committee of the All Birds Barcoding Initiative and member of the Scientific Steering Committee of the iBOL project. He was designated coordinator of the Committee for Genetic Resources of CONICET, being therefore in charge of the coordination of the iBOL activities in Argentina. He has taught behavioral ecology, systematics and evolution of vertebrates at the University of Buenos Aires for more than 15 years. His main research interest deals with the evolutionary biology of birds including: 1) systematics and phylogeography of Neotropical birds, 2) hybridization and speciation, and 3) comparative studies about the evolution of morphological and behavioral traits.

Born in Buenos Aires, Argentina, March 31 1963

Education

1986: University of Buenos Aires, B. Sc. in Biological Sciences
1990: University of Buenos Aires, Ph.D. in Biological Sciences

Recent publications (in ISI journals)

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APPENDIX 2. INSTITUTION PROFILES

NATIONAL MUSEUM OF NATURAL SCIENCES OF ARGENTINA (MACN): It was created in 1812 and belongs to the National Research Council of Argentina (CONICET). It holds the National Collections of Fauna, Flora, Paleontology and Geology, totalling more than 4 million specimens or sets of specimens, including 4125 types. The MACN is the head of the National Network of Biological Collections and has been designed as the national node of the GBIF (Global Biodiversity Information Facility). Since the year 2000 the MACN has been deeply involved in international initiatives of biodiversity information through GBIF, IABIN (Inter-American Biodiversity Information Network) and CYTED (Science and Technology for Development). In 2004 the MACN signed the Memorandum of Cooperation to conform the Consortium for the Barcode of Life. The museum's scientific staff includes 50 researchers, 50 research fellows and 40 technicians. Economically, the museum is supported by the CONICET, which pays the salaries of the personnel and general expenses. Additional resources are generated by visitors and services provided by the museum. These latter resources are mostly applied to the maintenance of the infrastructure, new exhibitions and collections. Research money comes from small grants to researchers provided by CONICET, the National Research Agency (ANPCYT) and the University of Buenos Aires. The public exhibits of the MACN are visited annually by more than 200.000 people. For more information go to www.macn.gov.ar

COLECCIÓN BOLIVIANA DE FAUNA (Museo Nacional de Historia Natural de La Paz) – UNIVERSIDAD MAYOR DE SAN ANDRES. It was created in 1980 and it holds the largest biological collections of Bolivian flora and fauna. It has a staff of 6 full time curators. This institution produces its own exporting permits (except for CITES materials). For more information go to www.boliviaenlared.com/pdf/museo-historia.natural-la-paz-bolivia-pdf

MUSEO DE HISTORIA NATURAL ALCIDE d'ORBIGNY: It is a scientific institution aimed to the research, conservation and dissemination of natural sciences in Bolivia. It is controlled by the Fundación para las Ciencias supported by the Universidad Mayor de San Simón and the Honorable Alcaldía Municipal de Cochabamba. The museum has a staff of about 30 researchers and students (many of them *ad-honorem*) and holds several biological collections. Of particular importance are those of freshwater fishes, herps and mammals. For more information go to http://museodorbigny.org/home.htm.

APPENDIX 3 List of tentative sites for field work and map of Bolivian Ecoregions

La Paz Department:
Chulumani (Yungas, 1400 m.a.s.l.), Road from Charazani to Apolo (Yungas and Amazonia forest up to 4000 m.a.s.l.), Inquisivi (Inter-Andean Dry Forest), Huaraco (Puna).

Cochabamba Department:
Tunari (Yungas, *Polylepis* Forest), Río Mizque (Inter-Andean Dry Forest), Valle del Sacta (Amazonia and Transition Forest, 200 m.a.s.l.), Omereque (Inter-Andean Dry Forest).

Santa Cruz:
Llanos de Moxos (wetlands), Samaipata, East Santa Cruz.

Tarija Department:
Aguaragüe (Chaco Forest, 300 m.a.s.l.), Aguareache Preverve (Mountain Forest and Prepuna, 900-2500 m.a.s.l.), Los Cóndores Preseve (Inter-Andean Dry Forest, 1900-2000 m.a.s.l.).

Pando Department:
Tahuamanu Preseve (Amazonian Forest, 100 m.a.s.l.).

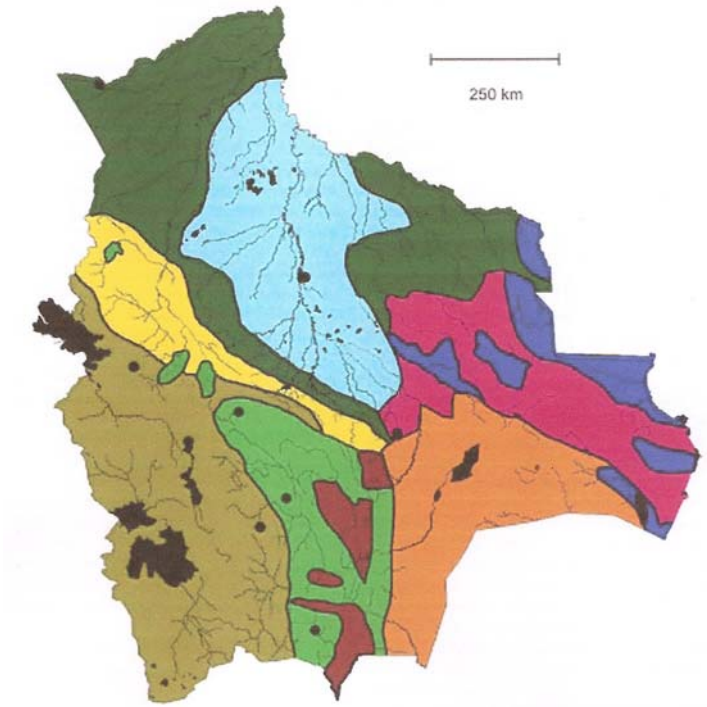

Figure 1.- Nine of the ten Bolivian ecoregions. Yellow: Yungas; light green: Inter-Andean Dry Valleys; dark green: Amazonía; blue: Eastern Bolivia; brown: Tucumán-bolivian Woodland; cyan: Llanos de Moxos; olive-green: Puna; pink: Chiquitanía; orange: Chaco (Figure taken from Herzong et al. 2005).

APPENDIX 4. EXPECTED RESULTS AND TIMETABLE

Activities in July-December 2010	Expected Outcomes
Four field trips executed (two by the Colección Boliviana de Fauna and two by the d´Orbigny Natural History Museum). Researchers from MACN will participate in one of these field trips. One Bolivian students/researcher trained at MACN in collections and DNA lab, producing the first batch of samples for barcoding. First batch of samples dispatched and processed at BIO-CCBD.	• 750-1500 vertebrate and 5000-7500 invertebrate specimens collected, tissue samples and vouchers prepared and curated. • Various projects opened in BOLD and 2000 – 4500 new barcodes deposited in its database. • Bolivian human resources trained. • Management of tissue and voucher collections improved in Bolivian Institutions.

Activities in January-June 2011	Expected Outcomes
Four field trips executed (two by the Colección Boliviana de Fauna and two by d´Orbigny Natural History Museum). Researchers from MACN and from abroad will participate in one of these field trips. Three Bolivian students and researchers attending the Leading Labs Training Workshop for DNA barcoding at MACN Second batch of DNA samples processed at BIO-CCBD.	• 750-1500 vertebrate and 5000-7500 invertebrate specimens collected tissue samples and vouchers prepared and curated. • Various projects opened in BOLD and 2000 – 4500 new barcodes deposited in its database. • Bolivian human resources trained. • Management of tissue and voucher collections improved in Bolivian Institutions.
Activities in July-December 2011	**Expected Outcomes**
Four field trips executed (two by the Colección Boliviana de Fauna and two by D´Orbigny Natural History Museum). Researchers from MACN will participate in one of these field trips. One Bolivian students/researchers trained at MACN in collections and DNA lab. Third batch of DNA samples processed at CCBD.	• 750-1500 vertebrate and 5000-7500 invertebrate specimens collected, tissue samples and vouchers prepared and curated. • 2000 – 4500 new barcodes deposited in BOLD. • Bolivian human resources trained. • Management of tissue and voucher collections improved in Bolivian Institutions. • Bolivian researchers/students presenting results at the International Barcode of Life Conference.
Activities in January-June 2012	**Expected Outcomes**
Four field trips executed (two by the Colección Boliviana de Fauna and two by d´Orbigny Natural History Museum). Researchers from MACN and from abroad will participate in one of these field trips. Three Bolivian students and researchers attending the Leading Labs Training Workshop for DNA barcoding at MACN Fourth batch of DNA samples processed at CCBD.	• 750-1500 vertebrate and 5000-7500 invertebrate specimens collected, tissue samples and vouchers prepared and curated. • 2000 – 4500 new barcodes deposited in BOLD. • Bolivian human resources trained. • Management of tissue and voucher collections improved in Bolivian Institutions.

EXPECTED ACHIEVEMENTS AT THE END OF THE PROJECT

- 3000 – 6000 vertebrate and 20000 – 30000 invertebrate specimens collected and deposited in permanent collections in Boliva and Argentina (tissues and their associated vouchers).
- 1500 – 3000 vertebrate and 10000 – 15000 invertebrate barcodes produced and deposited in BOLD.
- Several barcoding projects opened in BOLD by researchers from Bolivia.
- Reserachers and students from Bolivia trained and as a consequence the management and curation of collections in Bolivian institutions improved.
- Increased collaboration between Argentina and Bolivia around barcode projects and its derived studies, including many cases of species or groups of species studied in depth as a consequence of barcoding results.
- Establishment of a research network including nor only institutions from Bolivia and Argentina, but also from other countries (USA and Canada).
- Dramatic increase in the participation both of Bolivia as a country and of Bolivian researchers and Institutions in the barcoding community.

بسم الله الرحمن الرحيم

Princess Sumaya University for Technology
Office of the President

جامعة الأميرة سمية للتكنولوجيا
مكتب الرئيس

April 4, 2011

To: Lounsbery Foundation

Subject : PROPOSAL FOR HUMAN CAPACITY BUILDING AND THE PROMOTION OF SCIENCE IN THE SESAME REGION

This is to confirm that Princess Sumaya University for Technology (PSUT) will serve as the accounting officer for any funding awarded by the Lounsbery Foundation for the above named project and will be fully responsible in coordinating the efforts of the project with SESAME. The project management will be carried out by two Principal Investigators: Professor Khaled Toukan and Professor Sir Chris Llewellyn-Smith. The total requested funds for the project is $100,970 to be used purely for charitable purposes that will support training for SESAME and building links between the community of SESAME. PSUT is a not-for-profit University located in Amman Jordan. The funds will be committed as follows: $36,685 in 2011 and $64,285 in2012 including 15% overhead in each year to be kept at PSUT.

The Princess Sumaya University strongly supports the SESAME project which will have a major impact on science in the region. The proposed capacity building programme will make an important contribution to strengthening scientific and technical capacity and building a regional scientific community, and help ensure that SESAME is rapidly completed and produces excellent science from day one.

Please feel free to contact me at issa.batarseh@psut.edu.jo if you have any questions.

Regards,

Ref. Mash.

Issa Batarseh
President, Princess Sumaya University for Technology

PROPOSAL FOR HUMAN CAPACITY BUILDING AND THE PROMOTION OF SCIENCE IN THE SESAME REGION

OVERVIEW

SESAME (**S**ynchrotron-light for **E**xperimental **S**cience and **A**pplications in the **M**iddle **E**ast) is a third generation synchrotron-light source under construction near Amman (Jordan), modelled institutionally on CERN. SESAME will both

- Foster (and prevent or reverse the brain drain) by enabling world-class research in subjects ranging from biology and medical sciences through materials science, physics and chemistry to archaeology, and
- Build scientific and cultural bridges between neighbouring countries, foster mutual understanding and tolerance through international cooperation, and create a regional community of scientific users who will work together at SESAME.

The Members of SESAME are currently Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey. The Observer countries are France, Germany, Greece, Italy, Japan, Kuwait, Portugal, Russia, Switzerland, Sweden, the UK and the USA. Assuming the remaining necessary capital funding can be obtained, SESAME will come into operation in 2015.

There are some 60 synchrotron-light sources in the world. The need for a synchrotron-light source in the Middle East, which SESAME will satisfy, was recognised by the Pakistani Nobel Laureate Abdus Salam more than 25 years ago. SESAME brings together Salam's vision and that of the CERN and Middle East based 'Middle East Scientific Cooperation' group, which in the 1990s took concrete actions to promote regional cooperation in science.

Recognising that light-sources support a very wide range of applied and basic sciences, the Members created SESAME in the expectation that it will provide a major stimulus to science across the region and raise scientific standards. Their scientists will visit SESAME to carry out experiments in a stimulating international environment where they will be exposed to the highest standards, and will form links with scientists in neighbouring countries, regardless of creeds and politics. SESAME will promote scientific, technical, and economic development, thereby motivating the region's best scientists and technologists to stay in the region or to return if they have moved elsewhere. SESAME will not only strengthen collaboration between the participating countries, but also between them and scientifically more advanced countries whose scientists will collaborate in experiments at SESAME.

SESAME is a unique organisation: it is the only intergovernmental laboratory in the region and the only organisation (outside the United Nations) that brings together such a diverse set of partners. It is hoped that it will serve as an inspiration and template for other regional organisations (just as CERN led to EMBL, ESO, ESRF, etc.).

In parallel to the construction of SESAME, the initial scientific programme is being defined and a user community of scientists from across the region is being formed

through a series of Users' Meetings, Schools, and Workshops. The young engineers who are building SESAME and many of the young people who will use SESAME have been, and are being, trained in scientifically-developed nations, thanks to support from the world's synchrotron laboratories, various governments, and the IAEA (International Atomic Energy Agency).

Much more is needed, however, in the way of training of young scientists and engineers to ensure SESAME's timely completion, prepare a rapid and successful start-up of the experimental programme, raise scientific and technical standards across the region (which will of course have great value independent of SESAME), and forge stronger links between the young scientists who will use SESAME. Funding is sought from the Lounsbery Foundation to kick start an enhanced training programme which will meet these aims.

Specifically, Lounsbery funding will be used to support short-term visits by young scientists from the SESAME region, and by some young technical staff, to operational synchrotron radiation laboratories for *in situ* training, and (to a much smaller degree) short-term visits to SESAME by specialists in the construction and operation of synchrotron machines and beamlines for the purpose of providing training and advice linked to the construction of SESAME and the initial beamlines. It is planned to send young scientists with similar training needs from different SESAME countries in pairs to operational synchrotron sources in order to form bonds that transcend national boundaries – between them, and between them and their hosts.

Funding is sought for training from outside because the resources of the Members (many of whom have tiny science budgets) are stretched by completing the construction of SESAME: all the funding they can provide is currently needed for capital investments and to cover staff costs. A period of uncertainty over capital funding has recently been ended by an agreement between four Members (still subject to agreement on a detail in the case of one member at the time of writing) to together provide $20 million 'exclusively for capital funding' over the next five years, while all the members collectively are expected to contribute $(20-25) of operational funding (to cover salaries etc.) in this period. As a result, all except some $15 million of the total construction cost (of some $110 m, including the cost of the land and the value of donated equipment) is now assured. We are confident that it will be possible to find the additional funding that is needed (from the SESAME members and outside), which will allow SESAME to come into operation with three 'day-one' beamlines in 2015, assuming all goes well.

The following pages provide background information and details of this proposal and of the requested budget of $100,970: $36,685 to be committed in 2011 and $64,285 in 2012, and a 15% overhead for administrative services to cover costs incurred by the Princess Sumaya University, which will handle payment and act as accounting officer for the grant on behalf of SESAME. Brief profiles of the Principal Investigators are provided in an Annex. A second annex presents brief profiles of a small sample of people already involved in SESAME (who are typical of those who will benefit from Lounsbery's support).

1. FURTHER BACKGROUND

Detailed information about SESAME, including a description of how synchrotron-light sources function, how SESAME will operate as a 'user facility', the science it will enable, the initial suite of beamlines (which will focus the synchrotron-light on experimental targets), the machine parameters, and the history of the project, may be found at http://www.sesame.org.jo/brochure.pdf. Briefly:

- SESAME is an intergovernmental organisation, which was formally established under the auspices of UNESCO in 2004.
- SESAME will be a competitive third generation light-source – meaning that it will be equipped with devices called 'wigglers' and 'undulators' which produce highly collimated beams of intense synchrotron light, which can be used to study matter on scales ranging from viruses down to atoms. The key parameters are: beam energy - 2.5 GeV, stored current - 400 mA, and design emittance - 26 nm.rad. The design has been validated by SESAME's Technical Advisory Committee which consists of eminent experts from a number of leading synchrotron light sources in such countries as France, Germany, Italy, Spain, Switzerland, and the USA, and also by experts at CERN.
- The users of SESAME, who will mostly be young scientists and graduate students, will be based in universities and research institutes across the region. They will visit the laboratory periodically to carry out experiments, generally in collaboration, where they will be exposed to the highest scientific standards in a stimulating environment for international collaboration, They will then return home to analyse the data they have obtained.
- Several hundred scientists, working in disciplines ranging from the biological and medical sciences to physics, chemistry and archaeology, are expected to use SESAME from day-one. As more beamlines are built, the number of users is expected to grow to 1000 or more.
- The potential user community, which already numbers some 300, has been fostered by a series of Users' Meetings and training opportunities supported by the IAEA, various governments and many of the world's synchrotron laboratories, which have created special training fellowships, thereby demonstrating their support for, and confidence in, the project.
- Seven beamlines, selected by SESAME's Scientific Advisory Committee and Beamlines Advisory Committee (again consisting of eminent experts on the world stage), on the basis of requests from scientists in the region, will be available in the first few years of operation. From day one they will be able to support experiments spanning the fields listed above. Examples of the achievements of experiments at similar beamlines at operating synchrotron-light sources round the world include: insights into how antibiotics kill bacteria but not human cells; better understanding of motor neuron disease and help in designing drugs to treat this condition; new insights into how certain diseases, including liver diseases, develop; improvements in the performance of photovoltaic solar cells; studies of materials that could be used to store carbon dioxide to prevent it entering the atmosphere; demonstration that the ancient

Egyptians developed a new technology to make opaque glass. Similar discoveries will surely be made at SESAME.

2. THE NEED FOR MORE TRAINING AND TO FORGE BONDS BETWEEN FUTURE SESAME USERS

Fostering training has been a major part of SESAME's aims from the beginning. Much has been achieved, with outside help, and the SESAME training programme is already raising scientific and technical standards and bringing value to the region which is independent of SESAME. But *much* more is needed.

As SESAME moves towards operation, the training programme should be expanded, and the theoretical training that has been provided by Workshops, Schools and Users' meetings should be complemented with more practical training. Specifically, training is needed at operational synchrotron radiation laboratories in the use of beamlines to carry out experiments, so that there is a fully-trained users' community when the SESAME laboratory comes into operation.

The expanded and more practical training programme should be designed to forge links between young scientists in the different SESAME countries. This will be achieved by pairing scientists from different countries with similar training needs and sending them together to operational synchrotron laboratories. During their training visits, these young scientists will also build links with the world community of light-source users, of which they will become members. The major operational synchrotron laboratories have expressed their willingness to allow future SESAME users to join teams carrying out on-going experiments.

There is also a pressing need for more training for the young SESAME staff, who are preparing the scientific programme and building SESAME. At present the staff comprises 16 young engineers and scientists from the SESAME region, who were trained at the beginning of the project in world-leading synchrotron laboratories. Staff numbers are planned to increase to 83 during the remainder of the construction period. The additional technical staff, who will serve the needs of the beamlines as well as the machine itself, will need training in: accelerator physics, magnets and insertion devices, power supplies, diagnostics, radio frequency, vacuum, cooling, control, and mechanical and electrical engineering. This training will be provided on the job by working with experts brought in from outside and through visits to operating synchrotrons. Many of those involved in building SESAME will move on later to other jobs in the region, taking the expertise they have acquired with them.

It is worth noting that training Fellowships provided in the past by the US DOE (Department of Energy) had a catalytic effect and resulted in the host laboratories providing additional resources for the fellows (e.g. $44 k provided by the Advanced Light Source, $29 k by the National Institutes for Standards & Technology, $25.3 k by the National Synchrotron Light Source, $24 k by DOE through Argonne National Laboratory, etc.). Lounsbery funding is also expected to catalyse further support and seed an on-going expanded training programme.

3. PROPOSAL FOR SUPPORT FROM THE LOUNSBERY FOUNDATION

As indicated above, Lounsbery funding will foster the training and exchange of young scientists and engineers in the SESAME region, and sharing of knowledge and experience, in a way which will create strong bonds between them, and between them and light source users and engineers in scientifically-developed countries. This training will underwrite the successful completion of SESAME, rapid commissioning of the beamlines, and the success of the experimental programme from day one. Three components are proposed:

1. Visits of Young SESAME Users to Operational Synchrotron-light Sources

SESAME proposes to use Lounsbery funding to provide ten young scientists from the SESAME members with training at operational light sources. Scientists from different countries will be sent in pairs in order to strengthen or forge bonds between them.

During their stay at the host laboratory, the young scientists will perform experiments on beamlines with similar characteristics to those which will be installed at SESAME in phase 1, and will learn new techniques in the use of synchrotron radiation which they will need in their research at SESAME. They will receive this training at facilities in the USA (such as the Stanford Synchrotron Radiation Lightsource (SSRL), Advanced Photon Source (APS), and Advanced Light Source (ALS)), and in Europe (such as the SLS (Swiss Light Source), SOLEIL Synchrotron, CELLS-ALBA (Consorci per a la Construcció Equipament i Explotació del Laboratori de Llum de Sincrotró), Elettra Sincrotrone Trieste, ANKA, Diamond and BESSY), all of which have agreed to host young scientists proposed by SESAME.

The minimum duration of these visits will be two weeks and the maximum duration four weeks.

In order to ensure maximum efficiency and transparency in the selection of the young scientists who will benefit from this training, and to guarantee the high-quality of the proposals accepted:

(a) A call inviting proposals from young scientists from the SESAME region to participate in experiments at synchrotron facilities where SESAME has obtained beam-time will be advertised on the SESAME web site.

(b) A committee headed by the Scientific Director of SESAME will peer review the proposals. The SESAME Peer Review Committee will also include the Chairs of the Scientific and Beamlines Advisory Committees (SAC and BAC), the Technical Director of SESAME, and an expert in the field of the proposal submitted. The peer review will be based on the following criteria:

   i. Scientific merit of the proposal; and
   ii. Relevance of the proposal to the SESAME scientific programme.

(c) After the in-house peer review process, during which proponents from different countries will be paired up, the proposals selected will be sent to the partner synchrotron facilities where the beamline and techniques required to carry out the proposed work will be available, i.e. the SESAME Peer Review Committee will decide which proposal should be sent to which facility. Finally, the beam-time

allocation committee of the receiving facility will further review the proposal to ensure that it is indeed well matched to an on-going experiment and that the proponents are of a suitable scientific standard.

2. Staff Visits

The Technical Director at SESAME, who is leading the team working on the construction of the storage ring and beamlines, is one of the accelerator scientists who constructed the SOLEIL Synchrotron in France. The current members of the technical team are engineers and scientists from the SESAME region who, for the most part, have received long-term training at forefront operational synchrotron radiation laboratories. They are therefore fully qualified to carry out the work currently being entrusted to them. However, the team is about to expand rapidly. The new members will require training, while as the project evolves and the nature of the work being done changes, existing staff will occasionally require training in selected very specialized tasks.

In the case of SESAME, in the current construction phase of the project, there is a need for the following short-term training for new and existing members of the technical team:

(a) One XRF (X-ray fluorescence) scientist to spend four weeks at ESRF (European Synchrotron Radiation Facility) in order to take over the ROBL (ROssendorf BeamLine), which ESRF has donated to SESAME. This will provide the SESAME XRF beamline scientist with the know-how required to understand its operation and use when it is reinstalled at SESAME.

(b) Two RF (radio frequency) engineers to each spend eight weeks at the SOLEIL Synchrotron in order to learn and understand the operation of RF cavities operating at 500 MHz. The conditioning and testing of such cavities, which are at the heart of the accelerator, requires very specialized training.

(c) One power supply engineer to spend four weeks at the SOLEIL Synchrotron in order to test the power supplies ordered by SESAME for the booster ring. These power supplies were delivered to SOLEIL, as SESAME was not ready to receive them due to the construction of the shielding wall in the experimental hall and the lack of equipment required for testing.

(d) One diagnostic engineer to spend four weeks at the Diamond light source in order to learn about the instrumentation and tools required for the purpose of beam diagnostics.

The members of the technical team who are to receive this training will be selected by the Technical Director who will provide each of them with a well-defined task to carry out at the host laboratory. The selected members of the technical team may be accelerator physicists, engineers or beamline scientists.

The minimum duration of these visits will be one week and the maximum duration eight weeks.

3. Expert Visits to the SESAME Site

In a few cases there will be a need for an expert from an operating synchrotron facility to visit the SESAME site to help the SESAME technical or beamlines scientists install a

particular high technology piece of equipment or to discuss a particular issue in depth. Several Phase 1 SESAME beamlines were donated by synchrotron facilities around the world: visits by experts who designed, built and used these beamlines will be needed in order to ensure their rapid installation and successful commissioning. Visits by such experts will be made on the request of the Technical or Scientific Director of SESAME. The maximum expected duration of such visits will be no longer than two weeks.

Budget

The tables below summarise the proposed visits of young potential SESAME users and staff to operating synchrotron laboratories, and expert visits to SESAME, and the associated costs, broken down into commitments to be made in 2011 and 2012. The figures given in the column "estimated cost" are based on the estimated cost of a single economy class return fare from anywhere in Europe to Amman, Jordan, (US$ 700) and USA to Amman, Jordan (US$ 1400). Both for Europe and USA a daily subsistence allowance of US$ 150 is estimated to cover meals and accommodation in the guesthouse of the host facility.

YEAR 2011

Description	Duration (days)	Estimated Cost (US$)
Young scientists from the SESAME region visiting operational synchrotron radiation facilities (2 visits to Europe and 1 to the USA)	30 days each	16,300
Two RF Engineers to SOLEIL, Paris	30 days each	10,400
Power Supply Engineer to SOLEIL, Paris	30 days	5,200
Administration (15%)		4,785
TOTAL		**36,685**

YEAR 2012

Description	Duration (days)	Estimated Cost (US$)
Young scientists from the SESAME region visiting operational synchrotron radiation facilities (4 visits to Europe and 3 to the USA)	30 days each	38,500
XRF Beamline scientist visiting ESRF, Grenoble – France	30 days	5,200
Diagnostic Engineer to Diamond, Oxfordshire – United Kingdom	30 days	5,200
Four Expert visits for Control Systems to SESAME, Amman – Jordan	7 days each	7,000
Administration (15%)		8,385
TOTAL		**64,285**

4. CONCLUDING REMARKS

SESAME is a visionary project with enormous potential to build up the science base in the Middle East in a very wide range of fields, and create strong links between young scientists and engineers across the region. Training has always been seen as a vital element of the SESAME programme, in its own right and in order to ensure the rapid and successful completion and commissioning of the SESAME machine and beamlines, and that the experimental programme is of the highest quality from day one. Much more is however needed.

Funding is requested from the Lounsbery foundation to kick start an enhanced training programme, through supporting

- visits by pairs of young scientists from different SESAME members to operational synchrotron-light sources, where they will learn new skills while forming bonds to each other and with their hosts,
- a smaller number of visits by young SESAME engineers to operating light sources to acquire the skills needed to build the SESAME machine and beamlines, and in particular become familiar with equipment that is being donated to SESAME; the skills they acquire will be very valuable when later in their careers many move into other engineering jobs in the region, and
- a small number of visits to SESAME by experts from operational light sources who will provide on the spot training and help in installing donated equipment with which they are familiar.

These visits will have a major impact on the progress of SESAME and in fostering the creation of a close-knit community of young scientists in the region. Past experience suggests that Lounsbery funding will have a catalytic effect and lead the laboratories that host the proposed visits, and others, to seek ways to continue and expand further the proposed enhanced training programme.

Principle Investigators

1) Professor Khaled Toukan, Director of SESAME

Professor Khaled Toukan was born in Amman in 1954. He holds a B.E. degree in Electrical Engineering from the American University of Beirut (1971–1976), an M.Sc. degree in Nuclear Engineering from University of Michigan (1976–1978) and a Ph.D. in Nuclear Engineering from the Massachusetts Institute of Technology (1978–1982). He has worked as a Research Scientist at Kernforschungszentrum Karlsruhe, and as an Associate Research Scientist at the King Fahd University of Petroleum and Minerals, Saudi Arabia. He has served as Dean of the Faculty of Engineering & Technology and Professor of Industrial Engineering at the University of Jordan (1995-1997), President of Al-Balqa` Applied University (1997–2000), Minister of Education of Jordan (2000-2007), and Minister of Higher Education and Scientific Research (2001–2002 and 2005-2007). He is Chairman of the Jordan Atomic Energy Commission (since 2008), and the Director of the Synchrotron–light for Experimental Science and Applications in the Middle East (SESAME) (since 2007). Professor Toukan's awards include King Hussein's Medal of Excellence (2008), the Commanders Cross of the Order of Merit from the Federal Republic of Germany (2006), the Légion d'Honneur from the French Republic (2004), the UNESCO Ghandi Medal of Peace (2003), the Royal Grand Gordon of Alkukab Al-Urduni (2003), and the Theos J. Thompson Fellowship (1980-81) in the Department of Nuclear Engineering at M.I.T. He is a Member of the International High Level EFA Group and a member of H.M. King Abdullah II Economic Consultative Council. Professor Toukan is currently the Minister of Energy and Mineral Resources of Jordan.

2) Professor Sir Chris Llewellyn Smith FRS, President of the SESAME Council

Chris Llewellyn Smith is a theoretical physicist. He is currently Director of Energy Research, Oxford University, and President of the Council of SESAME (Synchrotron-light for Experimental Science and its Applications in the Middle East). He has served as Chairman of the Council of ITER (2007-09), the global fusion energy project, and of the Consultative Committee for Euratom on Fusion (2004-09), and was Director of UKAEA Culham (2003-2008), with responsibility for the UK's fusion programme and for operation of the Joint European Torus (JET). While at Culham he developed and promoted the 'Fast Track' development of fusion energy. He was Provost and President of University College London (1999-2002), Director General of CERN (1994-1998), and Chairman of Oxford Physics (1987-1992). During his mandate as DG of CERN the Large Hadron Collider (LHC) was approved and construction started. After completing his Doctorate in Oxford in 1967, he worked briefly in the Physical Institute of the Academy of Sciences in Moscow, before spending periods at CERN and the Stanford Linear Accelerator Center, after which he returned to Oxford in 1984. Chris Llewellyn Smith has written and spoken widely on science funding, international scientific collaboration and energy issues. He has served on many advisory bodies nationally and internationally, including the UK Prime Minister's Advisory Council on Science and Technology (1989-92). His scientific contributions and leadership have been recognised by awards and honours in seven countries on three continents.

SESAME People

SESAME is currently producing a brochure which features people from the SESAME Members who will or already are benefitting from the project (a draft may be found at http://www.sesame.org.jo/people.pdf). Lounsbery funding will benefit similar people: the next generation of SESAME users and builders near the beginning of their careers.

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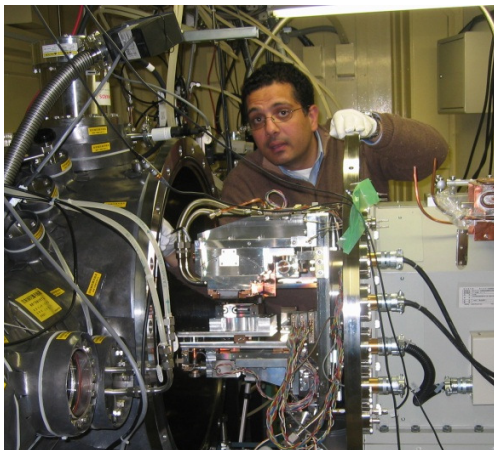
Dr. Mohammad Yousef, shown here inspecting a monochromator at the Japanese Photon Factory, is a biophysicist and structural biologist form Cairo University who works on analyzing proteins, protein/DNA and protein/ligand complexes The use of X-ray crystallography to determine the three dimensional structures of biological macromolecules at atomic resolution is central to his work. The results of such studies provide the basis for understanding biological functions and guide the rational design of new therapeutics.



Mohammad, who has attended and spoken at many SESAME meetings, says *"My research requires X-ray synchrotron beamlines, which are currently unavailable in the Middle East. Therefore, I do most of my research abroad. SESAME, when operational, will bring me home!"*

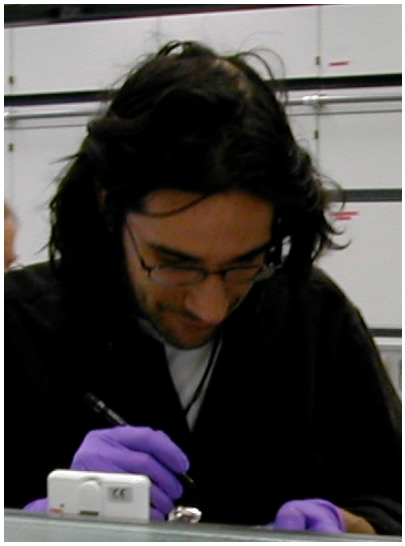
Sumera Javeed, pictured working on a hollow cathode DC magnetron sputtering setup for carbon film deposition, is based at the Accelerator and Carbon based Nanotechnology Laboratory, Pakistan Institute of Nuclear Science and Technology, in Islamabad. Her basic field of research is carbon based nanotechnology and ion physics. She is currently involved in the formation of carbon thin films on metal substrates using a wide range of techniques.

Sumera, who attended the 8th SESAME Users' Meeting in 2009, is interested in studying the growth of carbon nanoparticles and their disintegration using different techniques, says *"For most of the experiments of interest to us, the diagnostics can be most effectively carried out using the soft X-ray beam line of SESAME. The broad spectrum of research programmes at SESAME will cater for the synchrotron radiation needs of the region, including specifically those of Pakistan. There are definitely cultural benefits involved in having scientists from different countries working close together."*

Maher Attal, seen here with the SESAME Microtron injector, is a Palestinian accelerator physicist who works at SESAME on accelerator physics related issues.

Maher attended the first SESAME workshop in Jordan (at Al-Balqa University) in 2000, was subsequently a SESAME trainee at the French synchrotron LURE, and has attended all the SESAME technical meetings and several of the Users' Meetings. He says that *"As the first synchrotron light source in the Middle East, SESAME is a valuable and challenging experience through which I learned a completely new scientific field and obtained my PhD in accelerator physics. I think it will be a vital scientific research center which will activate, and make it much easier to carry out, scientific research in the region".*

Vasilis Promponas, seen here preparing sample for a yeast protein expression microarray experiment at the European Molecular Biology Laboratory, is a lecturer of bioinformatics in the Department of Biological Sciences at the University of Cyprus, and head of the Bioinformatics Research Laboratory, where he works on large-scale genome sequence analysis and protein structure and function prediction.



Vasilis, whose is interested in predicting the structure, function and evolution of biological macromolecules using information encoded in amino acid sequences, says that *"Our research so far is based on purely computational approaches to exploit experimental data. SESAME will provide unique opportunities for enriching our research with custom-produced experimental data, and the possibility for joint computational-experimental high-impact research activities. By predicting folding features of important classes of protein molecules (e.g. bacterial membrane proteins) we hope to open new directions in combating diseases".*

Hamed Tarawneh, seen here with a radio frequency cavity for the SESAME booster, is a Jordanian accelerator physicist. He attended the first SESAME workshop in Jordan in 2000 and then worked for a PhD in accelerator physics at the MAX-Lab, Lund University, Sweden, which he obtained in 2006. Since then he has worked as a staff member at SESAME, where he coordinates work on the SESAME booster synchrotron and is also involved in many aspects of the design of the main storage ring.

Hamed says that *"Through SESAME, I have had the chance to visit different synchrotron radiation facilities such as ALBA in Spain, SSRF in China, SOLIEL in France, Photon Factory in Japan, and also CERN in Switzerland. Such opportunities are fruitful as I discuss and learn many issues which benefit the progress of my work at SESAME".*

Zuheir El-bayyari, pictured here when visiting the Synchrotron Radiation Center at the University of Wisconsin-Madison, is currently receiving training through one of the numerous fellowships put at the disposal of SESAME. He is working mainly on early breast cancer detection using infrared micro-spectroscopy. When he gets home to Jordan he will work on the SESAME infrared beamline.

Zuheir, who has attended several SESAME Users' Meetings and Workshops, says *"I hope to close technological gaps and perhaps ease tensions in the Middle East by bringing back to Jordan the knowledge I gained overseas".*