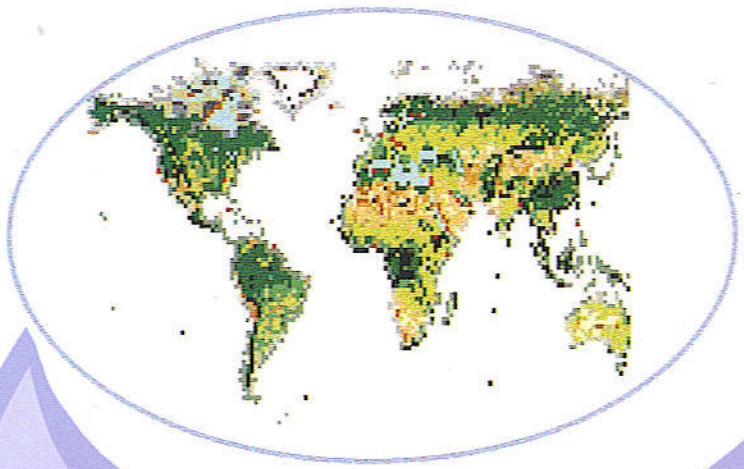
# BIOLOGY INTERNATIONAL

The News Magazine of the International Union of Biological Sciences (IUBS)



## Towards An Integrative Biology Program

## BioEd 2000: The Challenges of the Next Century

N° 37 May, 1999

# Biology International N° 37 (May, 1999)

## Editorial

# BIOLOGY INTERNATIONAL

## The Voice of IUBS

The last issue of Biology International (BI), number 36, appeared in February 1998. Its general content was in line with the tradition of the journal and presented a pot-pourri of feature articles on specific topics of IUBS scientific field (landscape biodiversity or stress biology), of opinions on the evolution of disciplines such as ethology, of information about IUBS sponsored activities (Registration of plant names), and about recently published books and meetings to come. But above all number 36 gave our community and our external readers a report on the highlights of the General Assembly held in Taipei in November 1997, especially on the scientific orientations envisaged for the future and the resolutions passed to implement IUBS activities.

Among the subjects debated by the delegates, special attention was paid to the communication and publication policy of our Union and to the content and the presentation of Biology International .

As illustrated by issue 36, the journal has served several purposes in the past. It has presented articles on ongoing researches of interest for our community, included expressions of specific opinions, papers and reports on passed scientific events, and reviewed the titles, subjects, schedules locations and references of scientific events to come (many of them but not all being congresses, workshops or meetings organized by our scientific constituencies). Motions of criticism and dissatisfaction are obviously and usually many about such a production. The concerns and questions among delegates were of several kinds :

Should the formula be kept as it is or turned into a more standard scientific journal with reviews and focused articles going through a demanding peer-review system ?

Should BI remain a paper journal, turn to an electronic production or combine the two technical supports ?

Should BI be a service provided to and essentially paid for by the Union (and at what cost ?) or should it be converted into a profit-making publication, run on a commercial basis and returning funds to the Union ?

Should the Union develop a publication policy of larger ambitions (books, special issues of the journal, education documents) or on the contrary restrict its activity to a minimal linking service of information and leave scientific publications to other journals and institutions ?

And so on....

In this debate, we must consider the specific problems of the scientific life and the goals of the Union, as well as the general questions and difficulties faced by the editors of scientific

literature, because Union interests and scientific publication are tightly intermingled. Some of these goals are expressed in Resolution 3, (Biology International, 1998, n° 36, p 40).

A specific committee was subsequently established by the IUBS Executive Committee and placed under the guidance of our Secretary General, Prof. M. Wake. It carried out a thorough examination of all these questions and provided the elements of a progressive evolution of the Union's publication policy, its recommendations are presented in this issue (see page 39). They establish the principles that revisit the goals and the formula of Biology International (a paper version and an Internet one). They envisage also an approach to the renewal of the publishing activity of IUBS. More changes are to come and cannot be decided at once, or ever in a final sense. They must be implemented one by one and the overall operation must be assessed regularly. The results of these experimental efforts will be presented and evaluated by the delegates of the next General Assembly in November 2000. In other words the Union has entered a dynamic process to carry on an evolving publication policy.

Setting down such matters in concrete and effective guidelines acceptable by the community at large is not an easy operation. It raises conflicts of opinions and interests, it takes time to consult biologists when their professional lives are constantly pressed by more immediate and specific issues. In consequence the voice of IUBS expressed by BI was not heard for more than a year in the concert of Biology and of Biologists.

The present issue opens a period of transformations. We would like our Union communication media to facilitate the evolution of biology, and the development of IUBS scientific programs (DIVERSITAS, Reproductive Biology and Aquaculture, Towards an Integrative Biology, Biological Education....), as well as the emergence of biological sciences into the movement of societies. We expect simultaneously BI to revive the internal link we need inside our Union, whatever our interests, our nationalities and our differences. Success in this endeavor depends on the commitment of each member of the Union, and the future will tell through BI how committed we all are. Today we are very grateful to our Secretary General, Pr. M. Wake, to colleagues of the committee and to all members who felt concerned and provided advice and help. The 26th General Assembly approved Integrative Biology as a scientific concept of great potential for the Union (see page 3). The 26th General Assembly has also given us an integrative philosophy for our communication policy.

Jean Claude Mounolou

President, IUBS.

A Call to the IUBS Members and Biology International Readers

Biology International is your voice.

Your comments, suggestions and recommendations for improvement are awaited.

Your contributions: topics, opinions, papers and information about meetings and scientific publications will keep it alive!

# Towards An Integrative Biology

## (TAIB) Program

1. Introduction

The International Union of Biological Sciences is developing a program that emphasizes and enhances the integrative nature of the biological sciences. "Integrative Biology" means different things to different practitioners and observers. To some, it emphasizes multidisciplinary (cross-disciplinary, transdisciplinary; including the incorporation of physics, chemistry, engineering, sociology, economics, etc., as appropriate) research, especially through the bringing together of scientists with different, but specific, areas of expertise to address particular questions. To others, it means using a diversity of techniques and approaches in one's own research program; and to yet others, the emphasis is on hierarchical approaches to questions and techniques. There are almost as many conceptions of "integrative biology" as there are people interested in the idea; this results in those people considering themselves to be "integrative biologists" without any clarification of or agreement upon the central themes of the concept. To that end, we herein attempt to articulate the concept of "integrative biology" that underlies our program.

What is "integrative biology?"

Traditionally, biologists are trained, and departments and institutes organized, in a manner characterized by specific approaches, techniques, levels of organization in the biological hierarchy, and/or organisms. Integrative biology is both an approach to and an attitude about the practice of science. It seeks both diversity and incorporation. It deals with integration across all levels of biological organization, from molecules to the biosphere, and diversity across taxa, from viruses to plants and animals. It provides both a philosophy and a mechanism for facilitating science at the interfaces of "horizontally" arrayed disciplines, in both research and training. Work at interfaces involves discussion of significant problems among scientists with diverse expertise and perspectives. It focuses on appropriate techniques, often from unanticipated sources, and on the appropriate choices of taxa for observation and experimentation (so that it is not taxon-bound). It particularly stresses an approach to problems and questions from diverse perspectives, so that the explication of the research protocol has the potential to be both innovative and integrative, as appropriate to the question being addressed. Many of the questions now being addressed by biologists require both reductionistic and incorporative elements, but in an integrated framework that allows resolution of the sub-elements of the question to contribute to an answer to a larger problem. For example, the data collected by a physiologist may also address hypotheses in ecology; conversely, the physiologist might use techniques and theory in ecology and evolutionary biology to answer the physiological question in a larger context.

New areas of biology are developing as a consequence of the kinds of questions and problems that require attention. As Rita Colwell, Director of the US National Science Foundation, has pointed out, "biocomplexity" requires a much broader approach and a common scientific

language. The many manifestations of biocomplexity, from fundamental science to socioeconomic concerns, require approaches that transcend standard disciplinary lines in terms of research, funding, training, and dissemination. The problems now being addressed by many biologists require a diversity and range of expertise. It can be provided by bringing together experts in several areas, but may be better provided by biologists who are adaptable, flexible, and trained to address new questions that span levels of biological organization and extend to "non-biological" realms.

## Education and training in "integrative biology"

If, as asserted, integrative biology is more than the aggregation of workers with different expertise to consider complex problems, and new ways of approaching those problems are important, serious effort is needed to change the way that biologists, scientists in general, and even non-scientists, are educated and trained. The "separateness" of disciplines and sub-disciplines currently is structured by the identification of separate courses of instruction at all levels of the educational enterprise, and is reinforced at the university level by the discrete course offerings of departments of instruction and research. It is increasingly rare that a "department of biology" offers a full range of courses, ranging from molecular biology to ecosystem biology, neontology and paleontology, and including members of all three domains of life, as well as the impact of non-biological domains of study. In fact, departments of biology are few, and their successors often focus rather narrowly, but with depth, on a small sub-set of biology. Even when taking courses in different sub-disciplines is encouraged, the course structure does not encourage an integration and synthesis of the information found in several such courses. This has several consequences: young biologists are well trained only in one sub-discipline; students who will become teachers in primary and secondary schools are not acquainted with the breadth of biology, let alone how to apply breadth to major questions; students who will enter other fields of endeavor, and become the educated public, and potentially policy makers, have only examples of parts of biology before them. Some institutions are attempting to develop cross-disciplinary programs, but they usually emphasize breadth of course work; the difficulty in effecting thinking synthetically is that most of the courses available to such programs are the traditionally structured ones.

## How, then, can "integrative biologists" be educated?

Clearly, the current course structure cannot be abandoned; it serves many purposes well. However, the content of such courses can be expanded to draw on a greater breadth of information, and new courses can be implemented, probably using information technology, especially Internet communication, that emphasize integration and synthesis. It cannot be stressed strongly enough that integrative biology is not just assimilating and synthesizing ever more information, but, rather, a way of approaching questions and being equipped with the resources to think broadly about their solutions. Several approaches to developing the curricular and training structure that would implement integrative biology are possible, and immediately: 1) the meeting of scientists with diverse expertise, but an interest in complex questions, to discuss ways of integrating their approaches (this is occurring with increasing frequency with the goal of good science, but rarely with the goal of good education in addition); 2) the production of teaching materials as well as research publications by such

aggregations of scientists; 3) greater breadth of examples in current courses, and especially a new emphasis in "traditional" courses of the relationship of course-specific material to other parts of biology and the current state of the world (this doesn't mean a separate, token lecture, but a common thread of interrelationship throughout the course); 4) at the level of graduate study, a real emphasis on transdisciplinary training in both theory and technique. These first steps would allow the "next generation" to implement education and training with new ideas and approaches to integration, synthesis, depth and breadth.

IUBS and "integrative biology"

Individuals, institutions, and agencies are proclaiming the necessity for integrative approaches to research and training in biology, often with rather different ideas about what "integration" is, and how to accomplish it. The International Union of Biological Science (IUBS) has recognized both the urgency of the need for integrative approaches to major issues in biology, and the need for rigorous approaches to research and training. To aid in meeting those needs, the IUBS is developing a program called "Towards an Integrative Biology". The program initially will focus on a small set of selected areas of concern in order to develop specific research and training programs as models that emphasize the elements of integrative biology discussed above by facilitating transdisciplinary approaches to problems: (1) that bring together a diversity of expertise appropriate to the problems, (2) that incorporate multiple levels of hierarchical approaches, (3) that deal with a diversity of taxa and techniques, and (4) that provide well designed instructional materials for the cross-training of young scientists so that they can be truly integrative, synthetic biologists, rather than simply bearers of a narrowly defined discipline's techniques and theory to address complex problems.

IUBS is gathering a body of scientists from many parts of the world to share their perspectives on the development of "integrative biology." It will focus its initial efforts by developing integrative approaches to five problem areas: (1) Episodic Events; (2) Stochastic Processes; (3) Reproductive Strategies; (4) Consistencies; (5) Interactions among Species. Workshops that emphasize the integration of molecular through ecological and evolutionary biology, other parts of science, and economic and social implications and interactions will be developed. Each such workshop will produce both research-based documents and educational materials. IUBS invites the collaboration of colleagues from all spheres of science and education, and representing diverse institutions, associations, and perspectives. The program thereby anticipates achieving a coherency applicable to many kinds of questions in many parts of the world, and that coherency is expected to provide a commonality and comparability of approaches so that problems and techniques can be broadly shared, resulting in more effective communication and efficiency of all facets of the biological research, training, and dissemination enterprises.

2. Program Themes

2.1. Biological processes involving stochasticity

The program element focusing on stochastic phenomena is transversal, cutting across all hierarchical levels of organization. Time adds a critical dimension to the integration of stochastic phenomena into living systems and in the development of their effects. Research aim in this area will be to identify stochastic events, to understand their processes and analyze their consequences. The approach is founded on the concepts of complexity analysis, involving modeling and the requirement of experimental validation in order to reach predictability.

This program element could simultaneously incorporate theoretical and experimental biology research projects. It has also direct inferences on very specific biological problems such as changes of fitness during the life span (e.g. aging) of an individual, the impact of environmental changes on development, cell differentiation and gene expression.

Active research groups and on-going restructuring efforts of the scientific community in North America, Japan or Europe, could greatly benefit from such an IUBS initiative. A symposium dealing with Stochastic Processes would focus on such areas as developmental events, cell death, senescence, achieving a harmonious whole, and the developmental morphology of social structure.

### 2.2. Episodic events and development

Developmental cascades and networks of gene expressions provide the framework for this second program element. Evolutionary conservation of genes and body plans are especially pertinent and this view of development and evolution will provide a rich perspective to biological research in the near future. A thorough effort to explore the extent and the limits of this concept is necessary and must be coordinated through a new and innovative understanding to physiology and comparative biology using the very modern tools issued from genome research (DNA chips). This program element encompasses the molecular understanding of these processes, epigenetics, genetic variation potential and plasticity in response to changes of environmental cues. Time and reversibility are critical parameters in the development of this research. It has direct inferences on the understanding and the predictability of long term effects of single or periodic climatic events on individuals as well as ecosystems. Such a program could be developed alongside research projects that would include short and long term ecological information into the examination of the intimate processes of individual development. Such research projects which, by essence, need modeling and call for long term (several years) experimental design and validation will require a significant change in the evaluation system of research. Furthermore, as the experiments will not yield publications in very short spans the program will need strong political commitment and financial support for several years, to be developed. Fortunately, some national institutions are now considering these possibilities but they are not fully established, and an IUBS initiative could provide an additional and welcome input.

### 2.3. Reproductive strategies

Some plants or animal species adapt their reproductive strategies to environmental conditions. The selection processes which determine the choice of reproductive alternatives are still poorly understood. They are however of critical importance in the case of weeds and domestic plants, or in the case of pests of vegetal and animal productions. Also, in the case of domestic mammals (pigs, cows), where breeding techniques are well developed and based on a thorough physiological knowledge, why sexual reproduction still fails in almost one out of every four fertilization attempts still remains unanswered.

The integrative biology perspective offers an opportunity to reexamine, with the new tools developed by molecular genetics and ecology, the questions raised by physiology, comparative biology and population biology. Through this perspective, the aim will be to understand integration at the level of reproductive activity of the individual, and the level of fitness of the selected reproductive strategy in a defined, reproducible or evolving ecosystem.

A Symposium on Reproductive Strategies would have three foci: (1) The evolution of viviparity; (2) Asexual - sexual "switching"; and (3) Parthenogenesis. Each of these three foci would consider molecular/genetic, immunological, physiological, developmental, morphological, ecological, evolutionary and theoretical aspects, as represented in both invertebrate and vertebrate animals. Immunological aspects would be emphasized, because immunological phenomena will be better understood through an Integrative Biology approach; the allo-interactions of sperm-ovum, fetus-mother, etc., are implicit in the evolution of sexual reproduction and the modes that it facilitates.

## 2.4. Consistencies

Squandering and sparing, reorganization and release of energy flows, genetic information, of molecules, cells, or individuals are two intricately intermeshed aspects of living systems. With respect to the concept of fitness (and of selection) these factors are often approached by biologists with the idea that economy and efficiency have been effected by organisms through evolutionary processes. Squandering perceived at one level of organization or pace of time may be thought to provide means for survival, sparing and even reproductive success on other scales of space and time : pollen biology and dynamics or the immunological repertoire of mammals may illustrate these simple statements. In other words the mechanisms that maintain the homeostasis of individuals towards a changing environment or the consistency of biosystems whether they are natural or managed ecosystems, cellular or molecular systems integrate the variability of genomes, the plasticity of physiological functions, the flexibility of population and community dynamics. For many years the discussion has been mainly driven by ecology and theoretical biology. Recently the merging of functional ecology and population biology has put the concept of resilience under new scrutiny and reconsidered the concepts of homeostasy and consistency. These advances attracted in their wake a novel perception of biological diversity and of its constant renewal and transformation. Insights into the underlying processes were rapidly drawn from advances in molecular biology, genetics, evolutionary and comparative biology. The question of time and space is revisited by merging these approaches with paleontology and evolution. Together these disciplines have the potential to bring new tools and to initiate new experimental tests of ideas and theories.

Efficient transfer of the foreseen advances in technologies already driven by molecular biology, genomics and structural biology allow the formulation of questions of basic interest for the scientists and for the producers of industrial or agricultural goods: the introduction or subtraction of functions in individuals, their consistency with the process of development, their transmission through cellular or organismal generations, their impact on fitness, and the response to environmental changes.

From evolutionary biology bases we already know that integrative strategies that will be deciphered by such researches may be at least as diverse as the species themselves. The ambition may be daunting especially because it takes the biologists out of traditional disciplines. It implies a shuttle activity from genome research to ecology through the complete panel of biological organizational levels and institutional structures. The challenge of diversity of the integrative strategies will be properly faced when biological research is conducted quantitatively on a very large scale. The present advances in automation systems, scale-up techniques and information management make this goal accessible for genotyping, gene expression control, physiological monitoring, individual tracking, data acquisition and communication, computation and modeling.... Because of obvious economic stakes, these developments attract and need large financial investments. Although private companies have already commenced investing largely in these areas (especially companies mostly interested in plants), substantial support from public funds has also been increasing. Because of this, open access to these equipment and techniques should consequently be made possible in the very near future. A window of opportunity is open here to develop a renewed relationship/a new partnership between public and private research sectors and to address questions of immediate economic interest at the levels of ecosystems, communities and single species.

In this respect, progress will depend on a more deliberate scientific coordination among scientists that IUBS can assist in establishing, together with very strong motivation and dedication from policy and decision makers.

### 2.5. Interactions among species

"Interactions among species" comprises the whole suite of associations and effects of one species on another. The theme is especially appropriate for an integrative approach because of the opportunity it presents to simultaneously address numerous and diverse aspects of species interactions at levels ranging from molecules to populations, from developmental biology to ecology. It also can provide a means to address the previous questions of the TAIB program, including understanding the forces and mechanisms that shape the individual and mediate its activities and its reproduction. Interactions could be addressed in the context of both basic and applied research; the latter includes, for example, associations between agricultural crop species and their insect pests, and the evolution of antibiotic resistance among pathogenic microorganisms that affect human health. Interactions between humans and other species would be appropriate targets of study, as well as the innumerable interactions among non-human species.

One possible venue for promoting "Interactions among species" would be IUBS sponsorship

of a one-day symposium at the annual meeting of the Society for Integrative and Comparative Biology (SICB; formerly, the American Society of Zoologists), which meets in North America each winter. Symposia typically include 1012 oral presentations and entail a commitment to publish the proceedings in a regular issue of the Society's journal, the American Zoologist. SICB meetings attract a large and diverse audience of biologists, and American Zoologist is distributed extensively, both in North America and abroad. Other regular and special conferences outside of North America may provide similar opportunities.

The DIVERSITAS program also has identified "Interactions among species" as an essential element of its operational plan on biodiversity science. Indeed, interspecific interactions mediate the evolution of biological diversity, and they do so through specific inter- and intra-individual processes. One or more joint initiatives to pursue the theme of "Interactions among species" might come from members of the IUBS community who are also involved in the DIVERSITAS Program, as a means of pursuing both groups' objectives simultaneously.

## 3. Organization and Activities

The first planning workshop and meeting of the Scientific Steering Committee of the TAIB Program was held on 19-21 January, 1999, at the University of California at Berkeley, Ca. USA. The plan of action for the period 1999-2000 was approved, consisting of a series of IUBS workshops and symposia to be held in collaboration and co-sponsorship of a number of national and international organisations (UNESCO, ESF, CNRS, JSC, AAAS). This planning workshop was followed by a symposium on "Integrative Biology" dealing with the rationale of the TAIB program and integrative approaches addressing its various themes, and held within the framework of the American Association of the Advancement of Science (AAAS) Congress, held in Anaheim, USA, 22-25 January 1999.

### 3.1. Scientific Steering Committee

The Scientific Steering Committee of the TAIB Program has been established as follows:

Prof. Motonori Hoshi (Japan), Chairman and Profs. Giorgio Bernardi (Italy), Jean-Claude Boucault (France), Chang-Hung Chou (Taiwan), Richard Dyer (UK), Brian Hall (Canada), James Hanken (USA), Peter Kareiva (USA), S.C. Lakhotia (India), Michel Loreau (France/Belgium), Jean-Claude Mounolou (France), Werner Rathmayer (Germany), Naoyuki Takahata (Japan), José Galizia-Tundisi (Brazil), Marvalee Wake (USA), Peter Whittaker (Ireland), Lars Wolloe (Norway), and Talal Younès (IUBS), Members.

### 3.2. Future Activities

Future TAIB activities include a series of three workshops to be organized in 1999, as follows: (1) A workshop "Integrative Biology Approaches to Study Episodic Events in

Watershed Systems", will be organized on 10-12 June, 1999, in San Pedro, Brazil, prior to the IUBS Executive Committee Meeting; (2) A Workshop on the "Various Aspects of Stress Biology within the Framework of the TAIB Program", will be held on 15-18 October, 1999, at Tongji Medical University, Wuhan, China; and (3) a Workshop on "Reproductive Strategies" to be held on November, in Hayama, Japan.

TAIB activities in 2000 will include the organization of a series of workshops on Integrative Biology Approaches to Study and Research of Stochastic Phenomena, Integrative Biology-the Relevance of Individual Based Models (IBM), Integrative Biology and Consistencies: Epigenetic Development and Genetic Imprints; and Integrative Biology Education.

### 3.3. More Information

For more information about this program contact the IUBS Secretariat , or write to :

Professor Motonori Hoshi, Chairman, IUBS/TAIB Program, Department of Life Science, Faculty of Bioscience and Biotechnology, Tokyo Institute of Technology, Nagatsuta, Midori-ku, Yokohama 226-8501, Japan.

Tel: 81 92 5720; Fax: 81 45 924 5777; E-mail: mhoshi@bio.titech.ac.jp

# BioEd 2000

## The Challenge of the Next Century

## International Symposium co-sponsored by

## IUBS, UNESCO, MNHN (France) and LDES (Geneva)

## 15-18 May, 2000, Museum Nationale d'Histoire Naturelle, Paris, France

During the last thirty years biology has advanced considerably, playing a central role in the development of the society and impacting on almost every human activity.

Rapid strides in researches within the various fields of biology have transformed its overall landscape, resulting in the development of new fields of genetics, biochemistry, biophysics, biodiversity, neurobiology, immunology, etc. with molecular biology taking the dominant position. Innovative approaches using cell and molecular biology techniques resulted in a better understanding of biological forms, processes and functions. Breakthroughs have been achieved not only in the knowledge of the brain functioning, but also in the comprehension of global ecological cycles and global change phenomena. With the new visualisation of the earth from space, and improved global ecological modelling and monitoring, more attention is being paid to biodiversity and ecosystem sustainability.

Applications of new technologies and recent biological advances in biotechnologies, genetic engineering, reproductive controls, etc., have important bearings on society through the production of new drugs, diagnostic procedures and clinical techniques as well as improvements in agricultural methods and anti- pollution processes.

The new biological knowledge and technologies have also raised many questions especially in relation to ethics. Just how far can we go in gene manipulation ? What are the risks involved ? Is it right for us to determine the sex of a unborn child ? To what extent can we use live animals in laboratory experiments ? Can one envisage and justify the cloning of humans, etc. Faced with such complex issues, what is the basic Biological knowledge that each individual should possess in order to address these questions ? Where and how can this basic knowledge be acquired ?

Paradoxically, with the advances of biological sciences, biological illiteracy has also increased, and the gap between researchers and the general public has widened. In addition to the changing content of biology, the methods of its teaching and learning have also changed. In order to address successfully various concerns of environment, health, ethics and global citizenship, general biological literacy emphasizing a high standard of public awareness and acquiring the basic biological knowledge has become a goal of education for entering the 21st century. Closely associated with this is the informal science education conducted through museums, aquaria and multimedia wherein biology education is increasingly occupying a more central role.

The use of computers and new communication technologies have also transformed the acquisition biological knowledge. It has not only provided access to more people, but has also brought within their reach large databases. Further, it has encouraged greater interaction

among teachers, scientists and students, and have opened the door to create new ways for teaching science in schools.

In the context of « research » biological education, it has been shown that learning is not merely the result of transmission or conditioning mechanisms. Constructive pedagogy, in fact, is limited by this process. The successful appropriation of knowledge requires a major transformation in the very thinking process of its recipient. It necessitates the development of multiple complex strategies and new educational environments for learning-teaching of biology. These developments have brought us to organising BioEd 2000.

The First International Congress on Biology Education, was held in 1975, in Uppsala, Sweden. It was organised by the Commission for Biological Education of the International Union of Biological Sciences (IUBS-CBE), with the co-sponsorship of UNESCO. Almost a quarter of a century later, there is now a need to ask questions about the relevance and effectiveness of biological education. Through the Bio.Ed. 2000, the Commission is inviting those concerned with biology and its education to share and evaluate their past experiences and to determine future policies. This meeting is essential because of the growing impact of technological and socio-cultural implications of biological research findings and concerns such as those raised by the mismanagement of natural resources and health. It has further become imperative because of the changes to the delivery of education through technological developments and the questioning of the current educational policies and with regard to the role of vocational education, life long learning , self learning and other various issues. This need has also been reflected in the report of the UNESCO International Commission on Education for the 21st Century. In assessing the situation of biological education, Bio.Ed 2000, in Paris will address the following questions with a view to develop guidelines and recommendations for making biological education more relevant for the year 2000 and beyond :

What is the core biological knowledge that needs to be internalized and why is this knowledge so essential for entering the next century ?

In particular, what constitutes this new knowledge ?

What are the questions the students and public at large asking ?

What bearing do they have on biology teaching ?

What are the most appropriate educational or communication strategies ?

What role does interdisciplinarity play ?

What are the new tools ? What are the new roles of teachers, curators and journalists ?

Who are the new partners ?

How can the school, mass media and museums help in the development of public awareness and understanding of biology ?

What would be its affect on education in relation to environment, health and civic consciousness ?

The symposium proceedings will comprise of plenary sessions, round table discussions and workshops. In addition to research papers, the programme will include exhibition of posters, books, manuals and documents as well as innovative educational materials. A daily Newsletter published during the symposium will be available to participants and accompanying persons.

Papers, communications, posters and educational materials relevant to the conference themes are invited. Final selection will be made by the International Committee, taking into consideration the space and time available.

What's New ?

BioEd 2000

The registration fee will be 200 Euros or 150 for those who register early (30 April 1999). This will cover the cost of initial preparatory documents, tea/coffee during breaks and the grand banquet.

Hotel costs and other living expenses will be borne by the participants themselves.

A list of hotels, of different price range, will be available from the Local Organizing Committee for participants.

Papers and proposals should be submitted before 30 April 1999 to:

IUBS-CBE,

51 Bd de Montmorency, 75016 Paris, France.

Ph : + 33 1 45 25 00 09

Fax : + 33 1 45 25 20 29

E-mail : iubs@paris7.jussieu.fr

http ://www.iubs.org

Registration forms should be returned before the 31 December 1999 to:

BioEd 2000, MNHN

Grande Galerie de l'Evolution

36 Rue Geoffroy Saint Hilaire, 75005 Paris, France

Ph : + 33 1 40 79 39 20

Fax : + 33 1 40 79 39 26

E-mail : laurier@mnhn.fr

Information, Registration forms can be obtained from the above address or on Internet Website:

www.unige.ch/fapse/SSE/teachers/giordan/LDES

(Information regarding proposals as well as registration can be sent by e-mail)

The IUBS Commission for Biological Education (IUBS-CBE)

The IUBS Commission for Biological Education was established in the early seventies as the Union's educational arm. Its major role is to formulate, initiate and facilitate effective methods of improving education in the biological sciences and allied fields, including the applications and implications of biological studies. The Commission is also committed to assist in the international dissemination and exchange of information about biological education and it acts in a consultative capacity when appropriate.

Besides the support of its parent body, the Commission has been fortunate in receiving cooperation and financial support from various bodies, particularly UNESCO and other regional and national organisations.

In the early evolution of the Commission's work, there was an international congress held in Uppsala, Sweden, in 1975. It was organised by the Commission with the co-sponsorship of UNESCO. Its aim was to define and evaluate current trends in biological education world wide; identify the issues, problems and challenges; and propose cooperative action required to deal with the variety of demands on biological education in the future.

Following the Uppsala congress, the Commissions policies were adapted to be more directly relevant to educational practice and mindful of broader concerns such as social health and environment. The Commission thus became more fully international and its interest reflected a particular concern for developing countries. During the past decades the Commissions activities have mainly involved working on projects guided by the said broader perspectives.

Its initial project was concerned with Biological Education for Community Development and among topics covered since are: University Biology for Non-Specialists; Out-of-school Biology Education; Field work for Secondary Schools in the Tropics; Health Education through Biology Teaching; Biology Education for Sustainable Development; Teaching of Systematics; Computers in Biological Education; Educational Aspects of Bioethics; Bio-technology Education; Biology Education and Basic Human Needs; Biology, Humanities and Education; New Learning Models for the Teaching of Biology; Health and Environ-ment; Order and Diversity in the Living World-teaching about taxonomy and systematics in schools; and Teaching Neurobiology and Behaviour. The product of each project was published in book form.

In association with the said work, the Commission has held regular annual meetings each held in a different country, e.g. UK, Germany, Finland, Australia, Singapore, India, Kenya, Netherlands, Japan, France, and Russia. Members of the Commission have also contributed to the work of a number of other international and regional bodies with similar interests.

BioEd 2000 is organised by the IUBS-CBE in collaboration with the 'Museum National d'Histoire Naturelle', in Paris, France and 'Laboratoire de Didactique et Epistémologie des Sciences', the University of Geneva, Geneva, Switzer-land, and with the co-sponsorship and assistance of UNESCO.

More information can be obtained from the IUBS Secretariat, in Paris, France.

Local Organizing Committee:

Prof. Doctor André Giordan

University of Geneva, Geneva (Chairman)

Prof. Patrick Blandin, MNHN, Paris

Dr. Orlando Hall Rose, UNESCO

Dr. Talal Younès, Executive Director, IUBS (Vice-Chairmen)

Dr. Faqir Vohra, General Secretary, CBE

(Coordinator)

Prof. Yves Girault, MNHN, Paris

(Executive Secretary)

International Committee:

Dr. Winston King, (Chair, CBE) Barbados

Dr. Faqir Vohra, (Gen. Secr., CBE) Malaysia

Prof. Patricia Morse, (Vice Chair, CBE) USA

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# The Human Dimension in Biodiversity

**A report of an IUBS-International Association of Human Biologists Colloquium, held on June 28-July 4, 1998 in Sun City, South Africa.**

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Among the wide variety of topics in Biodiversity discussed in the Dual Congress in Sun City, South Africa (June 28-July 4), the Human Dimension in Biodiversity was the subject of one special colloquium. At an earlier IUBS workshop on this subject in Denver in 1994, several themes were recommended for inclusion in the DIVERSITAS program (Hauser et al. 1994). By contrast, in the Sun City colloquium, attention was focused on actual work that had recently been done or was currently in progress, but with emphasis on studies in third world countries.

In her opening address, Gertrud Hauser pointed out that studies on the Human Dimension in Biodiversity are themselves diverse. For example there are inquiries into the duration of man's influence on his biological environment, seeking evidence from those earlier periods when it was thought that human populations were not large enough and their culture was too poorly developed to do permanent harm to co-existing species. Others inquire how recent and contemporary simple cultures with their close relationship to their environment have helped to maintain Biodiversity. A further group deals with Man's role in increasing biodiversity at the present time, covering both intentional and unintentional increase of variation. Illustrating the second of these themes were the papers in this colloquium.

Catherine Homewood's paper presented some results of her work in Tanzania. Mkomazi game reserve is a semi-arid savanna area with a long history of use by resident, as well as reserve-adjacent, populations of pastoralists, agropastoralists and hunters. That use continued for decades after reserve gazettement in 1951. In 1988 residents were evicted on the grounds that they were endangering biodiversity, and there has been no legally permitted use of the reserve by the local communities since that time. Recent species inventories show one of the highest biodiversity levels recorded among African savanna sites for a range of taxa. However, the way in which biodiversity values have been measured and interpreted in Mkomazi and elsewhere raises questions over the legitimacy of their use as a yardstick of relative conservation importance, often presented as justification for setting aside the user rights of local communities. Until recently savanna areas tended to be overlooked by natural scientists interested in biodiversity, but now detailed work has found unexpectedly high biodiversity in a number of savanna sites on different continents. Where claims of outstanding biodiversity are based on comparisons between areas that have been investigated in depth with others that have not been subject to similar detailed research, neither the comparisons nor conclusions as

to the relative value are legitimate. Comparative biodiversity values recorded for Mkomazi are analysed in this light. Secondly, the documenting of high biodiversity values within a few years of allegedly environmentally damaging levels of use by local people begs questions as to the real effects in indigenous communities, pre-use levels may have been even higher; recovery too may have been remarkably rapid, in which case levels of local resource use perceived by outsiders as deleterious do not in fact threaten the ecosystem, in the long-term; or indigenous land use in Mkomazi may even actively maintain and foster high biodiversity. Comparative data from Mkomazi and elsewhere are used to test these alternatives. Current understanding of the interplay of conservation with development, and of environmental issues with human rights imperatives, necessitates a reassessment of the way biodiversity is catalogued, interpreted and used in cases such as Mkomazi.

A similar change in the systemic man-environment relationship, but this time emphasizing the effect on human communities themselves, was illustrated by Philippe Lefevre-Witier. Drawing from his work among the Tuareg he showed how human biodiversity is related not only to their gene pools, but also to the cultural adaptations they have developed in the harsh environment which they sustain and manage. The tribes of Tuareg nomadic herders provide a striking illustration of a survival strategy under the severe pressures of the harsh environment of the Sahara desert. During the last thirty years this strategy has been threatened by drastic changes in their political and social environment. Cultural exchanges and herding capacity have been limited by the imposition of new political frontiers and by the occurrence of repeated droughts. The result has been increasing sedentarisation which has modified the mating structure (and therefore in due course the genetic structure), the nutrition and education. Lefevre-Witier asked whether it is possible to maintain a nomadic pastoral life in the changing conditions or whether this pattern of land use, sustained for centuries, will inevitably disappear.

The relationship between the human genome and the physical environment was explored by G.-F. De Stefano, comparing samples of populations who have lived in the same environment for differing lengths of time. His examples were put in the context of other determinants such as intermixture and ideology. His field studies on genetics and demography in populations in Ecuador showed the existence of tight bonds between cultural choice and biological features, again outlining the relevance of culture to the maintenance of intraspecific biological diversity.

The importance of preserving biodiversity for maintaining the economic lifestyle of traditional populations was illustrated by Mila Tommaseo Ponzetta and Maurizio G. Paoletti from their studies in Irian Jaya and Venezuela, in very different populations in very different habitats. Their work concerned the place of mini-livestock in human subsistence patterns. The number of insect species used as food is well over 1000, and the practice is found in many different habitats from arid savanna to equatorial rainforest. After describing the biogeography and biodiversity of insect food species, they showed the high nutritional value of insects compared with other common foods: the high content of proteins, fats, essential amino acids and micronutrients of insects makes them a valuable complementary food especially in those tropical populations where the diet is mainly based on a staple carbohydrate. They reported on work assessing the use of palm worms in Guajibo, and developments to encourage local small -scale production of them for consumption and sale.

Two species of rodents traditionally hunted by the Amerindians are in a stage of possible domestication and breeding at village level for meat production and sale. This work shows how strategies to help maintain and develop biodiversity for human sustainable use come from study of the populations knowledge of local species, so that the conservation of traditional knowledge is a priority aim.

P.S. Ramakrishnan's presentation consisted of two parts. Firstly he presented the IUBS SCOPE and UNESCO DIVERSITAS program showing its enormous range. Secondly he described the sacred groves in India and their importance as a reservoir of species that have disappeared or are threatened elsewhere. In the context of ecosystem functioning, one may view the role of humans from perspectives placed along a gradient. At the one extreme are human societies which are integrated well with their ecosystem, contributing from within to its functioning; these are the more traditional human societies who live close to nature, depend on their immediate natural resources and use biodiversity in a variety of ways for their livelihood. At the other extreme are the industrial societies which utilize heavily a wide range of natural resources, for the quality of life that they maintain, but more remotely; these are large ecosystem-level-processes affecting identified ecosystem from outside their boundary. Therefore one needs to consider the human dimensions of the problems related to biodiversity and ecosystem management differently, depending on the kind of biological and physical linkages with human societies that are involved. Ramakrishnan expressed concern at the apparent slowness in development of the human dimensions component of the Diversitas program, particularly in view of its importance to understanding present biodiversity and its maintenance.

In his concluding remarks D.F. Roberts said that he had the same feeling as Ramakrishnan about the slowness of development of the human dimensions project, and sought the reasons for it. Obviously some progress was being made, as the presentations in this colloquium showed. He compared the limited interest in, and enthusiasm for, this project amongst the appropriate research workers by contrast to that in the previous IUBS international programs (the Human Biology sections of the Decade of the Tropics 1984-1993 and the International Biological Program 1964-74) and he attempted to identify factors that may have contributed to this:

1. Contributions to the human component in previous biological programs were designed by and depended on the input of scientists and research teams who, realizing the importance of comparability of technique and problem definition, combined their efforts in a coordinated attack on particular problems. Funding of the work of those individuals and teams was their own concern, and central funding for the Program was minimal and restricted mainly to supporting meetings for planning and review. That is to say, existing work was built on, encouraged and channeled. In the human biology biodiversity program, the direction of the impetus has been different, and the scale is different, for it was initiated from the Union, by colleagues whose primary research interests lay elsewhere. There appear to be few topics in which rigorous comparability of technique is needed or possible. Moreover the financial climate has changed, there is less flexibility for research units to incorporate additions to, or to modify, approved schedules. The Steering Committee does not have the resources to be able to offer any, even a token, inducement to potential contributors to expand or to partially reorientate their existing activities to help with the biodiversity program.

2. Those interested in describing human intraspecific biodiversity may already have been active in other international programs, or may not have been interested in developing the ecological approach required. In some quarters attention to biological diversity of mankind is not regarded favorably. Indeed, the view was advanced by colleagues in some countries that it entails the perpetuation of the concepts of race and race classification, reawakening their fears of racism.

3. Obtaining human data will be to the advantage of the advanced countries and not to the traditional societies from whom much of the information must come. Related to this criticism is the feeling that the aims of the Program are political rather than scientific, in that its activities are directed towards the implementation of Agenda 21 and the Convention on Biological Diversity that were hammered out in Rio de Janeiro.

4. People outside the program but working in the topics accepted by the Steering Committee remain in ignorance of, or are unaware of, the mechanisms of international programs and do not know that they could tailor what they can offer to meet the requirements of the biodiversity program, or what they can achieve if they do so.

5. Finally, perhaps the Program was too broad in its formulation, so that potential contributors have been put off by the lack of precision. It might have been more attractive to select a more detailed topic of immediate interest to them that lay within the general concept of biodiversity. It seems then that for the apparent limited interest in the human dimension section of the biodiversity program, several factors are responsible. They stem from lack of communication between organizers and potential contributors, in both directions; from lack of comprehension by individual scientists of the working of international programs, and by organizers of the needs of potential participants; and lack of resources to meet those needs.

This IUBS-sponsored colloquium was well worth while, it illustrated a number of the types of study that deserve to be expanded. It showed the importance of the knowledge and practices of unsophisticated societies, essential for their survival and maintenance of the biodiversity of their habitats. It is to be hoped that studies along the lines of those in this colloquium as well as others recommended by the Denver working party, (G. Hauser et al. 1994) will be implemented as a matter of urgency.

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Future Trends in Research on Medicinal and Aromatic Plants

# A Report of the 2nd World Congress on Medicinal and Aromatic Plants for Human Welfare, WOCMAP-II, 10-15 Nov., 1997 in Mendoza, Argentina

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## Introduction

The 2nd World Congress on Medicinal and Aromatic Plants for Human Welfare (WOCMAP II) was held between 10-15 November 1997 in Mendoza, Argentina. It was organized under the mandate of IUBS by the International Council for Medicinal and Aromatic Plants (ICMAP) and in collaboration with the International Society for Horticultural Science (ISHS) and the 'Sociedad Argentina para la Investigacion de Productos Aromaticos (SAIPA)'. The theme of the Congress was 'Challenges for the 21st Century', and the main aims were:

To promote international cooperation in the broad field of medicinal and aromatic plant research and technology;

To offer a vehicle for the exchange of experience and information between experts from both less well developed and developed countries in all regions of the world to review the actual situation regarding the medicinal and aromatic plants sector in the Latin American region, one of the key areas in the world as regards biodiversity, availability of raw materials and culturization of the use of its natural resources in traditional medicine;

To make a contribution to the better understanding, reappraisal, correct use and protection of the plant genetic resources that are used for their medicinal or aromatic properties.

A National Organizing Committee based in Buenos Aires and a Local Organizing Committee in Mendoza bore the brunt of the detailed organization of the congress, supported by an International Scientific Committee and a Regional Committee.

## The Congress

The congress was attended by 1045 participants from 52 countries, more than double the expected attendance, and nearly three times the 350 participants attracted by the previous and first congress that was held in 1992 in Maastricht, The Netherlands. As might be expected, the greatest number of participants came from countries in South and Central America thus making the Congress a regional event for several organizations in Argentina and the neighbouring countries, Chile, Uruguay, Paraguay, Bolivia and Brazil. On the other hand, the

participation from North America and Asia was disappointingly small and there were no African representatives.

The host city of Mendoza, in the foothills of the Andes, was a perfect setting for the congress and in line with ICMAP's philosophy of regionalising the venues.

The congress brought together a wide array of experts from different fields pharmacologists, chemists, conservationists, biologists, commercial producers, ethno-botanists, and environmental legislators- all concerned with some aspect of medicinal and aromatic plants for the benefit of humankind. The large number of participants reflected the increasing interest world-wide that is being shown in these resources whose trade amounts to some 14 billion US dollars annually and constantly increasing. During the congress, four plenary lectures, 540 papers and a large number of posters were presented, grouped into the following sections:

Aromatic and medicinal plants as biological resources

Developments in agricultural methods

New approaches to the search for novel compounds

Advances in pharmacology and toxicology

Developments in industrial processing of medicinal and aromatic plants

Maintenance of standards and the need for new regulations.

Quality control

The economics of supply and marketing of medicinal and aromatic plant materials

Conservation and sustainable use

In addition, 39 firms, laboratories and universities participated in the exhibition 'Expoaromed '97' organized in the Congress Centre throughout the congress.

In his inaugural address, the President of the Congress, Professor Vernon Heywood, noted that the first World Congress on Medicinal and Aromatic Plants was organized to

commemorate the 500th anniversary of the meeting of the two cultures. It was therefore highly appropriate that this Second Congress should be held in the New World, in Mendoza, in the region of Cuyo, in the foothills of the Andes. In this province, what was originally a desert has been converted through the tenacious work of the inhabitants into a series of oases (los oases mendocinos) where vines, fruit trees and medicinal and aromatic plants are grown under irrigation in the 2.1% of the surface that is currently under cultivation.

He drew attention to the nature of medicinal and aromatic plants as natural resources, often harvested from the wild, and the need to use them intelligently and sustainably and to take steps to ensure their continued availability into the future. He also stressed the need to respect national and international legislation and recognize the sovereignty rights of the supplier countries over their natural resources and over information on the use of natural products generated in their own countries.

Prof. Peter Tétényi, President of WOCMAP I, gave a brief review of the historical background to the congress and the actions of ISHS and IUBS and other bodies during the previous 20 or so years that led to organize the first World Congress and subsequently to create an international umbrella body for medicinal and aromatic plants, ICMAP, under the aegis of IUBS.

Main Results

The Congress was notably multidisciplinary and it was encouraging to see the increased attention being given to the cultivation and propagation of MAPs based on 'Good Agricultural Practices'. However, from the biodiversity and conservation presentations, it became increasingly clear that much more attention needed to be focused on MAPs as natural resources and that coordinated development of national, regional and global policies and strategies for their conservation and sustainable use, is vital to protect and utilize the diversity.

Much material is wild-harvested, often with little or no control, and few genetic resource collections have been made. These issues, along with benefit sharing and the need to conserve traditional knowledge, were addressed in the congress resolutions (Annex 1).

The complex question of phytopharmaceutical standards (consumer protection benefits versus market supply constraints) was hotly debated, again resulting in a resolution to develop and clarify procedures and monographs. In his Plenary Lecture, Professor H. Wagner suggested that phytomedicines will not survive the year 2000 unless quality control is improved and therapy regularized.

The Congress was held at a time when many areas of concern regarding medicinal and aromatic plants are undergoing a major assessment. Some of the key points that arose during the meeting are:

the need to recognize that medicinal and aromatic plants are natural biological resources that need to be sustainably and wisely used so that they will continue to be available for future generations

the recognition that these resources are under enormous pressure through increasing demand that has arisen partly due to population increase coupled with widespread loss of habitat, and partly through a movement in the developed world towards the increased use of 'natural' plant medicines and herbal products of all kinds

the need to recognize that traditional knowledge regarding the use of medicinal plants is also a resource and one that is also becoming endangered, thus stressing the need for increased ethnobotanical/pharmacological surveys

the need for much more attention to be paid to medicinal and aromatic plants as genetic resources for conservation, selection and breeding

the urgent need to improve the quality and follow strict standards for phytomedicines

the need for much more extensive and detailed research into cultivation and propagation techniques

the need to be aware of and operate within international, regional and national legislation that affects access to, wild harvesting, collecting and developing medicinal and aromatic plant resources

in particular, efforts need to be made to propose species of medicinal and aromatic plants whose situation makes them suitable for addition to CITES appendices

the general need for more accurate and detailed information to be gathered and coordinated on most aspects of medicinal plants: distribution, conservation status, wild-harvesting, cultivation, genetic resources, trade, legislation and so on.

These points have mostly been taken up in the Resolutions of the Congress (Annex 1) and it is to be hoped that every effort will be made to bring them to the attention of the responsible authorities.

Proceedings

Through an agreement with ISHS, the Proceedings of the Congress were published in 1998/9

as four volumes of Acta Horticulturae : (1) Biological Resources, Sustainable Use, Conservation, Ethnobotany; (2) Pharmocognosy, Pharmacology, Phytomedicines, Toxicology; (3) Agricultural Production, Post-Harvest Techniques, Biotechnology; and (4) Industrial Processing, Standards and Regulations, Quality Control, Supply and Marketing, Economics.

Details may be obtained from the ICMAP Treasurer, Hijlekamp 11, 6585 XT Mook, The Netherlands.

ICMAP General Assembly

During the congress, the General Assembly of ICMAP was held and elections for the officers and Bureau took place. Prof. Vernon Heywood of The University of Reading was reelected as President, although at his request for only two years, and Prof. Dr. K. Husnu Can Baser of Anadolu University, Eskisehir, Turkey was elected as Secretary-General. The former Secretary General, Ing. H. van der Borg, was elected as Treasurer.

The members of the Bureau of ICMAP elected were:

Prof. V.H. Heywood (UK) President

Prof. Ch. Franz (Austria) Vice-President

Prof. S. Chatterjeee (India) Vice-President

Prof. H. Baser (Turkey) Secretary-General

Ing. H. van der Borg (Netherlands) Treasurer

Prof. J. Bernath (Hungary), Editor of the Newsletter

Prof. K.T.D. de Silva (Sri Lanka) Member

Prof. A. Shalaby (Egypt) Member

The Regional Representatives of ICMAP elected were:

Prof. K.H. Baser - Near and Middle East

Prof. L. Craker - North America

Dr. A. Demissie - Eastern Africa

Prof.C. Wambebe - Western Africa

Dr. D. Abbiw - Western Africa

Prof. A. Shalaby - North Africa, Egypt and Sudan

Dr. J. Douglas - Australian Region

Mgr. Seidler-Lozykowska - Eastern Europe

Prof. J.J.C Scheffer - Western Europe

Prof. D. Sidik - Asean Region

Dr. P. Pushpangadan - SAARC Region

Dr. I. Vahirua-Lechat - Polynesia

Prof. M. Gupta - Central America

Dr. S. Debenedetti - South America

The General Meeting of ICMAP discussed the choice of the region for the next congress, WOCMAP-III, in the year 2003. It was decided that it should place in Asia so as to maintain a geographical balance. Tentative offers to host the Congress were received from India with the SAARC countries (South Asian Agricultural Research Council), Indonesia with the ASEAN group, Thailand and China P.R. Detailed proposals, in accordance with guidelines to be prepared by the Bureau of ICMAP, will be invited from these countries for consideration by the Board.

The World Congresses are a major element of ICMAP's activities and play an important role in achieving one of its primary goals, to act as a forum for establishing effective cooperation between the wide range of organizations and individuals that work in this complex and multidisciplinary field. Judged by this criterion, WOCMAP II was a great success and this was the result of a great amount of hard work undertaken by our Argentinian colleagues, by the officers of ICMAP and by all those who contributed to the meeting in one way or another.

Future Perspectives and the Role of ICMAP in Medicinal and Aromatic Plants Research and Conservation

The Convention on Biological Diversity has added a new dimension to the context in which medicinal and aromatic plants are considered today. The Convention specifically mentions species of medicinal value in the indicative list of categories of the components of biological diversity to be identified and monitored (CBD, 1994). It also calls for measures to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities for conserving and sustainably using biodiversity.

The International Technical Conference on Plant Genetic Resources held in Leipzig, 17-23 June 1996 is also highly relevant. In the 'Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture' that was endorsed by governments, the promotion of the development and commercialization of under-utilized

crops and species and in situ conservation of wild plants for food production (in the broad sense), were amongst the priorities listed. Medicinal plants come under both these headings, both wild harvested and underexploited. Likewise, medicinal and aromatic plants were included in the discussions held at the 'Ad Hoc Inter Agency Consultation on Promoting Cooperation on the Conservation and Sustainable Use of Wild Plants of Importance for Food and Agriculture' held in Paris, France, 11-13 February 1998, that was convened by DIVERSITAS, in association with UNESCO, FAO, IPGRI and the CBD Secretariat.

Genetic conservation of medicinal and aromatic plants has received little priority so far by genetic resource agencies and ex situ collections are very limited in coverage and size of accessions. There are substantial gaps in our scientific knowledge and understanding of in situ conservation of wild species such as the distribution of genetic variation within populations and methods of sampling it effectively, dynamics of gene flow over time, the role of marginal populations, demography, etc.

However, although there is now wide recognition of the important contributions that medicinal and aromatic plants make to the global economy and to human welfare, one of the greatest difficulties in assessing their importance as resources, either locally or globally, is the shortage of hard information about what species are used, what their distribution is, how they are collected or harvested, which species are cultivated and where, what are the quantities involved, what are the trade statistics. Much of the evidence is anecdotal although there has been a concentrated effort in recent years to gather information on these various aspects. Thus, national and regional assessments have been published for several countries; also various global reports have been prepared such as Husain (1996) on international trade, marketing and consumption of essential oils, and McAlpine et al. (1997) on future world trends in supply, utilization and marketing.

The use of medicinal and aromatic plants has an important socio-economic dimension. This is especially apparent in what is now termed bioprospecting, the collection and utilization of biological and genetic resources for the purpose of applying the knowledge derived from them to scientific or commercial purposes.

In recent years, there has been an increasing number of contractual agreements that have been entered into by a number of developing countries with pharmaceutical companies for the collection of genetic resources of potential useful plants, including medicinals, and sharing any benefits that may be derived from them. The most commonly cited and discussed one is that signed in 1991 between INBio (a private non-profit organization) in Costa Rica and the US-based Merck Pharmaceuticals whereby INBio would provide Merck with chemical extracts from wild plants, insects and microorganisms taken from Costa Rica's protected areas for Merck's drug screening program in return for a two-year research and sampling budget and US$ 1135000 and royalties on any resulting commercial products.

Biodiversity prospecting has raised a whole series of major social, economic and ethical issues as well as the biological, chemical, clinical and commercial aspects. Useful reviews may be found in the volumes 'Biodiversity Prospecting' by Reid etal. (1993), 'People Plants,

and Patents' by The Crucible Group (1994) and 'Access to Genetic Resources' by Mugabe et al. (1997). A summary of the field is given in a recent article in the scientific journal Nature (vol. 32: 535-540) under the title 'When rhetoric hits reality in debate on bioprospecting'.

The failure of a large number of companies to follow the example of Merck may be explained by the fact that the Convention on Biological Diversity signed at the Rio Summit in 1992 and that came in effect on 29 December 1993, reaffirmed the concept of national sovereignty of states over the biological resources within their frontiers. Thus raised issues such as intellectual property rights and access to genetic resources, also addressed by the Convention. What is not widely realized is that the Convention defines genetic resources, previously viewed in a mainly agricultural context, in a way that effectively includes all plant, animal or microorganism material from which genetic material of actual or potential value can be extracted. Thus collections of plants in botanic gardens are clearly genetic resources and so are herbarium specimens if DNA can be extracted from them.

As a consequence some countries have introduced such restrictive legislation that it makes access to genetic material very difficult and has had the effect of driving away researchers who would otherwise work in the countries concerned on plant exploration and related fields.

Another possible reasons for the reluctance of pharmaceutical companies to enter into bioprospecting agreements with countries is the increasing tendency for the industry to depend on combinatorial techniques to create new molecules and synthetic drugs rather than searching for new natural products as a source of new drugs. Others see the future as one in which the emphasis in bioprospecting will be on seeking gene-sequence information that can be used in medicine and biotechnology.

In the years ahead, ICMAP will endeavour to address these technical, scientific, legal and socio-economic issues and bring together under its umbrella the many organizations that are engaged in different aspects of this multidisciplinary field of medicinal and aromatic plants.

Annex 1. WOCMAP II Resolutions

The participants of the Second World Congress on Medicinal and Aromatic Plants for Human Welfare- WOCMAP II - meeting in Mendoza, Argentina, from 10-14 November 1997, bearing in mind:

The growing global demand for medicinal and aromatic plants products,

The growing threat to these resources caused by the continual conversion of natural and semi-natural ecosystems to other uses,

The need for the sustainable use of these resources,

The need to implement quality control of phytomedicines and other natural plant products,

AGREED the following Proposals and Resolutions, arranged according to the Sections of the Congress:

Section I: Medicinal and Aromatic Plants (MAPs) as biological resources.

1. To record ancestral knowledge of the species employed in traditional medicine and protect the cultural and biological capital they represent.

2. To recommend the protection of the natural resources used therapeutically in traditional medicine, as a matter of priority.

Section II: Developments in agricultural methods.

1. To compile information regarding the cultivation of MAPs, their propagation and their edapho-climatic requirements as a result of surveys, with a view to preparing guidelines on specific domestication and cultivation methods.

2. To promote the cultivation of MAPs for the development of phytotherapeuticals and food supplements of plant origin for the feed of animals used in human diet.

Section III: New approaches to the search for novel compounds.

1. To promote, in all countries, taxonomic research on the native flora with a view to validating traditional uses, and at the same time discover new compounds that might be applied in the food, pharmaceutical and cosmetic industries, and in agriculture

Section IV: Advances in pharmacology and toxicology.

1. To establish a centralized pharmacological and toxicological information system on MAPs and products derived from them, to which all countries should have access.

2. To request ICMAP to establish a Working Group to harmonize the protocols used in clinical trials on plants used in traditional medicine.

Section V: Developments in industrial processing of medicinal and aromatic plants.

1. To promote the application of Good Manufacturing Practices and methods for the validation of industrial processes applied to these plants or extracts from them

2. To recommend that UNIDO and other relevant organizations provide technical assistance in developing countries for the industrial processes used in MAPs; and to continue and strengthen training programs in the industrial use of MAPs for the benefit of humankind.

3. To create a technical information system in modular form, on agriculture, industrial processing, quality control, equipment design, formulation of products derived from MAPs; and that this should be freely accessible though suitable means of information communication.

Section VI: Maintenance of standards and the need for new regulations. Quality control.

1. To harmonize at international level the standardization and regulation of phyto-therapeutic preparations through the production of national and international mono-graphs, pharmacopoeias, regulations and registration systems.

2. To encourage governments and supranational regulatory bodies to accept monographs prepared by groups of experts as basic elements for the register of phytotherapeutical preparations.

Section VII: The economics of supply and marketing of medicinal and aromatic plant materials.

1. In view of the lack of information regarding trade in industrial products based on MAPs, and about the means of access to these, thereby constituting one of the major obstacles to their development:

a. Make available information on national, regional and international markets.

b. Establish and strengthen the legal infrastructure (sanitary register) for the commercialization of MAP products used in human health.

c. Prepare technical norms and the cost levels of agricultural, forestry and industrial production on a sustainable basis.

d. Establish national associations in the production sector, assisting in commercialization methods.

2. Make the information available through proper channels in cooperation with the relevant agencies of the United Nations, the World Trade Organization and the International Trade Centre.

Section VIII: Conservation and sustainable use

1. Request ICMAP, in association with FAO and IPGRI and other relevant organizations, to establish a working group, to review the conservation and sustainable use of the genetic diversity of medicinal and aromatic plants, and in particular to:

a. Make an inventory of the species concerned, their distribution, variability and conservation status.

b. Make a survey of the location of genetic resource collections of MAPs and the size of the accessions.

c. Make proposals for action, jointly with rural producers, the agricultural; industry and consumers, for the in situ and ex situ conservation of MAPs through local, regional and international organizations.

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# The Key Issues Facing Research in Horticulture Today and Tomorrow:

## Funding, Management and Organisation

### A Report of the XXV IHC Congress, Brussels, 1998

**By Silviero Sansavini**

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## Introduction

Horticulture is a heavy 'consumer' of research, a demand that is growing for a number of reasons. One reason is the marked gap in the horticultural development rates between countries and research can help to bridge it. Another reason is that horticulture is capital- (over 20 times a grain crop) and labour - (50 times) intensive, and only through research can the technology be developed to save time and money.

Horticulture also has a highly diversified market profile running from foods to flowers, ornamentals, the landscape and urban greens. It thus encompasses a vast variety of products, market niches, and production, management and processing modules, all of which require advanced research that extends into information and communications systems. Hort-Research increases and upgrades the quality, healthiness and value-added of produce, and provides a more balanced dietary regimen. It often drives the improvement of other sectors and crops. It is mistaken to allocate HortResearch funding in proportion only to its yield profile. Rather, it is to be seen within the overall framework of the needs in agriculture and of the given country. Thus HortResearch should be considered on a par with the other production factors which bear high returns on investment. In the USA, for example, the USDA reports that allocations to agriculture are a good investment because of their 35% return rate.

Of the many factors contributing to a competitive horticulture, research is certainly one of the most important, along with the environment, capital, labour, technology, skills, education, training and consumption. The World Congress on Horticulture Research (WCHR), held in 1998, underscored that countries featuring advanced development in horticulture also enjoyed advanced development inresearch, especially basic research. This kind of research aims to achieve excellence in yields, quality and healthiness of produce. This means that basic and applied research and any derivative technology are interrelated.

Countries with fairly developed or emerging economies feature research profiles heavily marked by goals for applications designed to increase yields, improve environmental adaptation, promote consumption and strengthen the overall industry. Developing countries often have enormous production potential, and their research, which is necessarily linked to their economic development plans, must make the best use of natural resources (e.g. germplasm) and create the conditions needed to introduce new ones. Promoting consumer

demand as incomes rise is also a priority in these countries. These examples show how much organisation and targets change from case to case and how important it is to direct consumer preferences on a parallel track with respect to rising disposable income.

## Organisation

There are as many models of research organisation as there are policy decisions that have determined them. The success of research depends on a good organisation chart, and research can only be successful when it meets targeted objectives with efficient costs and inputs, enhances resources, means and human capital, and when it is translated into technology and other outputs with short-term economic returns.

A well-organised research means skilled human resources and adequate facilities, priority setting and attainable objectives, economic resources adequate to the agenda, skilled management, and technological development and transfer, enhanced market share

## Research Goals and Priorities

The priorities in research that emerged from the WCHR include the following:

### General Goals

The Environment: Reduce the impact of energy inputs and develop an eco-friendly, sustainable horticulture with Integrated Pest Management (IPM), and organic production protocols.

Improve Produce Quality: Breeding, selection, best crop management practices (BMPs).

Health: Food security guaranteed by production and postharvest technologies, eliminate chemical residues, pests and pathogens of stored produce and assure higher quality and shelf-life.

New Product Development: Fresh & processed foods; material for nursery, landscape, urban green space, ornamentals and flower sectors.

Other components of these priorities include: (i) cutting production costs by using more flexible technologies adapted to given circumstances, (ii) developing mass-media channels to educate the consumer at home, at work and at school about new technologies and the health value of foods, (iii) promoting technology transfer from research laboratories to field application, and (iv) developing effective and efficient systems of cooperation.

Research Areas

Plant genetic resources: The identification, preservation, use and control of plant genetic resources play a vital strategic role in horticulture for the future develop of produce diversification. Conserving and protecting germplasm, as experts call it, means first of all safeguarding biodiversity, i.e. the natural genetic variability that is the savings bank for the future needs of mankind. Here too political controversy is no stranger, despite the general consensus on the basic objectives. As is well known, most of these resources are found in developing countries, whereas the technologically advanced countries have the ways and means to exploit the potential of these resources.

Biotechnology: this is the driving force behind the new green revolution in agriculture. It is being seen as the only way to meet the future needs of the world's fast growing population. Yet biotechnology is not without its adversaries. Controversial too is maintaining the balance of nature and biodiversity, both presumably being at risk because the genetically engineered organisms released into the environment might over the long term pose a threat to man and his crops and lessen biodiversity in the process. Nor is economics immune from these polemics, in that the patenting of genes and genetically altered organisms and plants has so far benefited multinational corporations whose oligarchic or monopolistic positions would enable them to control the world's main production pipelines. This opposition, which is ideologically freighted and scientifically questionable, has proved a stumbling block to the commitment of various countries to programs of scientific research. Nor should we forget to mention the strong impulse provided by the private sector in biotechnologies. Most of the US companies engaged in genetic engineering are posting losses of several billion dollars.

Sustainable Systems (integrated production & organic farming): Integrated production systems (IPSs) are a leading concept in the European Union (EU), and in other advanced countries throughout the world, and are often included within the realm of sustainable agriculture. The organisation of the production process and related research can be included therein. Main issues subsumed in (IPSs): Crop management (training, pruning, thinning, etc.); Crop protection; Soil management, nutrition; Water supply and irrigation; Ripening and picking; Crop quality assessment.

Post-Harvest Handling, Storage & Processing: Throughout the world postharvest crop losses are high. Many research programs are active in this field. Of course, postharvest is linked not only to growers but also to others involved in the distribution chain, although storage (physiology and maintaining crop quality) and packaging are paramount. There are also alternative techniques for improving the healthiness of edible produce, or to reduce costs of storage and handling, that are part of this research. They involve the very large field of processing (with new techniques that make processed fruits as competitive as fresh fruits visà vis quality and price). For some developing countries processed produce is more important than fresh produce because it is better suited to long-distance transport (market globalisation).

Marketing: It is common knowledge that promotion and marketing are essential in the

commercialising of horticultural products. Both are expensive and require specific organisation on the part of growers and supermarket/retail groups. They address two basic needs: Establishing an image (brand names & trademarks, labels, etc.) and building confidence in the consumer through education while providing a good safety guarantee in the production process.

## Research Funding

The key issues in research funding (who it comes from, what form it takes, and the criteria used to evaluate who gets what), are changing almost as fast as the pace of change being brought about by scientific and technological advances and in the process, global marketplace is changing the ways in which horticulture is developing. Public-sector spending in agriculture has gone from block grants to competitive grants and intramural allocations, i.e. more than one government department or agency funding a given project or projects, and these are project-specific in the United States. In the EU, same block allocations are increasingly becoming share-cost and marginal-cost grants whereby the partner institutions in a given project must defray many of the costs including overhead and management costs, being two significant examples.

On the private-sector side, what we see are certain companies, usually multinational corporations or their affiliates, performing all research in-house, with co-financing from the public sector or even user-contributor financing with associations or other groups in the private sector. The 'brain drain' of top-calibre scientists being lured to private industry from university departments can to some extent fall within the issue of funding, too, as this represents investment in research, management and human resources and a source of potential results, profits in spin-off technology, Intellectual Property Rights (IPRs) and the like.

As noted earlier, the large international agencies, foundations, non-governmental organisations (NGOs) and even governments play important roles as donors in international projects, although most of these are focused on research and development (R&D) and not merely research as such. The last approach to funding is the public-private partnerships and cooperation agreements.

## Management

Management in research is largely, if not entirely, a matter of how best and most efficiently, human and financial resources can be to harnessed in order to achieve the desired results. Yet this basic proposition has important implications regarding skills, performance, productivity and benefits that extend beyond purely economic aspects into the ethical sphere of human activity, where accountability and socio-economic concerns loom large. In short, management is the arena in which policy, organisation and allocated resources must coalesce into a whole which, under proper direction and motivation, becomes greater than the sum of its parts by virtue of the synergies and results it generates.

The public sector of national and local governments and private corporations, foundations, NGOs, cooperatives, growers and other end-users of research have a natural common ground in the universities and research institutes, whether public or private. That there is such a point of convergence means enhanced flexibility of vertical and horizontal movement in decision-making and task execution, although the risk of undue bureaucratic interference is a concern. It also ensures that the range of skills and expertise available is the broadest possible because the potential for setting up networks and partnerships, not to mention the information and communications systems that underpin the attendant logistics, is very important. If a proper management team can be put in place, the potential to achieve results that generate spill-overs and value-added is also greater.

## Cooperation

Internationally, there are several umbrella organisations supporting cooperative research. There are the European Union and other groupings in homogeneous geographical areas. In such cases, the member countries are legally bound to contribute to research funding. The research institutions can apply for funds on the merits of the projects submitted for evaluation. This competition in the funding arena means, for example, that in the EU only about 10-20% of the applications are approved. All EU applications for the Fifth Framework Program 1998-2002 must compete for 16.3 billion ECU. Funding requests for past programs were 5-10 fold higher than appropriations. Supply far outstrips demand, without mentioning the compulsory involvement in the projects of the private sector.

Another approach to cooperation is through agencies like the World Bank and the Consultative Group of International Agricultural Research (CGIAR). This type of system usually target certain issues in certain areas in order to encourage development and help solve important problems impeding that development. Yet horticulture's needs and identity in research are specific and the industry must find its own international approaches to concentration and cooperation in resource use and management. There are two starting points: by geographical area or individual commodity. The geographical approach seems to be easier because there can be a certain extent of homogeneity and of produce within and between given areas. For example, water is scarce in the Mediterranean Basis because of low rainfall. Setting up groups of international cooperation funded by member governments, and with the input of scientific associations like the International Society for Horticultural Science (ISHS), to solve key regional issues is one viable way to accomplish such tasks. Note that the World Trade Organisation (WTO) regards such regionalisation as a limit to trade and an encouragement to the erection of tariffs and other barriers thereto. Yet this should not be the case with research, although IPRs may pose a threat here.

The commodity approach has been successful to date only for major crops like soybean, grains, maize, rice. Yet most horticulture produce does not represent such enormous trade volumes internationally. Even the FAO did not include horticultural produce as part of the strategic commodities for food security. It should be noted, however, that crops like coffee, cocoa, banana, apple and orchids have global reach. One example of concerted cooperation is the ProMusa project for banana and plantain in Africa. Another example is the tomato where

cooperation in research is supported by the private sector and the collaboration of the ISHS and American Society for Horticultural Science (ASHS). There is also an umbrella group for nuts and ICMAP for medicinal and aromatic plants (see ICMAP Report page 17). Yet the commodity must have enough trade volume to warrant cooperation in research on an international scale.

An intermediary role between regional and commodity cooperation is played by certain large agencies and government organisations like FAO and IPGRI for plant genetic resources. Their role is also on the policy-making side as they deal with governments.

Countries that have a broad based international experience like France, the Netherlands, the UK and the US can significantly contribute to the merging of both approaches and achieve a certain measure of success. Of course, given that the WCHR is promoted by the ISHS and ASHS, it is quite germane to note here how much both societies have done and continue to do to promote international cooperation in research. Both follow their members from the time they first join as young scientists, help them to meet their counterparts all over the world, enhance their cultural maturity and encourage their joining international projects and programs. It is our ambition to bring the world of research closer to that of private enterprise and that of policy making. Our societies have among their membership recognised world-wide leaders and experts in all fields of horticulture.

## Research Policy

It is difficult to measure and monitor research in horticulture because of a dearth of official data. Dr. Jules Janick indicates that in the US publicly funded research is a solid investment with a 35% rate of return, a stake being shared by consumers, farmers and investors. We know that, in general, research appropriations for all sciences amount to somewhere between 1.5 to 3% of GDP in the advanced economies. Yet this indicator skews the measure drastically when applied to agriculture because the farm-gate does not include all the added value, usually double or thrice the Gross AgriProduct (GAP), and the health and social benefits resulting from the industry. Many countries are cutting support for agriculture to the benefit of secondary and tertiary sectors that have greater political returns.

This is all the more true in certain developed countries where the rural population ranges between 1% and 5% of the total. Lest governments forget, horticulture brings with it enormous advantages because it is labour, technology and capital intensive and assures a relatively high degree of expertise by people who live on, work and manage the land.

Research policy thus tends to safeguard agriculture in general, and horticulture in particular, against the enhanced risks of a completely free market. Especially in the advanced European countries overall supports for agriculture amount to 40-50% of the total value of all produce, and in Switzerland and Japan that figure can run as high as or higher than 80% between direct and indirect subsidies. Complete market liberalisation in such a scenario would lead to the demise of agriculture for the main commodities in many countries, beginning with Europe. It

would be utopian to think that the WTO's GATT accords can in a short time lead to full liberalisation of trade and the marketplace even if that were really desirable.

Technology quite apart, there are regions in the world that can produce crops at very low cost because of favourable climate, environmental and social factors. Fortunately, horticulture is able in part to avoid certain market risks because of the marked genetic variability of its species and their strong interaction with the environment. This creates the basis for quality traits that typify its produce and the districts of origin which the consumer is educated to recognise by special labelling.

Another consequence is that the same fresh product can be supplied to markets throughout the year because it is raised in both hemispheres in different seasons. This year-round seasonality now affects a range of products. To it, must be added the miracles of technology, which consist of modifying plant cycles, bringing crops to market 1 to 2 months earlier or 1 to 2 months later than the standard harvest dates. All of this is made possible by greenhouse, plastic coverings, soilless and hydroponic techniques in temperate zones and defoliation and doubling the growth cycle in warm and tropical zones. This represents a net gain for consumers and the economy. The American consumer, for example, can find cut flowers in the winter from Central America, as his European counterpart does from Africa. The cherry season in Europe alone can now be extended from 2 to 4 months by running the production pipeline from late April in southern Spain and in Italy to August-September in Norway. The market competition in horticulture is strongly affected by seasonality and complementary harvest dates. This also holds for all other highly perishable fresh produce, but naturally excludes such storable fresh products as apple, banana, tubers, bulbs and processed items like tomato and other vegetables, pears and the like.

The policy-making of governments should in part clearly focus on trade and commercial accords among regional areas to encourage produce integration, which would also mean integrating complementary research among countries interested in the same products. Such policy instruments would in effect shift a part of the funding allocations earmarked today for production and price supports to the field of research. This approach has the added advantage of reducing the risk of surpluses and of better regulating over the season supply and demand, which also matches the strategies of the large-scale distribution chains.

## Involvement of the Private Sector

The involvement of the private sector in cooperating with the public sector leads to better organisation and more efficient monitoring of human and financial resources (performance, productivity, deliverables, impact). This type of cooperation also delivers transparency in given projects, a more focused target in terms of goals and their pursuit, and an ethical dimension to overall management. The involvement of the private sector is also positive in the promotion and planning of projects, cutting costs and, more fundamentally, in directly applying results.

The private sector can participate in financing projects in various ways:

1. This can be done through partnerships with the public sector as, for example, taking a fifty-fifty share in a given program. Indeed, there are examples throughout the world that span a broad range of the cost-sharing spectrum.

2. Another way is having the private sector as an outside supporter of a publicly funded project, as in the case of grower associations funding certain research.

3. Perhaps the most important today, if we glance around the world, is in-house research conducted by private companies, whether in the form of groups of firms or by a single enterprise such as a large multi-national corporation. These latter have become world-wide leaders in certain research fields through patent rights and the immediate application of the findings stemming from that research. As scientists, it is in the interest of us all that technology continues to advance and that horticulture and agriculture continue to reap the ensuing benefits. Today this occurs not only in genetics and biotechnology but also in chemicals, engineering, information technology and advanced communications systems.

The multi-nationals, however, are essentially focused on short-term returns and a flexible market response. Given the trend to globalisation of economies, in some cases these firms tend to control large shares of certain markets and can exclude growers from added value of produce. It is therefore not possible to ignore criticisms advanced about wholly privatised research because there is a risk that policy will not be coordinated by public agencies that must take into account social as well as purely economic factors. Not to mention the case of those emerging economies where wee see progress occurring at two different speeds which leads to an imbalanced growth of the domestic horticulture industry and the economy. So that pure profit-seeking by private firms is certainly a risk in such cases.

## Concerted International Research

The benefits of cooperation are to be sought not only in public-private cooperation, as we have seen, but also in cooperation among countries on an international scale. Programs of international cooperation, especially between or among geographic areas of homogeneous development, are becoming increasingly more frequent. The programs funded by the European Union are a visible example of this, with the EU serving as the support umbrella for public-private partnerships and even for partnerships among countries on given projects. The fields of research that regard concerted cooperation include biotechnology, ecology, extensive production, protection of genetic resources, low environmental impact at all levels and the enhancement of all produce and commodities. Included among the benefits of this international cooperation, which in certain countries amounts to more than 30% of their research funds, are avoiding redundancy of projects and cutting costs, realising multi-disciplinary and interacting projects never before possible, providing the 'critical mass' for projects involving 'minor' crops, protecting biodiversity, developing new products, diversifying consumption, promoting partnerships with private industry and stimulating the economy, development and trade, upgrading the expertise of researchers, promoting cultural

wealth, enhancing life 'values' (nature, seasons, pleasure), and enabling country-to-country interaction.

## From a Strategy of Survival to a Strategy of well-being

The reports of the UN, World Bank and other international organisations agree that policy must meet the challenges posed by hunger and famine, water consumption and food security in terms of caloric intake (which was also the topic of the recent FAO conferences at Rome and Leipzig). Such staples as cereals, rice and maize rank at the top of their lists while horticulture and the benefits deriving therefrom are largely neglected.

While it is only right that all populations must first have their primary needs met, it is equally true that as soon as these populations reach the educational and income levels compatible with making their own choices, they will want a higher standard of living and greater assortment of products, including the foods they eat. They will also want those foods to contain the minerals, vitamins, fibres, organic acids, sugars, flavonoids and so on that play such an important role in physical well-being. This has been found among the peoples that have migrated to Western Europe and the US from Africa, eastern Europe, Asia, etc.

A fine-tuned agri-research policy would include research in such areas as medicine, dietetics, geriatrics, nutrition, sociology. It is probable that in future many kinds of produce will be customised by consumer age group, and there will be varying levels of quality at varying prices. It is evident that policy making must, once survival and food security are ensured, encompass the strategy of well-being that is compatible with the sustainable agrisystems discussed heretofore.

## Conclusions

The foregoing clearly outlines the enormous potential within the field of horticulture, the benefits that can flow from this potential and how these benefits can address the needs and requirements of populations in terms of food, health and well being. While the developed economies must assess whether it is more convenient to let the market determine horticultural production development or to pursue and maintain leadership in advanced HortResearch, with all the implications as to costs and returns. In the emerging and developing economies there is more interest in directly encouraging HortResearch in order to develop the entire economy and meet the primary needs of the societies.

There are also certain factors regarding the worldwide economy that call for reflection. While liberalised market globalisation generates economy dynamics it can also threaten weak and emerging economies, bringing with it the risk of instability, protection policies generating economic stagnation, international trade barriers and different rates of development among areas (regionalisation). Agriculture should have priority among primary industries in policy planning and HortResearch should be a priority within agriculture. Agriculture requires

strategic policy planning and implementation. Horticulture and its research arm are at the cutting-edge of scientific advances in agriculture, and policy must be informed by research input to help policy set the economic agenda.

The main elements necessarry in developing HortResearch in the future are public-private partnerships in funding and management through cooperation and international networks, which are the keys to bridging policy gaps and effectively handling the challenges facing horticulture. Only international networking can further research and the implementation of sustainable development. Cooperation is a key way to achieve efficient networking. Public-private funding partnerships are also fundamental in achieving the over all goals, profits, sustainable economic growth, social solidarity and environmental safeguards.

Research is the driving force of new technologies and management skills in a sustainable concept of agriculture. Horticulture is the core of this model, as the world moves gradually from a strategy of subsistence to one of sustainable well-being.

# ECOLOGY

## New Perspectives for the Third Millennium

### A Report on the VII International Congress of Ecology
### 19-25 July 1998, Florence, Italy

**By Almo Farina,**
**Secretary General, INTECOL, Lunigiana Museum of Natural History 54011, Aulla, Italy.**
**e-mail: afarina@tamnet.it**

According to the best scientific tradition, the World Congress of the International Association of Ecology has always represented a unique opportunity for thousands of ecological scientists to nurture a permanent high -profile world-wide. This forum has been available for more than three decades.

This last congress has lived up to these expectations with 2,200 offered papers and 80 symposia. Ten plenary speakers of world stature and a plenary round table on ecology and economy contributed to the success of the congress. Satellite events like the working groups on Long Term Ecological Studies, and on Statistical Ecology increased the scientific attractiveness of the program. More than 1,800 regular registrations from 70 countries confirmed the important role INTECOL plays on the international stage. It is important to note the number of young scientists that attended the congress.

Tab. 1: Attendants from the top ten countries.

Country Registered Regular Registrations Students

Italy 224 131 93

USA 251 132 119

Germany 172 116 56

Japan 123 95 28

UK 132 82 50

France 77 44 33

Switzerland 61 28 33

Canada 56 31 25

The Netherlands 50 40 10

Australia 48 40 8

The "diversity" of the INTECOL "family" has been respected and reflected through out the decades and again the congress served as a central forum especially for scientists from developing countries. In order to ensure a better communication between members, governments and environmental agencies, the initiative taken by Richard Hobbs (President of the Australian Ecological Society) to create a permanent forum comprising of presidents of the Ecological Societies was a very relevant move.

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In the "warm" climate of a sunny Florentine July the congress sessions were driven by a heavy scientific program in which "attendant defaillances" and organization gaps were rare events.

The handling of such a big event was not an easy task for the organizers (INTECOL and the Italian Ecological Society), and even participants experienced "navigating" difficulties in their efforts to attend the 15 daily concurrent sessions.

The scientific productivity of ecologists was of a very high standard and profile. The plenary sessions served as a reference status especially for the young scientists. The themes- The Integration of Ecology and Economy (Jane Lubchenco), The Theoretical Importance of the Ecology (Frank Golley), The Globalization and the Mediterranean Scenario (Francesco di Castri) dominated the first two plenary sessions. Jon Wiens and Henri Decamps discussed respectively the Scaling Properties of the Ecosystems and the Ecology of the Riparian Zone. Sir Robert May focused on the Processes Responsible for Complexity and Simplicity in Ecological Systems. A presentation of an ecological model based on the Everglades was made by Donald De Angelis. Harold Mooney reviewed the global efforts to capitalize the knowledge of biodiversity and finally Andy Dobson showed the importance of pathogens for ecosystem health. Most of these lectures will be found, in an extended version, in the first chapter of the congress proceedings. The round table, chaired by Gary Barret and Almo Farina, covered a wide range of topics relating to the conflicting role of economic processes from an ecological perspective. Francesco di Castri, Marino Gatto, Simon Levin, Jane Lubchenco, Zev Naveh and Bob O'Neill addressed this controversial issue from varying perspectives, sustaining a high audience interest in an afternoon session. They discussed most of the relevant approaches available today in order to integrate the economic world into the ecological one. The contributions presented during the round table will be extensively published in a special issue of Bioscience.

Although it is very difficult to summarize in a few words the level of interest generated by this congress, from my perspective as organizer, I have received a clear message from delegates that a genuine interest for such a large congress formula exists. For many scientists from developing countries, the INTECOL congress offers a unique opportunity for many experts in the area of ecological research to gather and discuss their respective areas of research. It is true also that from the INTECOL fora there generally springs new ideas and new fields for future research topics. And in particular from this last congress there emerges the necessity and the urgency to reconcile theoretical and applied research in order to meet the needs of todays world. Ecology more than other scientific discipline has the responsibility to carry out research that will contribute to a healthy life support system for all organisms from bacteria to humans.

The spread of old and new pathogens, the dramatic depletion of non-renewable resources, the diffusion into the ecosystems of thousands of new chemical substances, are some of the new challenges linked to the alarming acceleration in global change. In order to meet these challenges prompt action is needed in the area of ecological research. It demands a move from theory to practice using more and more integrated strategies. To meet this, high technologies and inter-disciplinary confrontation capacity are required in the new open-mind profile of the ecologist of the third millennium.

The Florence Congress was proof of a new workable means of interpreting the complexity of the real world. This global permanent workshop every four years allows for the verification of precedent guidelines by the use of an open, dynamic, self regulated and autopoietic scientific procedure. Never in the past has this facility been as important or as urgently required as it is today. Ecologists are beginning to realise the importance of establishing permanent connections in the different sub-disciplines and to be open to common language discussions with other disciplines particularly in the socio-economical and public health realm. The INTECOL mission has been strengthened by the success of the Florence meeting. It has gained a new vigour in its future implementation. The possibility of attaining this mission has also been enhanced by the new methods of electronic communication available to-day.

In conclusion many challenges are facing the future of ecology and the motto of the VII Congress "New tasks for ecologists after Rio 1992" appropriately represents our common commitment to meeting these challenges and solving the ecological problems of the future.

Fifth International Congress of Systematic and Evolutionary Biology (ICSEB V)

A Report on ICSEB-V, 19-25 August 1996, Budapest, Hungary

By Eôrs Szathmary

President IOSEB, Collegium Budapest, Szentharomsag utca 2, H1014, Hungary

This Fifth International Congress of Systematic and Evolutionary Biology (ICSEB-V) was hosted by the Hungarian Academy of Sciences and the Hungarian Biological Society on August 17-24,1996, in Budapest, Hungary. The Local Organizing Committee was composed of Gabor Vida, President; Eôrs Szathmary, Executive Vice-President; Istvan Molnor, Program Coordinator; Laszlô Vanicsek, Treasurer; and Laszlô Peregovits, Publications Manager.

ICSEB-V was co-sponsored by Boehringer Ingelheim Fonds, Collegium Budapest (Institute for Advanced Study), Hungarian Scientific Research Fund (OTKA), National Committee for Technological Development (OMFB), the International Union of Biological Sciences (IUBS), and Hungarian Airlines.

General

The main meeting of evolutionary biologists and systematists worldwide was attended by 600 participants. The Congress organization included 31 scientific symposia (see list below), 69 contributed papers and 170 posters. Most participants declared the meeting more interesting than many others with a similar topic and audience. Several publishers displayed their products. From the organizational point of view, ICSEB witnessed a major transition, with the establishment of IOSEB, the International Organization of Systematic and Evolutionary

Statistical inference of molecular phylogeny
The evolution of cells
The evolution of insect societies
The role of phenotypic plasticity in evolution
Parasite manipulation of hosts
The role of extracellular matrix in development and evolution
Biodiversity dynamics
The origin of the genetic code and translation
The reliability theoretical aspects of evolution
Geographical parthenogenesis: a model system in evolutionary ecology
Biogeography: geographical patterns and evolutionary interpretations
Morphometrics and evolution
Coevolution and mutualism: processes and patterns

International Society of Animal Genetics

(ISAG) Conference 1998

The 1998 International Society of Animal Genetics Conference took place in August 1998 in Auckland, New Zealand. Approximately 400 scientists participated in this event, and workshops were conducted on (1) Blood groups and biomedical polymorphisms in cattle, horse, pigs, sheep, goats and deer, and parentage testing in dogs; (2) Leukocyte antigens in cattle; (3) Avian immunogenetics; (4) Genetics of immune response; (5) Gene mapping in cattle, sheep, goat, deer, dog, horse, pig, poultry and rabbit; and (6) Comparative genomics and animal diversity.

Several of these workshops discussed results from ISAG-sponsored Comparison Tests which had been conducted since the last conference. These included Comparison Tests for deer blood typing, cattle blood and DNA typing, and horse typing. Participants in Comparison Tests are ISAG Institutional members and their efforts are aimed at standardizing blood group and DNA typing.

The next scheduled ISAG Conference will take place on July 22-26, 2000 in Minneapolis, Minnesota (USA). This meeting will include plenary sessions featuring invited speakers giving presentations on animal genomics. However, a more significant part of the meeting will consist of papers by the conference participants and workshops conducted by the ISAG members focusing on genomics, blood group polymorphisms, and parentage testing in specific species of domesticated animals. More information on ISAG and its meetings and activities can be found on the ISAG Website, (http://www.wisc.edu/animalsci/isag).

# Fifth International Congress of Systematic and Evolutionary Biology
# August 17-24,1996, Budapest

Dr. Eors Szathmary
President,
International Organisation for Systematic and Evolutionary Biology (IOSEB)
Permanent Fellow, Collegium Budapest
Szentharomsag utca 2, H 1014,
Hungary

The Fifth International Congress of Systematic and Evolutionary Biology (ICSEB) was hosted by the Hungarian Academy of Sciences and the Hungarian Biological Society.

## The Local Organizing Committee

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## Plenary lectures

Bickerton, D. (Dept of Linguistics, Univ. of Hawaii, USA)

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Plenary lectures

Bickerton, D. (Dept of Linguistics, Univ. of Hawaii, USA): Language evolution and social intelligence

Cavalier-Smith, T. (Dept of Botany, Univ. of British Columbia, Vancouver, Canada): The origin and diversification of cells

Davidson, E.H., Peterson, K. & Cameron, R.A. (Div. Biology, CalTech, Pasadena, USA): Developmental regulatory programming and the evolution of metazoans

Harvey, P. H. (Dept of Zoology, Univ. of Oxford, Oxford, UK): Revealing the processes responsible for phylogenetic and family tree structure

Maynard Smith, J. (School of Biological Sciences., Univ. of Sussex, Brighton, UK): Evolution and information

Page, R. E. (Dept of Entomology, Univ. of California, Davis, UK): The evolution of insect societies

Templeton, A. R. (Dept of Biology, Washington Univ., St. Louis, USA):

On the origins of species

Congressional Symposia

Experimental evolution
The evolution of language
Stress, adaptation and evolution
Macroscopic approaches to evolution
Adaptive dynamics: beyond the ESS
Philosophical aspects of individuality and evolution of development
The evolution of transmission of genetic information
Determinants of morphological evolution
Processes of molecular evolution
Mammalian molecular evolution
Plate tectonics and evolution
Biosystematics: meeting the demand
The new bionomenclature
Epigenetic inheritance and evolution
The evolution of insect-plant interactions
Origins of senescence and evolution of longevity
Evolutionary biology of mangroves
Why species exist?

Language Evolution and Social Intelligence

Cavalier-Smith, T. (Dept of Botany, Univ. of British Columbia, Vancouver, Canada)
The Origin and Diversification of Cells

Davidson, E.H., Peterson, K. & Cameron, R.A. (Div. Biology, CalTech, Pasadena, USA)
Developmental Regulatory Programming and the Evolution of Metazoans

Harvey, P. H. (Dept of Zoology, Univ. of Oxford, Oxford, UK)
Revealing the Processes Responsible for Phylogenetic and Family Tree Structure

Maynard Smith, J. (School of Biological Sci., Univ. of Sussex, Brighton, UK)
Evolution and Information

Page, R. E. (Dept of Entomology, Univ. of California, Davis, UK)
The evolution of insect societies

Templeton, A. R. (Dept of Biology, Washington Univ., St. Louis, USA)
On the Origins of Species

Congressional Symposia

1. Experimental evolution
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13. The new bionomenclature
14. Epigenetic inheritance and evolution
15. The evolution of insect-plant interactions
16. Origins of senescence and evolution of longevity
17. Evolutionary biology of mangroves
18. Why species exist?
19. Statistical inference of molecular phylogeny
20. The evolution of cells
21. The evolution of insect societies
22. The role of phenotypic plasticity in evolution
23. Parasite manipulation of hosts
24. The role of extracellular matrix in development and evolution
25. Biodiversity dynamics

26. The origin of the genetic code and translation
27. The reliability theoretical aspects of evolution
28. Geographical parthenogenesis: a model system in evolutionary ecology
29. Biogeography: geographical patterns and evolutionary interpretations
30. Morphometrics and evolution
31. Coevolution and mutualism: processes and patterns

# International Society of Animal Genetics (ISAG) Conference 1998

The 1998 International Society of Animal Genetics Conference took place in August 1998 in Auckland, New Zealand. Approximately 400 scientists participated in this event, and workshops were conducted on (1) Blood groups and biomedical polymorphisms in cattle, horse, pigs, sheep, goats and deer, and parentage testing in dogs; (2) Leukocyte antigens in cattle; (3) Avian immunogenetics; (4) Genetics of immune response; (5) Gene mapping in cattle, sheep, goat, deer, dog, horse, pig, poultry and rabbit; and (6) Comparative genomics and animal diversity.

Several of these workshops discussed results from ISAG-sponsored Comparison Tests which had been conducted since the last conference. These included Comparison Tests for deer blood typing, cattle blood and DNA typing, and horse typing. Participants in Comparison Tests are ISAG Institutional members and their efforts are aimed at standardizing blood group and DNA typing.

The next scheduled ISAG Conference will take place on July 22-26, 2000 in Minneapolis, Minnesota (USA). This meeting will include plenary sessions featuring invited speakers giving presentations on animal genomics. However, a more significant part of the meeting will consist of papers by the conference participants and workshops conducted by the ISAG members focusing on genomics, blood group polymorphisms, and parentage testing in specific species of domesticated animals. More information on ISAG and its meetings and activities can be found on the ISAG Website, (http://www.wisc.edu/animalsci/isag).

## 1998 International Prize for Biology

## Professor Otto Thomas Solbrig

The International Prize for Biology was instituted in April 1985 by the Committee on the International Prize for Biology in commemoration of the sixty-year reign of the Japanese Emperor Showa and his long-time devotion to biological research. In 1998 the prize was awarded to Dr. Otto Thomas Solbrig. Department of Organismic and Evolutionary Biology, Harvard University.

Dr. Solbrig has been for over forty years at the vanguard of research in the fields of biodiversity, plant taxonomy and population biology, and has contributed immensely to the advancement of biodiversity science. His achievements, obtained through keen powers of observation and analysis and highly systematic research approach, have been compiled in numerous original papers and scientific reviews.

Man's modern lifestyle has caused dramatic transformations in the global environment, exerting an overbearing impact on its biodiversity. Dr. Solbrig was among the first researchers to emphasise the importance of a global and integrated approach to this problem. Under the International Biological Programme (IBP), planned and organised by the International Union of Biological Sciences (IUBS), Dr. Solbrig conducted research on the "Convergence and Divergence of Ecosystems", comparing Ecosystems in North and South America, and directed its following-up "Decade of the Tropics" program exerting an enormous influence on the development of biodiversity research. Furthermore, Dr. Solbrig provided a conceptual framework for the implementation of DIVERSITAS, an international programme of biodiversity science cosponsored by IUBS, the Scientific Committee on Problems of the Environment (SCOPE), UNESCO, International Council of Scientific Unions (ICSU), and other international organisations. In the development and successful implementation of numerous other international research projects as well, his contributions have been immeasurable. Books written and edited by Dr. Solbrig have gone through several editions, translated into different languages, and used as essential reference by various international agencies.

Dr. Solbrig's wide-ranging research in the fields of taxonomy, population biology and ecology led him to realize it inadequate to perceive biodiversity as a mere community or mosaic of species and to, thus emphasize the adoption of a comprehensive method of research that incorporates all components of biodiversity from the gene level to the individual, population, ecosystem levels. This idea exerted a determinant influence on the development in biodiversity research. Moreover, he pointed out the unpredictability of biodiversity due to the complexity, dynamicity and chaoticity inherent in biological systems. Through his field studies on savanna ecosystems, he found that the structure and function of ecosystems are maintained by the diversity of their component organisms, and thus showed the major role of diversity in the sustaining of ecosystems.

The achievements of his research on savanna ecosystems have had a widespread influence not only on biology itself but on other fields such as agriculture, economics and politics as well. Based on the non equilibrium theory of species coexistence, which asserts that savanna ecosystems can undergo unpredictable changes as they contain a human component, he has proposed the setting of flexible measures that accord to the unique conditions of specific ecosystems for land use and agricultural cultivation. Further-more, in a world that is experiencing a transformation from primitive, natural-resource-dependent farming to large-scale modern agriculture, he advocates conservation agriculture through the use of techniques that satisfy the requirements of both high productivity and environmental integrity.

Dr. Solbrig has over the years continuously taken research initiatives on the origin and evolution of plant diversity. Combining field work with theoretically based experimental studies, he has conducted taxonomical, cytological and population biology research on the family Asteraceae and the genus *Viola*, contributing immensely to the advancement of biodiversity science. As the researcher to first apply isozyme analysis to research on genetic variation of plant, he elucidated the processes and mechanisms by which the genus *Taraxacum*, the common dandelion, adapts itself through genetic modifications to different environmental situations. Dr. Solbrig's theoretical and experimental studies on life history strategies and on phylogenetic speculation through various phylogenetic analyses are highly esteemed as "classical" work in these fields. In addition to such highly originative research, he has also written various textbooks, which offer valuable guidance in the study of the fields of plant taxonomy and population biology. In one of them, he demonstrated a research agenda for pursuing the processes and factors of speciation, the source of biodiversity. This textbook, which has been translated into various languages including Japanese, received acclaim for introducing a totally new approach on taxonomy.

In conclusion, Dr. Solbrig has obtained outstanding achievements in his studies of the relationship between biodiversity and global environmental changes, and between biodiversity and the structure and function of ecosystems. Adopting an integrated, global view of the subject, he has been a leading scientist in international academic circles and has organised and directed various international collaborative projects on biodiversity research.

**Publications**

Solbrig, O.T., C. Passani, and R. Glass, 1968. Artificial hybridization between different polyploid levels in *Glandularia* (Verbenaceae). *Am. J. Botany* **55**: 1235-1239.

Solbrig, O.T. 1970. *Principles and Methods of Plant Biosystematics*. New York: Macmillan Co., 226pp; 2nd printing 1971.

Solbrig, O.T. 1970. The phylogeny of *Guttierrezia*: an electric approach. *Brittonia* **22**: 217-229.

Gadgil, M. and O.T. Solbrig. 1972. The concept of r and K selection: evidence from wild flowers and some theoretical considerations. *Amer. Naturalist* **106**: 14-31.

Solbrig, O.T. 1976. The Origin and Floristic Affinities of the South American Temperate Desert and Semidesert regions. In D.W. Goodall (ed.) *Evolution of Desert Biota*, pp. 7-49. Austin: University of Texas Press.

Solbrig, O.T. and D.J. Solbrig, 1979. *Introduction to Population Biology and Evolution.* Addison-Weslely, Reading, MA

Solbrig, O.T. 1981. Energy Information, and Plant Evolution. In P. Calow and C. Townsend (eds.) *Physiological Ecology. An Evolutionary Approach To Resource Use*, pp. 274-299. Oxford: Blackwell's.

Solbrig, O.T., R. Sarandon, and W. Bossert. 1988. A density dependent growth model of a perennial herb, *Viola fimbriatula. Amer. Naturalist* **131**: 385-400.

Solbrig, O.T. 1991. Ecosystem Complexity in Time and Space. In O.T. Solbrig and G. Nicolis (eds.) *Perspectives to Biological Complexity*, pp. 163-187. Paris: IUBS.

Solbrig, O.T. 1991. *From Genes To Ecosystems: A Research Agenda for Biodiversity.* Paris: IUBS, 128pp.

Solbrig, O.T. and M.D. Young. 1993. Economic and Ecological Driving Forces Affecting Tropical Savannas. In M.D. Young and O.T. Solbrig (eds.) *The World's Savannas: Economic Driving Forces Ecological Constraints and Policy Options for Sustainable Land Use*. Paris: Parthenon Press.

Solbrig, O.T., H. van Emden, and P.J.W. van Ordt (eds.) 1994. *Biodiversity and Global Change*. London: CAB International (2nd edition).

Solbrig, O.T. and D.J. Solbrig. 1994. *So Shall you Reap.* Washington, D.C.: Island Press.

Solbrig, O.T. 1995. The Diversity of the Savanna Ecosystem. In O.T. Solbrig, E. Medina, and J. Silva (eds.) *Biodiversity and savanna ecosystem processes: a global perspective*, pp. 1-30. Heidelberg: Springer-Verlag.

## Past Recipients of The Prize

1985 (Taxonomy or Systematic Biology)
Prof. Edred J.H. Corner
Professor Emeritus, University of Cambridge, UK

1986 (Systematic Biology and Taxonomy)
Dr. Peter H. Ravn

Director, Missouri Botanical Garden, USA

1987 (Developmental Biology)
Sir John B. Gurdon
Professor of Cell Biology, University of Cambridge, UK

1988 (Population Biology)
Dr. Motoo Kimura
Professor Emeritus, National Institute of Genetics, Japan

1989 (Marine Biology)
Sir Eric Denton
Retired Director, Marine Biological Association Laboratory
Plymouth, UK

1990 (Behavioral Biology)
Prof. Masakazu Konishi
Professor of Behavioral Biology, California Institute of Technology
USA

1991 (Functional Biology of Plants)
Dr. Marshall D. Hatch
Chief Research Scientist, Division of Plant Industry
CSIRO, Australia

1992 (Comparative Physiology and Biochemistry)
Prof. Knut Schmidt-Nielsen,
Professor of Physiology, Duke University, USA

1993 (Ecology)
Prof. Edward O. Wilson
Professor of Science and Curator in Entomology
Museum of Comparative Zoology, Harvard University, USA.

1994 (Systematic Biology and Taxonomy)
Prof Ernst Mayr
Professor Emeritus, Harvard University, USA

1995 (Cell Biology)
Professor Ian R. Gibbons
Kewalo Marine Laboratory, University of Hawaii, USA

1996 (Biology of Reproduction)
Prof. Ryuzo Yanagimachi
Department of Anatomy and Reproductive Biology
Medical School, University of Hawaii, USA

1997 (Plant Science)
Prof. Elliot M. Meyerowitz
California Institute of Technology, USA

**African Fish and Fisheries: Diversity and Utilization International Conference- 1998**
**and Grahamstown Biodiversity Resolution**

An International Conference on "African Fish and Fisheries: Diversity and Utilization" was held on 13-19 Sept., 1998, at Rhodes University, Grahamstown, South Africa. Organised by the Paradi Association and the Fisheries Society of Africa, the Conference brought together more than 300 participants from over 40 countries of which 25 were from Africa.

In a series of plenary and parallel sessions, the Conference dealt with African Fish and fisheries issues such as Fish evolution and systematics, Fish conservation and fisheries management; Aquaculture, Fish parasites and diseases; and Fish biodiveristy conservation.

As noted in the many biodiversity papers presented at the Conference in Grahamstown, it was evident that we are witnessing a rapid deterioration of African inland water habitats, leading to a consequent decline in aquatic biodiversity. Many scientists attending the conference expressed the opinion that it is imperative to take immediate measures in order to maintain biodiversity in inland African waters. The outcome of the biodiversity workshop was the Grahamstown Biodiversity Resolution which was accepted by participants at the conference during the closing session.

The enclosed resolution is intended to help maintain biodiversity in African aquatic ecosystems. Please don't just file it away. Present it wherever it will lend weight to your argument - to decision makers, conservation authorities, the press and at any presentation at the popular level which might help to make every one, everywhere, realize the urgency of the situation.

Jim Cambray, South Africa
Menachem Goren, Israel

## Grahamstown Biodiversity Resolution

During recent years biodiversity has become a central issue in the process of sustainable development. Biodiversity is internationally recognized as a valuable biological and cultural heritage to be passed on to future generations. The economic value of biodiversity is reflected in its

provision as a major food resource for people, as an important genetic resource for agriculture and the pharmaceutical industry, and for the ever growing ecotourism industry.

In Africa the inland water ecosystems are the lifeline for all countries that provide good quality water and biological resources. However, there is a major concern for the future of these water resources as the result of global climatic changes and human impact.

In contrast to other ecosystems, the conservation of biodiversity in inland water systems can be achieved only by adopting a comprehensive watershed approach. Simply restricting and protecting areas is not in itself sufficient.

As scientists we are aware of the fact that exploitation of aquatic resources requires their proper management in order to meet the needs of expanding human populations. Changes are inevitable, but we must ensure the long-term sustainability of aquatic biodiversity and water resources.

Freshwater biodiversity should be addressed at all levels: genetic, specific, generic and at higher levels. Although there are many gaps in our scientific knowledge of African inland water biota we can wait to act no longer, but must do so immediately in order to maintain biodiversity on the basis of the best current available scientific knowledge. Thus we urge all African governments, academic and conservation institutions, as well as fellow scientists, to accept and carry out the following:

1. To develop the tools to ensure integrated watershed management approaches.

2. To intensify research into aquatic biodiversity and the functioning of aquatic systems in order to provide viable solutions. At present there is a lack of qualified African aquatic scientists especially systematists. It is therefore essential that measures be taken to overcome this lack of capacity.

3. To make the present available and scattered information on African aquatic biodiversity more accessible to all people involved in research and management. This would be made possible through the establishment of clearing-house mechanisms within Africa. This could facilitate the mobilization of the available knowledge to provide developers, decision-makers and the public with the

essential background for sound management practices of aquatic resources.

4. African countries are part of the international commitment to conserve aquatic biodiversity as expressed in conventions such as the Convention on Biodiversity and the Ramsar Convention. Therefore the management of biodiversity should be a high priority in the decision-making process on the national level.

5. For the benefit of the long-term conservation of African aquatic resources it is essential to develop curricula at all levels of education which will ensure the understanding and maintenance of biodiversity. This would eventually lead to the involvement of local communities in this important issue.

Grahamstown, September 18th, 1998

# OBITUARY

## Sir Otto H. Frankel

1900 - 1998

A world citizen and an eminent prophet-scientist of biodiversity, Sir Otto H. Frankel, born November 4, 1900 in Vienna, Austria, died November 21, 1998, IN Canberra, Australia.

I met Sir Otto Frankel for the first time on March 10-11, 1980, at the meeting of the IUBS *ad hoc* Committee of Review, held at the Royal Society in London. I was amazed by the energy, alertness and enthusiasm of his performance as chair of this important meeting which laid the foundations for the revival of the IUBS and the renewal of its scientific programmes. Unaware of his reputation, I would not have believed that a man of his age (he was eighty) arriving straight from Heathrow after 30 hours in the air changing flights and airports on his way from Canberra, Australia would have been capable of doing what he did. After the meeting he went skiing in the Alps in Switzerland!

The young Frankel was rejected by the Austro-Hungarian military as unfit for the cannon fodder because he was short and short-sighted, and as a result the University was closed to him because he wasn't a war hero. However he studied the university curriculum as an outsider and gained some credit. He also attended universities in Vienna, Munich, Giessen, and Berlin where he gained his Doctorate on an early study of genetic linkage.

From 1925 to 1927 the young Dr Frankel worked as a plant breeder on a large private estate near Bratislava, after this he spent a brief stay in Palestine as part of a team, whose mission was to establish a plant and animal breeding programme. He then took up a temporary post in plant breeding in Cambridge, UK.

This itinerant phase ended in 1929 with his appointment by the New Zealand Division of Scientific and Industrial Research as a plant breeder and geneticist at the new Wheat Research Institute at Lincoln College, near Christchurch. He worked there for 22 years breeding a series of highly successful wheat varieties and carrying out research in cytogenetics which led to his election as a fellow of the Royal Society of New Zealand (1948) and of the Royal Society of London (1953). In 1951, he was appointed chief of the Division of Plant Industry of the CSIRO, which has, thanks to his leadership, become Australia's leading plant biological institute. He was Treasurer, President and Secretary General (consecutively) of the International Genetics Federation (1966-1983).

His early scientific work focused on wheat, cytology and evolution of *Hebe* and *Parahebe* spp. Since 1966, he has worked on the scientific principles and management of the conservation of crop plants, and genetics of nature conservation. He published some 100 papers on genetics (mainly wheat), cytology, plant breeding, and genetic conservation. The books he co-edited or co-authored have become valuable sources of references in the aforementioned fields : "Genetic Resources in Plants, their Exploration and Conservation", in 1970, "Crop Genetic Resources for Today and Tomorrow" 1975, "Conservation and Evolution" in 1981, and the most recent "Conservation of Plant Diversity" published in 1995, at the age 95!

His major achievement on the world scene took place after his retirement. He was a leading actor of the development of the IUBS/ICSU and UNESCO International Biological Program

(IBP). He persuaded FAO to join forces with IBP and chaired their joint committee of experts until it disbanded when the International Board for Plant Genetic Resources was established in 1974 (now IPGRI). In his Mackay Memorial Lecture (1970) he argued that "humankind had acquired evolutionary responsibility" and must develop an evolutionary ethic. This and several related papers by Frankel present "the conceptual and moral agenda for the discipline of conservation genetics" as M. Soulé has put it. Frankel and his panel of experts kept the genetic resources issue alive throughout the 1960s and 1970s, long before the term biodiversity was coined and before it become such a popular issue.

With the passing away of Sir Otto Frankel, the IUBS, the scientific community and in particular the biological sciences community have lost an outstanding scientist, a world citizen and a man whose contribution to science throughout the 20th Century will have an impact on future scientific research well into the 21 Century and beyond.

But most of all we mourn the passing away of a dear and special friend.

by Talal Younès,
Executive Director,
IUBS

# OBITUARY

## VLADIMIR E. SOKOLOV
## (1928 - 1998)

Vladimir E.Sokolov passed away after the long and painful illness on April 19 1998. He was the prominent scientist of zoology and ecology, and his premature death is a great loss for the Russian and international science.

Professor V.E.Sokolov was the Full Member of Russian Academy of Sciences and Academy of Agricultural Sciences, Member of Presidium of Academy of Sciences, Head of Department of General Biology Acad.Sci., Vice-President of the International
Union of Biological Sciences, Chairman of Russian National Committee of Biologists, Chairman of the Russian (formerly Soviet) Committee for the UNESCO Program "Man and Biosphere" (MAB), and served few terms as the Vice-President of the UNESCO International Coordinating Council for MAB Program, Chairman of Scientific Council "Study, Sustainable Use and Protection of Animal Life" of Acad.Sci, Member of the UN Commission on Environment Development (1985-1987), Research leader of the Russian-Mongolian Biological Expedition, President of the Russian Theriological Society, founder and for many years a Chair of the IUBS Commission on Mammalogy (Theriology).

V.E.Sokolov was born in Moscow (Russia) on February 1 1928. In 1950 he graduated from the Biological Faculty of Moscow State University and in 1953 - from the post-graduate course in Moscow Fur and Peltry Institute. After getting of the candidate scientific degree he taught in the Moscow Institute of Fishery (1953-1956) and in Moscow State University (1956-1998). In 1964 he defended his Doctor of Biological Sciences' Thesis. The teaching activity of V.E.Sokolov in the Moscow State University was located in the Department of Vertebrate Zoology; he started as the assistant, than became the associate professor, professor and the head of Department. He read a rate of lectures on systematics and ecology of mammals, supervised seminars and a field practice for students and has brought up many pupils, who have successfully developed recent zoological researches. V.E.Sokolov was denominated as the recent leader of the native scientific school on functional and evolutionary morphology of animals, which had great traditions in the Russian biological science incorporated by works of A.N.Severtsov and I.I.Schmalhausen.

From 1967 V.E.Sokolov has become the Director of A.N.Severtsov Institute of Animal Evolutionary Morphology and Ecology (since 1996 - Institute of Ecology and Evolution of Russian Academy of Sciences), where he has organized and supervised the Laboratory of Morphology and Ecology of Higher Vertebrates. He was elected as the Correspondent Member (1970) and later as the Full Member (1974) in the Academy of Sciences.

V.E.Sokolov developed the recent natural system of mammals. His monograph "*Systematics of Mammals*" ( Vol. 1 - 1972, Vol. 2 - 1977, Vol. 3 - 1979) was well known among zoologists and serves as the fundamentals of the mammalian taxonomy.

He gave the special attention to studies of a skin cover of mammals and skin derivatives (hair, glands etc.). Together with his co-workers he, for the first time, carried out comparative morphological-functional studies of a skin cover of mammals on extensive materials including the representatives of all mammalian orders collected from all continents. Results of these researches were published in books "*Mammal Skin*" (Moscow,1973; California, 1982) and "Skin of Tropical Ungulate Animals" (Moscow, 1984). V.E.Sokolov organized many zoological expeditions the USSR and abroad, including complex biological expeditions in Mongolia, Viet-Nam, Ethiopia, Peru. He combined pilot field researches with stationary long-term studies. A number of experimental stations were organized by V.E.Sokolov in different natural-climatic regions of Russia and adjacent territories for perennial ecological and faunistic researches on different animal groups.

V.E.Sokolov was interested in the eco-physiology ("Diurnal Rhythms of Mammalian Activity" (1978), ethology (chemocommunications of animals), hydrodynamics of aquatic mammals. He is the author of more than 500 publications including scientific reports and monographs, manuals, dictionaries and popular-scientific editions. V.E.Sokolov is one of creators of the Red Books of the USSR and of Russian Federation.

The circle of his scientific interests was extremely wide and far left for frameworks of zoological researches. It is difficult to overestimate merits V.E.Sokolov in organization of nature protection in Russia. He participated in the development of the world system of biosphere reserves and initiated the organization of 23 biosphere reserves in Russia and adjacent territories ( former USSR area). He realized the program of the optimization and expansion of this network for the monitoring of global changes of natural ecosystems and biological diversity. V.E.Sokolov considered preservation of natural biodiversity as a necessary condition of the future existence of mankind. He was the foundator of the State Research Program "Biological Diversity of Russia" (1994) and headed the Scientific Council of this Program.

V.E.Sokolov was the internationally known scientist, and his scientific and social merits were highly appreciated by the international scientific community and governmental organizations. He was the member of the Academy of Sciences Mongolia and Academy of sciences of Bosnia and Herzegovina, Academy of Zoology of India, Honorary Doctor of Rikardo Palma University (Peru, Lima), a foreign member of scientific societies in different countries. He was awarded by the orders and medals of the USSR, Mongolia, CSSR, Cuba, Viet-Nam. He receivedalso two USSR State Prizes and the prestigious Prizes of A.Severtsov (USSR) and A. Karpinski (Germany). The name of academician Vladimir Sokolov will long live in his works and achievements . And we are mourning a great man and outstanding scientist.

Academician N.G.Khrushchev
Academician D.S.Pavlov
Professor B.R.Striganova
Professor M.I.Shatunovski
Doctor V.M.Neronov

# CALENDAR OF MEETINGSCALENDAR

**IUBS-sponsored meetings are indicated in bold type-face**
**Additional information may be obtained from addresses in ( ) parentheses**

## 1999

### BOTANY
**26th Int'l Botanical Congress**
1-7 Aug., Saint Louis, U.S.A.
(Contact: XVI IBC Secretariat, c/o Missouri Botanical Garden, P.O. Box 299, Saint Louis, MO 63611-0299, U.S.A.
Ph: 1 314-577 5175; Fax: 1 314 577 9589
Email: ibc16@mobot.org.
http://www.ibc99.org)

Int'l Conifer Conference
22-25 Aug., Kent, England
(Contact: Lisa von Schlippe, The Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AE.
Ph: 44 181 332 5198
Fax: 44 181 332 5197
E-mail:L.von.schlippe@rbgkew.org.uk)

### BIODIVERSITY
Global Biodiversity Forum (GBF),
7-9 May, San Jose.
(Contact: Ramsar Convention Bureau, Rue Mauverney 28, CH-1196 Gland Switzerland.
Ph: + 41 22 99 0170 Fax: + 41 22 99 0169
E-mail: ramsar@hq.iucn.org

Fourth Meeting of CBD SBSTTA
24-28 May, Montreal Canada.
(Contact: CBD Secretariat, World Trade Centre, 393 St. jacques St. Office 300, Montreal, Quebec, Canada H2Y 1NY.
Ph: + 1 514 288 2220; Fax: + 1 514 288 6588
E-mail: chm@biodiv.org)

### BIOMONITORING
**10thIUBS-Symposium on Biomonitoring**
15-18 Sept., Karlsruhe, Germany
(Contact: Dr. W. Schmitz, Kirchbergstr. 32, D 75356, Weingarten, Germany
Ph/Fax 00 49 72448464)

### BIOTECHNOLOGY
9th European Congress on Biotechnology
11-15 July, Brussels, Belgium.
(Contact:Benoit Leveque, Lakenweversstraat 21, B-1050 Brussels.
Ph: + 32 2 510 2314; Fax: + 32 2 510 2615
E-mail: secretariat@ecb9.be

### PURE AND APPLIED CHEMISTRY
37th IUPAC Congress
14-19 Aug., Berlin, Germany
(Contact: Gesellschaft Deutscher Chemiker, IUPAC 99, P.O. Box 90 04 40,
D-60444 Frankfurt am Main, Germany.
Ph: + 49 69 7917 358; Fax + 49 69 7917 475;
E-mail:tg@gdch.de
http://www.gdch.de)

### CRYSTALLOGRAPHY
Eighteenth General Assembly and In'l Congress of Crystallography
4-13 August, Glasgow, Scotland.
(Contact: Professor C. Gilmore, Department of Chemistry, University of Glasgow, Glasgow, G12 8QQ, Scotland, UK.
Fax: + 44 141 330 4419
E-mail: chris@chem.gla.ac.uk/iucr99
http://www.chem.gla.ac.uk/iucr99)

### CLIMATE CHANGE
Fourth Int'l Conference on Modelling of Global Climate Change and Variability
13-17 Sept., Hamburg. Germany
(Contact: Dr. Lydia Dümenil, Conference Coordinator, Max-Planck-Institut für Meteorologie, Bundesstrasse 55, D-20146 Hamburg
Ph: + 49 40 41173 310, Fax: + 49 40 41173 366,
E-mail: mpi-conference@dkrz.de
Http:// www.mpimet.mpg.de/ mpi-conference

### ECOLOGY
**VIII European Ecological Congress**
18-23 Sept., Halkidiki, Greece.
(Secretariat EURECO '99, Dept. of Ecology, School of Biology,U.P.B.119 Aristotle University GR-540 06 Thessaloniki, Greece.
Ph +30 31 99 83 16/ + 30 31 99 82 54
Fax + 30 31 998379
E-mail: secretariat@eureco99.auth.gr
http://www-eureco99.auth.gr)

### ETHOLOGY

25-30 July, Jerusalem, Israel
(Dr. Yaacov Katan, Chairman Organising Committee, The Hebrew University of Jerusalem, P.O. Box 12, Rehovot 76100 Israel. Fax + 972 8 9466794; E-mail: gamliel@agri.huji.ac.il http://wwwkenes.co.il/IPPC)

**STRESS BIOLOGY**
**2nd Int'l Workshop on Molecular Biology of Stress**
15-18 Oct., Wuhan, China
(Contact: Prof. S.C. Lakhotia, Cytogenetics Laboratory, Centre for Advanced Study, Dept. Of Zoology, Varanasi 221 005, India
E-Mail: lakhotia@banaras.ernet.in)

## 2000

**BEE RESEARCH**
**7th IBRA Conf. on Tropical Bees: Management and Diversity**
19-25 March, Chiang Mai, Thailand
(Contact: 7th IBRA Conference on Tropical Bees, Int'l Bee Research Association, 18 North Road, Cardiff CF1 3DY, United Kingdom
Fax: + 44 1222 665522;
E-mail: ibra@cardiff.ac.uk)

**BIOTECHNOLOGY**
Biotechnology 2000- The World Congress on Biotechnology
11th Int'l Biotechnology Symposium and Exhibition
3-8 Sept., ICC, Berlin, Germany
(Contact: DECHEMA e.V.c/11th IBS, Theodor-Heuss-Allee 25, D-60486 Frankfurt am Main, Germany
Fax: + 49 69 7564 176
E-mail: tagungen@dechema.de
http://dechema.de/biotechnology2000)

**EDUCATION**
**IUBS-CBE BioEd 2000**
**The Challenge of the Next Century**
15-18 May, Paris, France
(Contact: Prof. F. Vohra, IUBS-CBE, 51 Blvd de Montmorency, 75016 Paris.
Ph: + 33 1 45 25 00 09
Fax: + 33 1 45 25 20 29; E-mail: iubs@paris7.jussieu.fr http://www.iubs.org)

**GENETICS**
Conference of the Int'l Society of Animal Genetics
22-26 July, Minneapolis, Minnesota, USA.
(http://www.wisc.edu/animalsci/isag/index.html)

**IUBS**
**IUBS 27th General Assembly and Associated Symposia**
5-10 Nov??., Naples, Italy
(Contact: Dr. T. Younès, IUBS, 51 Blvd de Montmorency, 75016 Paris.
Ph: + 33 1 45 25 00 09
Fax: + 33 1 45 25 20 29; E-mail: iubs@paris7.jussieu.fr http://www.iubs.org)

**MARINE**
Int'l Marine Biotechnology Conference
Sept-Oct, Townsville, Australia
(Contact: Australian Institute of Marine Science, P.O. Box 216, Aitkenvale, QLD 4814 Australia.
Ph: + 61 7 4781 6219
Fax: + 61 7 4781 5822
E-mail: imbc_2000@aims.gov.au
http// www.aims.gov.au/imbc-2000)

**PALAEOBOTANY**
The Sixth Quadrennial Conference of the Int'l Organisation of Palaeobotany
July 30-Aug. 3, Qinhuangdao of Hebei, China
(Contact: Prof. Liu Gengwu, Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing 210008, China.
Fax: + 86 25 3357026)

**PLANT REPRODUCTION**
**Int'l Association of Sexual Plant Reproduction Research**
1-6 April, Banff, Canada
(Contact: Dr. David Cass, Department of Biological Sciences, University of Alberta, Edmonton, Canada T6G 2E9. Ph: + 403 492 3308; Fax: + 403 492 9234)

**SCIENCE EDITORS**
7th General Assembly and Conference of the European Association of Science Editors (EASE)
21-24 May, Tours, France
(Contact: Secretariat, EASE, P.O. Box 426, Guilford, GU4 7ZH, UK.
Fax: + 44 1483 211 056)

## ZOOLOGY
### The New (XVIII) Int'l Congress of Zoology
28 Aug.-2 Sept., Athens, Greece
(Contact: Dr. R. Polymeni, Hellenic Zoological Society, P.O. Box 3249 K.T. GR-102 10 Athens, Greece)

## 2001

## ENDOCRINOLOGY
### 14th Int'l Congress of Comparative Endocrinology
26-30 May, Sorrento, Italy
(Contact: Studio Congressi Cicala de Pertis, Via S. Anna dei Lombardi, 38-80134 Napoli, Italy
E-mail: studiocongresse@napoli.com
http://www.napoli.com/studiocongressi)

## 2002

## HORTICULTURAL SCIENCE
### XXVI Int'l Horticultural Congress
Aug, Toronto, Canada
(Contact: Ir. J. Van Assche, Executive Director, K. Mercierlaan 92, 3001 Leuven, Belgium. Ph: + 32 16229427; Fax: + 32 16229450; E-mail: info@ishs.org)

## ORNITHOLOGY
### 23rd Int'l Ornithological Congress
11-17 Aug., Beijing, China
(Contact: Professor Xu Weishu, Secretary General, Organisation Committee, 1-1-302 Beijing Sci. and Tech. Commission Apt., Lingnan Rd., Beijing 100037
Ph/Fax: + 86 10 6846 5605
E-mail: s-g@ioc.org.cn)

## PATHOPHYSIOLOGY
4th Int'l Congress of Pathophysiology
June 29-July 5, Budapest, Hungary
(Contact: Prof. Dr. Lajos G. Szollár, Secretary General, Institute of Pathophysiology, Semmelweis University Medical School, Budapest P.O.B. 370. H-1445, Hungary)

## TRAINING COURSES
## 1999

## INTERNATIONAL CELL RESEARCH ORGANISATION

FRONTIERS IN REPRODUCTION: MOLECULAR AND CELL CONCEPTS AND APPLICATIONS
24 May-4 July, Woods Hole, USA
(Contact: Prof. Gerald Schatten, Oregon Regional, Primate Research Centre, Oregon Health Sciences University, 505 N.W. 185th Street, Beaverton, OR 97006-3499, USA
Fax: + 1 503 614 37 25;
E-mail: schatten@ohsu.edu)

GENES AND DEVELOPMENT
17-18 June, Puerto Rico, USA
(Contact: Dr. Graciela C. Candelas, Department of Biology, University of Puerto Rico, P.O. Box 23360, UPR Station, San Juan, PR 00931-3360, USA
Fax: + 787 764 3875;
E-mail: gcandel@upracd.upr.clu.edu

MICROBIAL BIOLOGY AND BIOTECHNOLOGY
13-26 June, Mosonmagyaróvár, Hungary
(Contact: Prof. Vince Ördög, Institute of Crop Sciences, Pannon Agricultural University, Faculty of Agricultural Sciences, Kolbai Károly Str. 8, H-9200 Mosonmagyaróvár, Hungary
Fax: + 36 96 215 931;
E-mail: molnarz@movar.pate.hu)

CELLULAR SIGNALLING FROM PLASMA MEMBRANE TO NUCLEUS
12-23 July, Santiago, Chile
(Contact: Dr. Andrew Quest, Instituto de Ciencias Biomédicas, Facultad de Medicina, Casilla 70086, Santiago 7, Chile.
Fax: 56 2 735 55 80
E-mail: jallende@abello.dic.uchile.cl)

PLANT POLYPHENOL ANTIOXIDANTS IN THE BIOLOGY AND PATHOLOGY OF FREE RADICALS
19-30 July, Santiago, Chile.
(Contact: Dr. Federico Leighton, Departamento de Biología Celular y Molecular, Facultad de Ciencias Biológicas, Universidad Católica de Chile, Casilla 114-D, Santiago, Chile.
Fax: + 56 2 222 25 77
E-mail: fleighto@genes.bio.puc.cl)

BIOMEMBRANE AND MOLECULAR MEDICINE

**XXVI International Ethological Conference**
2-9 August, Hotel Ashok, Bangalore, India
(Contact: Dr. Shakunthala Sridhara, Secretary General, XXVI International Ethological Conference, University of Agricultural Sciences, G.K.V.K., Bangalore-560 065, India
Fax: + 91 080 3330277
E-mail: sridhara@blr.vsnl.net.in)

## ENVIRONMENT

Int'l Scientific Conference on the Environment in the 21st Century
8-11 June, Santa Clara, Cuba
(Contact: Dr. Cándido Quintana Pérez, Universidad Central de Las Villas, Santa Clara, 54830, Villa Clara, Cuba.
Ph: + 53 422 81630/81194
Fax: + 53 422 81608
E-mail: ceta@ucentral.quatum.inf.cu)

## ICSU

General Assembly of the International Council of Science
25-30 Sept., Cairo, Egypt
(Contact: M. J-F Stuyck-Taillandier, 51 Bd de Montmorency, 75016 Paris, France
Ph: + 33 1 45 25 03 29 Fax: + 33 1 42 88 94 31
E-mail: icsu@1mpc.jussieu.fr)

ICSU/UNESCO
World Science Conference
25 June-3 July, Budapest, Hungary
(Contact: M. J-F Stuyck-Taillandier, 51 Bd de Montmorency, 75016 Paris, France
Ph: + 33 1 45 25 03 29 Fax: + 33 1 42 88 94 31
E-mail: icsu@1mpc.jussieu.fr)

## MICROBIOLOGY

IXth International Congress of Bacteriology and Applied Microbiology
16-20 August, Sydney, Australia
(Contact: IUMS Congress Secretariat, GPO Box 128, Sydney NSW 2001, Australia
Ph: + 61 2 9262 2277
Fax: + 61 2 9262 3135
E-mail: iums@tourhosts.com.au
http://www.tourhosts.com.au/iums)

IXth International Congress of Mycology
16-20 August, Sydney, Australia
(Contact: IUMS Congress Secretariat, GPO Box 128, Sydney NSW 2001, Australia
Ph: + 61 2 9262 2277
Fax: + 61 2 9262 3135
E-mail: iums@tourhosts.com.au
http://www.tourhosts.com.au/iums)

XIth International Congress of Virology
9-13 August, Sydney Australia
(Contact: IUMS Congress Secretariat, GPO Box 128, Sydney NSW 2001, Australia
Ph: + 61 2 9262 2277
Fax: + 61 2 9262 3135
E-mail: iums@tourhosts.com.au
http://www.tourhosts.com.au/iums)

## NEUROSCIENCES

4th Int'l Congress
Society of Neuroscientists of Africa (SONA)
12-16 April Dakar, Senegal
(Contact: Management and Communication Int'l, SONA 99,
P.O. Box 4000, Dakar, Senegal, West Africa.
Ph: + 221 824 24 00; Fax+ 221 824 04 63.
E-mail: mci@telecomplus.sn
http://www1.telecomplus.sn/neurosen)

## PACIFIC REGION

XIX Pacific Science Congress
4-9 July, Sydney Australia
(GPO Box 2609 Sydney NSW 2001 Australia
Ph: + 61 2 9241 1478; Fax: + 61 2 9251 3552
E-mail: pacsci@icmsaust. com.au
http://www.icmsaust.com.au/PacificScience)

## COMPARATIVE PHYSIOLOGY AND BIOCHEMISTRY

**Fifth (5th) Int'l Congress of Comparative Physiology and Biochemistry (1CCPB 99)**
Aug 23-28, Calgary, Canada.
(Contact: The Secretariat, ICCPB 99, Conference Management Services, The University of Calgary, 1833 Crowchild Trail N.W., Calgary, Alberta, Canada T2M 4S7
Ph: + 403 220 6229; Fax: + 403 284 4184
E-mail: iccpb@ucalgary.ca
http://www.acs.ucalgary.ca/ iccpb99/

## PLANT PROTECTION

**14th Int'l Plant Protection Congress (IPPC)**

19-30 July "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca, Romania
(Contact: Prof. Gheorghe Benga, "Iuliu" University of Medicine and Pharmacy, Dept. of Cell and Molecular Biology, 6 Pasteur St. 3400 Cluj-Napoca, Romania.
Ph: + 40 64 194 373
Fax + 40 64 197 257 or 196 585 or 194 373)

MOLECULAR BIOLOGY TECHNIQUES IN MALARIA
1-10 Sept. Med Biotech Laboratories, Kampala, Uganda.
(Contact: Dr. Thomas G. Egwang, Med Biotech Laboratories, P.O. Box 9364, Kampala, Uganda.
Fax: + 256 41 268251
E-mail: egwang@imul.com;
office.mbl@infocom.co.ug

MOLECULAR ASPECTS OF FERTILIZATION AND EARLY DEVELOPMENT
8-22 October, Asamushi, Aomori, Japan
(Contact: Dr. Hideki Katow, Director Marine Biological Station, Faculty of Science, Tohoku University, Asamushi, Aomori, Aomori 039 3501, Japan.
Fax: + 81 177 52 27 65
E-mail: hkatow@mail.cc.tohoku.ac.jp)

SIGNAL TRANSDUCTION PATHWAYS IN HOST AND PARASITE CELLS
22 November-1 December, Buenos Aires, Argentina.
(Contact Dr. Mariano J. Levin, INGEBI, Vta. De Obligado 2490, 1428 Buenos Aires, Argentina.
Fax: + 54 1 786 8578;
E-mail: mlevin@proteus.dna.uba.ar)

MOLECULAR GENETICS
27 November-6 December, Dakar Senegal
(Contact: Dr. Alioune Dieye, Laboratoire Immunogénétique Moléculaire, Institut Pasteur de Dakar, 36 Avenue Pasteur, B.P. 220, Dakar, Sénégal.
Ph: + 221 839 92 10;
E-mail: dieye@pasteur.sn)

**TRAINING COURSES 2000**

MOLECULAR AND CELLULAR BIOLOGY OF REPRODUCTION
January 2000, Colombo, Sri Lanka
(Contact: Dr. N. Goonesekere, Department of Chemistry, University of Colombo, Colombo, Sri Lanka
Fax: + 94 1 583810,
E-mail: naling@sri.lanka.net)