

Biology

International

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



1993 January

N° 26

CONTENTS (N° 26, 1993)

1. Editorial

FEATURE ARTICLES

- 2. "Human Biology and International Research Programmes ",
by D. F. Roberts.**
- 13. "Biodiversity and Wheat Improvement in China ", by Li Zhensheng.**
- 17. "The IUBS Commission for Biological Education: a conceptual
framework", by G. Schaefer.**
- 21. "DIVERSITAS, IUBS-SCOPE-UNESCO Programme on Biological
Diversity: a Progress Report", by J. Robertson Vernhes & T. Younès.**

NEWS HIGHLIGHTS

- 23. "The Biodiversity Information Network BIN/21.**
- 25. "VIIth International Congress on Culture Collections.**
- 26. "First International Congress on Medicinal and Aromatic Plants for
Human Welfare.**
- 28. PUBLICATIONS REVIEW**
- 31. CALENDAR OF MEETINGS**

EDITORIAL

In Britain the Biological Council each year chooses a different biological subject and invites a distinguished authority to give a lecture on it. In 1991, the subject was human biology, and Professor D.F. Roberts of the University of Newcastle upon Tyne was asked to speak. Under the title of "Human Biology in International Research Programmes", Professor Roberts' objective was to draw the attention of human biologists to the potential in contributing to international work.

A revised version of that lecture is included in this issue of *Biology International*, partly because the aims and content of modern human biology are not generally known among other biologists, who, if they think of it at all, think of it in terms of the topics in the syllabus for school leaving, pre-university examinations.

The principal reason however, is that its lessons are of relevance to other biological disciplines. It shows, for example, that at the present time there are several programmes of interest to any one discipline, and though the programmes change with time, the situation is recurrent.

Secondly, it shows that the practitioners need to look outside their immediate concerns and activities to see how their ways of thought and their approaches can contribute to the broad aims of each programme. No one person, no steering committee, responsible for an international programme can possibly be aware of all the potential contributions to it. It is up to the practitioners of each discipline to search out what they have to contribute and to make the offer to participate. The success and impact of international programmes depends heavily on such offers.

Human Biology and International Research Programmes

by Derek F. Roberts
Department of Human Genetics
University of Newcastle upon Tyne, U.K.

Introduction

Internationally sponsored research, today an established feature of modern science, is still little known by the majority of scientists. Of those responsible for obtaining funds to support the researches of their institutes and departments, only a proportion are aware of what it has to offer and what its disadvantages are, its potential and its procedures. The others still look primarily to grants from national research councils or other national sources.

International research programmes, as distinct from small joint research projects that can be undertaken on a collaborative basis by two or three units, require international scientific organisations to bring them into being and administer them. The first such organisation dates from the first half of the 19th century, when Gauss (1777-1855), well known in other scientific contexts, established the "Magnetic Union", the first international programme of studies of the earth's magnetism. This was followed in 1864 by the foundation of the International Geodetic Association. At the end of the century there were joint meetings of the Association of German Academies and the Royal Society in London in 1898, and the Academies of Sciences in Paris, St. Petersburg and Washington in 1899. But the first real step was the foundation in 1919 of the International Research Council (IRC) by the Academy of Sciences (Paris), the National Academy of Sciences (Washington) and the Royal Society (London). Its aim was to coordinate efforts in the different branches of science. The life of the IRC was short, only 12 years, mainly for political reasons. For its membership was restricted to the Allied Powers and to some countries which had been neutral in World War I; the Central Powers were excluded. The delegation of the Royal Swedish Academy of Sciences proposed in 1922 that the statutes be changed to allow all nations to be admitted to the Council. This proposal was adopted in 1931, when the IRC was dissolved and was replaced by the International Council of Scientific Unions (ICSU), with membership open to all nations. There was an immediate change, for whereas the IRC had consisted only of scientific union members, with the foundation of ICSU came the admission of national members, followed later by commissions (1956), scientific associates (1971) and national associates (1975). But the fundamental division into scientific members and national members still remains.

ICSU is a non-governmental organisation whose aim is to promote international scientific activity in the different branches of science and its applications for the benefit of humanity. The national members are the scientific academies or research councils of different countries, multi-disciplinary bodies; the scientific members are the unions which are international single-discipline organisations. Today it has 75 national members (including associations), and 20 scientific unions, together with 29 scientific associates. It initiates, designs and coordinates major international interdisciplinary research programmes, and set up interdisciplinary bodies which undertake activities and research programmes of interest to several member bodies. These activities endeavour to surmount the barriers of specialisation.

International Union of Biological Sciences

At the first conference of the International Research Council in 1919, the International Union of Biological Sciences (IUBS) was established. Biology already had a tradition of international congresses - botany in 1864, zoology in 1889. The first President of IUBS was Yves Delage of France, and its vice-president William Bateson of the U.K. Its statutes were accepted at its 1922 assembly, and it was formally admitted a member of the International Research Council in 1925. Before World War II its principal activities lay in its encouragement of bibliographic work through the Bibliographic Commission in France, the Zoological Record in London, and the *Concilium Bibliographicum* in Zurich.

Of the seven scientific unions that existed when ICSU was founded, only one was biological. At that time biological sciences were largely descriptive and discrete - botany, zoology, bacteriology. Human biology as we know it today was nowhere to be seen. But then came an interesting development. The biologist lifted his eyes from classification and cataloguing to look around him. He became aware of the relevance of chemistry and physics, and the application of the techniques of those subjects. There emerged the new breed of biologists, the biochemists, the biophysicists. They made far-reaching and irreversible contributions to society right from the early years, for example the synthesis of vitamins, the steroid hormones, the antibiotics. In due course they gave rise to enormous expansion of biology. In parallel after the war emerged the modern biological disciplines of evolutionary biology, genetics, cell biology, ecology and these new biological disciplines were represented by five Presidents of IUBS (three geneticists Montalenti, Waddington and Sirks, an animal physiologist Munro Fox, and an embryologist Horstadius). With a structure resembling that of ICSU, today IUBS has 75 scientific members (representatives of different disciplines) and 43 national members (nations represented by their scientific academies).

Human Biology

It was in this flowering of modern biology after World War II that modern human biology emerged. Represented in IUBS by the International Association of Human Biologists, it is a remote derivative of the natural history of man as expounded by Buffon and Darwin, respectively in the mid-18th and mid-19th centuries. In the later 19th and early decades of the 20th century, there was a period of wandering in the wilderness of typology and racial classification, craniometry and comparative anatomy, all essentially descriptive and without a fundamental theory, without dynamic concepts, without biological interpretation. Certainly the activities in that period were of little relevance to the great biological problems facing mankind today.

After 1945, especially in Britain and the United States of America, there was a transformation. In the previous decade much had been happening. The school of animal ecologists, following Elton, had been developing vigorously, showing the intricate pattern of relationships among animal communities and their habitats; the rise of population genetics under the influence of Fisher, Haldane and Wright showed the mechanisms of the new Darwinian evolutionary biology; the publication by Huxley in 1942 of "Evolution, the Modern Synthesis" provided just what its title states, a synthesis bringing together these two and other fields; the demands of war time, focussing on the limits of human endurance and factors that influence them, brought intensified application of biology and medicine to practical needs for survival and efficient functioning, and particularly brought recognition to the usefulness of experimental enquiry. All these pointed to the pivotal importance of

variation, earlier regarded as a mere nuisance. The new human biology saw the units of study as populations, varying among themselves and within themselves, occasionally succumbing to the rigours of the environment and becoming extinct, sometimes conquering their biological and cultural limitations and expanding, usually continuing in a dynamic and often balanced equilibrium with their environment.

Under the influence of LeGros Clark, Washburn, Weiner, Edholm and others, the new subject adopted an adaptive and ecological view of the biological function of the community. The community is seen as a functional entity displaying adaptive responses to the demands and stresses of its environment and of day to day events, and the efficiency of those responses can be characterised in physiological, nutritional, biomedical, developmental, genetic, demographic and cultural terms. Thus environmental physiology and work physiology showed the production capacities in a given environment of a community made up of individuals differing in sex, size and shape, age, and health; nutritional studies showed the extent to which the community met the food requirements necessary to maintain its productive capacity, its health, its reproduction, its children's growth; energy flow analysis led to objective explanations of the activity patterns of different ways of life (planting, harvesting, hunting) and their seasonal variations. Pathology and epidemiology showed the drain on the equilibrium caused by disease; genetic studies endeavoured to discover the contribution of inherited variation to the success of individuals and populations. Only with this approach is it possible to understand how the biological entity that is the human population is affected by, and in its turn affects, its biotic and abiotic environment, to discover whether those effects are balanced or unbalanced and, if the latter, which of the components, the human or the nonhuman, will be destroyed. In its turn human biology has much to offer to other biological disciplines, for no other species is so thoroughly or comprehensively known as is man.

The International Biological Programme

In international research modern human biology first appeared as part of the International Biological Programme (IBP). With the coming of the new ways of thought in biology, and the more modern interests of the presidents, notably Montalenti and Waddington, IUBS proposed a biological programme, the first serious effort to develop an international programme in the life sciences. There was a broad spectrum of biologists concerned at the problems of the increasing human population in the face of limited biological resources. The theme, biological productivity and human adaptability, was timely and particularly so since the science of ecology was passing from description to analysis of function supported by experimentation. The IUBS did not have the resources to mount a full scale programme at that time, so the programme was developed by ICSU. There were three phases, preparatory (1964-6), operational (1966-72), and synthesis (1972-74). There were 7 sections and leading biologists were appointed to the sectional committee for each, both centrally and in the IBP organisation in a number of countries. Each participating country was responsible for financing its contributions to the international projects. The first task was to list research, already in progress or proposed, relating to the objectives of the programme, so that new ideas could be added and realistic plans made. Since the methods of research were very varied, a series of 24 handbooks of recommended methods was prepared.

Though there were criticisms, the IBP as a whole was an undoubted success. Many thousands of biologists from more than 50 countries worked together with the object of improving knowledge on a comparative basis of the factors that govern the survival of plant, animal and human communities throughout the world. Particularly successful was the

human biology section, entitled "Human Adaptability". Its history and details are summarised by Collins and Weiner (1977). There were 12 themes, half of them concerned with particular aspects of human biology (e.g., growth and development, physical fitness, genetic constitution) investigated in populations throughout the world, and the other half were regional/ecological concerning, for example, peoples of high altitudes, in tropical and desert climates, migrant and hybrid populations. But the adaptation of peoples of widely different origins and cultures to environmental conditions was central to all. In the human adaptability sections no fewer than 43 countries participated, registering 320 separate investigations, carried out in communities throughout the world. Some of the proposals fell by the wayside, but reports on and published references to, 230 of the investigations are listed by Collins and Weiner. There is no doubt that the success of this section was largely due to the vision and energy of the convenor (J.S. Weiner), and the timeliness of the theme and his efforts.

Man and the Biosphere Programme

Towards the closing stages of the IBP in 1970, a new international research programme Man and the Biosphere (MAB) was initiated by UNESCO. This programme aimed at understanding the interactions between human activities and natural systems, as a basis for the rational use and conservation of the earth's resources; and at encouraging closer research between social and natural scientists so as to predict the consequences of today's actions for tomorrow's world. With its concentration on the effects on the environment, this unfortunately was rather less successful for Human Biology than the IBP.

Nevertheless, several projects were the direct descendants of the IBP, both in aim and relevance of IBP experience. There was for example the multinational Andean genetic and health project in north Chile, where the migration that has occurred between the different altitudinal zones provided a natural experiment to explore how the differing environmental conditions affected the biological characteristics of the population (Schull & Rothhammer, 1977). The research design produced a unified appraisal of the health of the groups against the background of the contrasting variables of the natural environment. Another project utilising migrants was that in Samoa, designed to explore the effects of rapid culture change on the biology and behaviour of Samoan emigrants to Hawaii and elsewhere (Baker, 1981). It thus provided important comparative material for the New Zealand migrant project dealing with the Tokelau islanders. There were important findings on cardiovascular disease, diabetes, obesity, blood pressure, nutritional status, and emotional, social and biological stress. In New Guinea the demography of the Gainji was investigated against the background of the limiting factors of their environment, their food resources and diseases (Campbell & Wood, 1988). It used, I believe for the first time, endocrinological investigation to support field observations of fertility. In Africa there was the considerably broader south Turkana ecosystem project (Little et al., 1988). It investigated the effects of patterns of human exploitation on the ecosystem, of herd management and environment on the social system, and of each on the health and adaptability of the people. It showed how the Turkana pastoralists managed their lives in their arid environment by ingenious exploitation of ephemeral vegetation for their livestock, a complex social exchange and support system that assists individuals and families to survive difficult times, and behavioural adaptations. Also in Africa, the Ituri forest project focused on the "symbiosis" between the Efe pygmy hunter-gatherers and the Lese Bantu settled village farmers (Bailey & Peacock, 1988). It explored the adaptation of the pygmies to both the forest environment and the settled life of their Bantu neighbours; from its results it appeared that the pygmies from this region have interacted with their Bantu neighbours for centuries out of absolute

need, and are incapable of surviving alone as hunter-gathers.

For the more limited success of MAB a number of factors were responsible. Many national funding agencies have no satisfactory mechanism to support multidisciplinary research. The financial climate for many countries had changed, fewer funds were available for support of large scale and integrated projects so countries were unable to give support on the same scale as they had to IBP. MAB had not identified multidisciplinary research as of high priority, few research projects into human biology were clearly formulated and the central organisation of UNESCO had only limited appreciation of the extent of the interaction of human and other ecological factors. Research effort was partly directed instead to conservation in nature reserves. And most important there was no central driving force, no energetic coordinator, to publicise the programme and encourage participation of colleagues throughout the world.

The Human Genome

More recently there has developed the human genome initiative, an ambitious project, probably the most ambitious in the whole history of biological science. It aims to map man's genes, to lay bare that infinite complexity of biological information that makes him human. It is the outcome of decades of progress in the knowledge of human genetics, and is only conceivable and practicable now because of that progress.

The development of recombinant DNA technology in the mid 1970s gave rise to a wide range of associated techniques, from the simplest uses of restriction enzymes, restriction fragment length polymorphisms, variable number tandem repeat sequences, to sequencing by the variety of complex procedures now available and still being explored, e.g., thermal stability mapping, X-ray diffraction, flow cytometry to identify individual bases following cleavage from the molecule. It is obvious then that only countries with the most sophisticated scientific units can contribute, so that perhaps the human genome initiative is less a truly international effort but more a collaborative endeavour on the part of a small group of countries. A great deal of finance has been poured into it, so much that it is impossible to say how much. The United States government committed itself to the extent of \$200,000,000 per year, with formal human genome programmes in the National Institutes of Health and in the Department of Energy. The human genome programme in the former Soviet Union was allocated nearly 90,000,000 roubles for funding of its initial three year period. In Britain the human genome mapping project of the MRC has already supported 54 research grants totalling some £6.5 million in two years, and the budget for the present year is £4.5 million. France developed its first human genome laboratory in Paris in 1991, though CEPH (Centre d'Etude du Polymorphisme Humaine) has been active for some time. At the international level there is the Human Genome Organisation (HUGO) and the European Community Programme Eurogen, while UNESCO's coordinating committee for its human genome project, among its other activities, provides training fellowships for third world scientists (21 in 1991).

Progress is reviewed in gene mapping workshops that have been held at intervals since 1973, and the next will take place in Japan in 1993. However, the work has now proceeded so far that the international workshops have to be devoted to specific chromosomes. For example the first international chromosome 4 conference was held in Philadelphia in June, the second international workshop on chromosome 3 was held in Denver in April and so was the second international workshop on chromosome 21. As of November 1991, the chromosome 19 map is about 70% covered in contiguous sets of clones, and there is a 90%

coverage of chromosome 16.

Perhaps because of this concentration of effort in a few countries, the real problems still lie ahead. The genome project, as it is at present, is a descriptive listing, directed to a standard human. This stage of description is reminiscent of that of the earlier days of physical anthropology when man's place in nature was sought by listing of his morphological features which were then compared with primates and other vertebrates. Pursuing the analogy, the next phases should concern the variations that there are among populations and among individuals, and attempts at their explanation, as called for by IUBS (Roberts, 1990). The exploration of the variations about the human standard genome has barely started, other than in regard to some inherited diseases. This is where the contribution of human biologists will lie, in exploring the variations about that standard, and their biological significance. Some time in the future, sooner rather than later, it is to be hoped that the importance of population variation will be recognised in this programme.

Decade of the Tropics Programme

Perhaps the true successor of the IBP may well prove to be the IUBS Decade of the Tropics Programme. For this involved many countries, including those of the third world; it had a broad central theme; a number of disciplines participated and human biology was a principal component. The programme was launched in 1982 by the IUBS with the object of answering some key biological and ecological questions in tropical environments, such as the resilience of tropical ecosystems, the role of organisms in soil fertility, the sustainability of traditional mountain agriculture. There were four themes:

- a) tropical soil biology and fertility, with the object of understanding the biological processes in tropical soils and how they contribute to soil fertility;
- b) grassland systems, with the aim of understanding the way tropical savannas respond to natural and human stresses and disturbances, through a comparative intercontinental analysis of selected topics, including plant demography, nutrient cycling, the effects of fire, of grazing;
- c) tropical mountain ecosystems, comparative studies to improve understanding of the functioning and productivity of natural and man-made mountain ecosystems, and to analyse the relations between natural ecosystems and prevailing patterns of land use.

The improved understanding that would emanate from all three of these would be expected to provide a basis for more rational management of these areas. But management is only possible through the human populations; the importance of including in the programme relevant studies in human biology was immediately apparent, so these provided the fourth theme (d).

There are so many human problems that bedevil tropical populations, the majority with a biological basis; for a significant contribution to be made by the programme it would be necessary to concentrate effort on a few of the more important topics. Through the IAHB, practising human biologists throughout the world were canvassed on those topics currently under investigation and those thought important to develop. Some fifty topics were proposed, from which after discussion there emerged two thought to require urgent attention, forward-looking in content and likely to contribute the most to the aims of the programme as a whole. These two were variations in working capacity and factors affecting it in tropical populations, and genetic variation, its extent and maintenance outlined by Roberts and De Stefano (1986a).

For both of these, meetings were held to review critically the knowledge then available, as a first step in identifying areas for further research. The volumes of proceedings of both meetings were published by Cambridge University Press, with the titles "Capacity for Work in the Tropics" (1988) and "Genetic variation and Its Maintenance" (1986b). An important difference was immediately apparent between the two topics. While in genetic surveys the different laboratories examining specimens were usually in close agreement in the methods that they employed, among investigators of work capacity there was considerable divergence in the methods that they used. The first priority in the work capacity programme was to establish a concordat on methods to be employed. This very difficult task was successfully carried out through the skill, knowledge and tact of Dr. K.J. Collins, and the result was a "Handbook of Recommended Methods" (1990) published by IUBS. In the meanwhile, work in the field was continuing, carrying out examinations or collecting specimens for subsequent laboratory investigation, often under very difficult conditions.

On the working capacity theme three contributions may be picked out. The investigations in the Congo of working capacity in Pygmies and Bantu in relation to body morphology and fitness showed better performance in simple motor tasks by the Pygmies than the settled villagers, evidence relevant to the concept of energy-sparing mechanisms and their development as an adaptive strategy. Secondly, the comprehensive cross-sectional studies of the effect in Samoans of the coming of modernization, the departure from a traditional lifestyle, produced some surprises. The rather higher work capacity in the more traditional than the more modern samples in Samoa is remarkably low by comparison with that seen in other peoples, traditional and western. This low fitness would have been adequate to meet the work requirements of the population living in their traditional lifestyle, but is likely to prove a handicap in excluding them from the more demanding physical employments of modern society. Third is the long-term longitudinal study of the effect on the capacity of Tokelau islanders of the stresses of migration to New Zealand and the accompanying exposure to a Western lifestyle. Selection of these for special mention does not detract from the value and utility of the other investigations, by units of varying size and sophistication. The topics that recur throughout their work are the relationships of working capacity to undernutrition, protein depletion, weight loss, fitness, growth patterns and stress.

In the genetic investigations too, the participating units range from the very small and modestly equipped to the large and sophisticated. By 1988, work was proceeding in all continental and oceanic areas in the tropics, and this has continued, so that today the genetic map of tropical man is much fuller than it was when Mourant's (1976) comprehensive compendium was published. Moreover the dimensions of genetic analysis have changed. That compendium covered mainly data on blood group polymorphisms, some on red cell enzyme and serum protein systems. Work on the gene frequencies of these characters has continued, and it is here that the smaller and less well endowed units have made their principal contribution, for example in simple descriptive studies of single systems. But these "classical" systems have also been a focus of activity of the more established units, for example by Kirk and his colleagues throughout the Pacific area tracing the migrations of the various peoples to estimate the times of their separation, so important to understanding the possible selective significance of the traits. In South America these serogenetic characters have been the subject of a remarkable series of studies among the various Indian tribes, establishing their relationships, how these compare with estimates from other types of data, how their gene pools are being diluted by admixture from outside.

Of the polymorphisms that in the '70s and early '80s were discovered so rapidly that there was no time to examine world distributions before the new findings were shouldered aside

by still newer developments, those of the white cell groups and other components of the major histocompatibility complex have proved their utility, some antigens virtually ubiquitous and probably predating the divergence of the major races, while others are more restricted and many show meaningful patterns of variation within continents. A further dimension is provided by the linkage relationships and disequilibrium between genes.

But the major contribution in the genetic investigations has been at the molecular level. The restriction fragment length polymorphisms associated with the HLA-D locus subdivisions confirm and enhance the conclusions from the serological analysis of Pacific peoples in their indication that the ancestral populations from whom the Micronesians, Melanesians and Polynesians derive left south east Asia before the Mongol expansions from the north, so that the Pacific groups are closer to the Japanese than to the Chinese. The molecular studies show that there is greater diversity between groups than could have been predicted from the serological data alone. The RFLP's and sequence-specific oligonucleotide hybridisations of PCR (polymerase chain reaction) products show not only different frequencies of DR alleles in Australian aborigines from those in Europeans, but the alleles themselves are different. There is obviously unsuspected genetic variation, the existence of which has profound implications for organ transplantation.

RFLP's at other points in the genome provide similarly interesting data, notably those associated with β globin and the Y-chromosome, the latter being particularly informative in hybrid groups showing the direction of male gene flow. Similar information but on the maternal contribution comes from mitochondrial DNA studies. These suggest, for example, that more women took part in the colonisation of the Pacific than previously thought.

Variable number tandem repeat polymorphisms (VNTR's) are also in use. As with the nuclear RFLP's the genetic distances among the populations correlate well with those from other DNA and serological polymorphisms.

Other investigations in the programme utilise the immunoglobulin polymorphisms, genetic variants detected in tissues other than blood (liver, brain, placenta), and an increasing number of DNA sites.

The Human Biology contribution to the programme has been world wide, embracing all major tropical regions and very many of their peoples. It has been vigorous, a truly international effort carried out by dedicated workers be their units small or large. It has already resulted in notable advances in knowledge. And if, a major aim, the understanding of the variation revealed seems as far in the future as when the work started, at least now we are in a better position to ask the right questions of the data.

Global Change and Ecological Complexity

The processes by which a certain number of different species is maintained in a given ecosystem, the role of gene pool size on species adaptability in changing environmental conditions, the consequences of human land use on size and quality of habitat, are all related to the study of ecological complexity. Yet how global change affects ecological complexity is not well defined. As part of the International Geosphere/Biosphere Programme on Global Change (IGBP) of ICSU, the International Union of Biological Sciences adopted a new programme on biological diversity in 1988, entitled *Diversitas*, and this is likely to become its major scientific endeavour during the 1990s. The IUBS initiative focuses specifically on the ecosystem function of biodiversity, processes of species extinction, and biodiversity

inventorying and monitoring. The position of human biology in this new programme has not yet been defined, and is worth some consideration. For example, our knowledge of the extent of diversity at the molecular level in man is unparalleled in any other species, and the extent of variation in nuclear DNA, mitochondrial DNA, both within and between populations has much to offer as a model in helping identify the true range of molecular variation in different ecosystems. The contribution of pastoralists to the enhancement of tree cover through the soil fertilisation and the excreted seeds from animals is an important contribution to the vegetation of the areas grazed. The effect of culling game animals by hunter gatherers must affect selectively the biota, as well as helping to maintain equilibrium numbers. There must be many other examples where human studies can contribute to the understanding of the diversity in ecosystems, a positive contribution instead of just writing off mankind as a negative element in the system, the destroyer of others.

World Health Organization

In a number of programmes of the great international organisations, there is scope for contributions in human biology. For example, the United Nations Development Programme/World Bank/World Health Organisation have a special programme for research and training in tropical diseases. This was established in 1975 to undertake research and development for new and improved tools to control six major groups of tropical diseases and to strengthen the research capabilities of tropical countries in which these diseases are endemic. Among the target diseases malaria was the most important, with a budget for 1990-1 of over \$15,000,000, followed by leprosy with nearly \$7,000,000, and filariasis with nearly \$5,000,000. Much of the total \$73,000,000 in that year was spent on vaccine and drug development, and biological control of vectors.

But down amongst the smaller allocations is heading under research capability strengthening, "Epidemiology and Field Research", and another "Social and Economic Research"; for the latter \$100,000 was allocated apart from the amount for drug distribution studies and research activities. This part of the programme has as its objectives:

- 1) to increase the effectiveness of disease control programmes by integrating human behavioural factors into programme design and management;
- (2) to determine the effect of social, cultural, demographic and economic conditions on tropical disease transmission and control; and
- 3) to promote the design and use of cost-effective acceptable disease control measures and policies.

The work at present focuses on human behaviour affecting tropical disease transmission and control, on the development of methods to evaluate medical and social steps to control disease, and on social and economic studies of different disease control measures. Another activity is the propagation of the results of such research. The programme has not yet tackled a major problem, namely the biological effect of implementing the results of these researches. For example, a study in the Gambia found a 70% reduction in mortality from malaria in 1-4-year-olds, as a result of using insecticide impregnated bed nets. If these results are confirmed, and such bed nets are brought into general use, what will be the effect on the community?

European Community Research

From time to time the Council of the European Communities makes recommendations for specific research programmes, and several of these have included topics of relevance to human biology. A research programme is drawn up setting out the detailed objectives and types of projects to be undertaken, and the financial arrangements for their support. The Commission of the European Communities then invites organisations who are eligible to declare their interest, and to submit proposals. These proposals must usually include two independent partners established in different member states. The new programme (1991-94) now being initiated concerns research and technology development in biomedicine and health. There are four areas:

- a) the development of coordinated research on prevention, care, and health systems;
- b) major health problems and diseases of great socioeconomic significance, for example AIDS, cancer, and mental illness. Curiously under this heading come the aging process and age-related problems and handicaps, and this, apart from the effectiveness of prophylactic and therapeutic measures, includes such topics as the maintenance of the quality of life in the aged, aging in different social settings, the relationship between decrease in functional capacity and resulting disability, and effects of the environment on health of people in the more vulnerable age groups.
- c) biomedical ethics, notably problems relating to research carried out in areas 1-3 and the possible applications of the research results.

For these 3 areas a budget of \$72,000,000 has been allocated. The fourth area identified, d) human genome analysis, is not included in the current call for participants, but will be included in the next, scheduled for 1992/93. There have been many such research programmes, and in the majority there is a lot of some interest to human biologists.

Conclusion

Enough has been said to demonstrate the considerable potential that there is for research in human biology in international research programmes, and how much the human biologist has to offer in varying ways. To take advantage of the opportunities, it is useless to sit back and wait for the central organisations to decide on the topic that is in our own personal interest. From the nature of these programmes, which are interdisciplinary, none is ever likely to be concerned with human biology alone. Nor is it immediately clear from the brief announcement of programmes as to where the contributions of human biologists will lie. It is necessary to read the small print attaching to each proposal, to look at the financial allocations, for each of us to consider what we have to offer and how to tailor it to the requirement of the programme.

Most of the biological programmes in recent years have had an ecological slant, and here mankind, as a principal factor in maintaining or destroying ecological balance, is of primary relevance. It is up to us, as with the biologists of 50 years ago, to look outside our current preoccupations and activities, and see how our ways of thought and our approaches can contribute to much broader investigations.

References

- BAILEY, R.C. & PEACOCK, N.R. 1988. Efe Pygmies of Northeast Zaire: Subsistence Strategies in the Ituri Forest. In: *Coping with Uncertainty in Food Supply*. I. de Garine & G.A. Harrison (Eds.) pp.88-117. Oxford University Press, Oxford.
- BAKER, P.T. & HANNA, J.M. 1981. Modernization and the Biological Fitness of Samoans. In: *Migration, Adaptation and Health in the Pacific*. C. Flemming & I. Prior (Eds.) Wellington, New Zealand.
- CAMPBELL, K.L. & WOOD, J.W. 1988. Fertility in Traditional Societies. In: *Natural Human Fertility: Social and Biological Determinants*. P. Diggory, M. Potts & S. Teper (Eds.) pp.39-69. Macmillan, London.
- COLLINS, K.J. 1990. *Handbook of Methods for the Measurement of Work Performance, Physical Fitness and Energy Expenditure in Tropical Populations*. I.U.B.S., Paris.
- COLLINS, K.J. & ROBERTS, D.F. (Eds.) 1988. *Capacity for Work in the Tropics*. Cambridge University Press, Cambridge.
- COLLINS, K.J. & WEINER, J.S. 1977. *Human Adaptability. A History and Compendium of Research in the International Biological Programme*. Taylor & Francis, London.
- LITTLE, M.A., GALVIN, K., SHELLY, K., JOHNSON, B.R.Jr., & MUGAMBI, M. 1988. Resources, Biology and Health of Pastoralists. In: *Arid Lands Today and Tomorrow*. E.E. Whitehead, C.F. Hutchinson, B.N. Timmermann & R.C. Varady (Eds.) pp.713-726. Westview Press, Boulder.
- MOURANT, A.E., KOPEC, A.C. & DOMENIEWSKA-SOBCZAK, K. 1976. *The Distribution of the Human Blood Groups and Other Polymorphisms*. Oxford University Press.
- ROBERTS, D.F. 1990. The Human Genome Initiative and the International Union of Biological Sciences. *Biology International*. 21:3-11.
- ROBERTS, D.F. & DE STEFANO, G.F. 1986a. Genetic Variation and Its Maintenance in Tropical Populations. *Biology International*. 14:2-13.
- ROBERTS, D.F. & DE STEFANO, G.F. (Eds.) 1986b. *Genetic Variation and Its Maintenance*. Cambridge University Press, Cambridge.
- SCHULL, W.J. & ROTHHAMMER, F. 1977. A Multinational Andean Genetic and Health Program: A Study of Adaptation to the Hypoxia of Altitude. In: *Physiological Variation and Its Genetic Basis*. J.S. Weiner (Ed.) pp.139-169. Taylor & Francis, London.

Biodiversity and Wheat Improvement in China

by Li Zhensheng
Vice-President, Chinese Academy of Sciences, Beijing, China

Introduction

Wheat is the largest crop in its planting area and production among the twenty major cultivated plant species in the world (Solbrig, 1992). During the last two decades, the production of wheat more than doubled due mainly to the use of modern varieties. For example, in China, the increase of wheat production attained 6% while the cultivated area was increased by only 1%.

With the increase of population the demand for wheat production must be increased on a yearly basis. The question is how can this be made possible? Improving varieties and their growing conditions are undoubtedly necessary. However, genetic improvement of seeds causes the narrowing of the genetic base and may result in disasters.

The most effective approach to avoid the above mentioned risks will consist of the use of wild relatives of wheat crossing with wheat. In other words, to use biodiversity in wheat improvement.

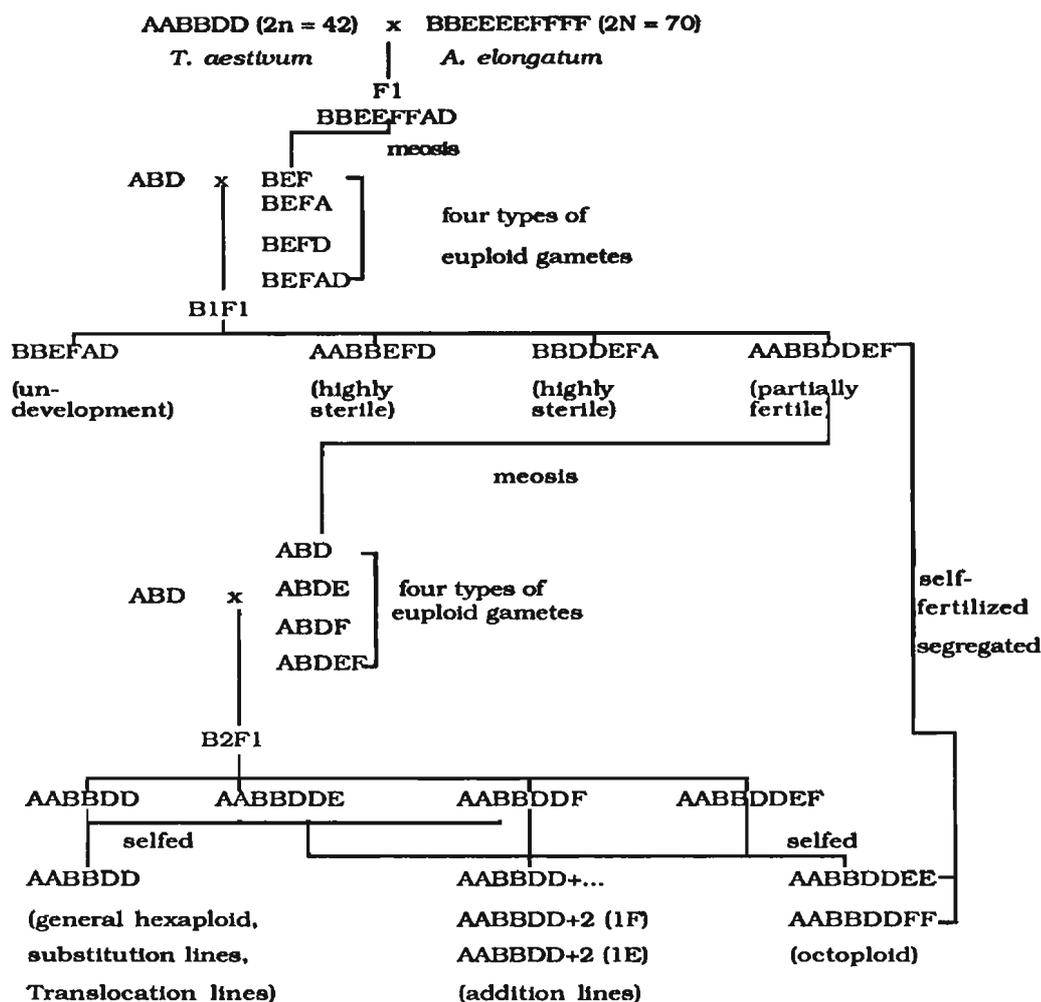
It is known that there are 55 wild relatives of wheat which have been crossed with common wheat (*Triticum aestivum*) successfully (Li *et al.*, 1985) (Table 1).

Table 1. Wild Relatives of Wheat

<i>Elytrigia</i> (<i>Agropyron</i>)	<i>E. intermedia</i> , <i>E. elongata</i> , <i>E. trichophora</i> , <i>E. juncea</i> , <i>E. repens</i>
<i>Secale</i>	<i>S. cereale</i> , <i>S. ancestrale</i> , <i>S. vavilovii</i> , <i>S. montanum</i> , <i>S. africanum</i>
<i>Aegilops</i>	<i>Ae. umbellulata</i> , <i>Ae. ovata</i> , <i>Ae. triaristata</i> , <i>Ae. columnaris</i> , <i>Ae. caudata</i> , <i>Ae. cylindrica</i> , <i>Ae. comosa</i> , <i>Ae. uniaristata</i> , <i>Ae. mutica</i> , <i>Ae. aucheri</i> , <i>Ae. speltoides</i> , <i>Ae. longissima</i> , <i>Ae. sharonensis</i> , <i>Ae. bicornis</i> , <i>Ae. searsii</i> , <i>Ae. squarrosa</i> , <i>Ae. cressa</i> , <i>Ae. ventricosa</i> , <i>Ae. juvenalis</i>
<i>Haynaldia</i>	<i>Ha. villosa</i> , <i>Ha. hordeacea</i>
<i>Leymus</i>	<i>L. giganteus</i> , <i>L. arenaris</i> , <i>L. mollis</i> , <i>L. chinensis</i>
<i>Elymus</i>	<i>E. canadensis</i> , <i>E. dahuricus</i> , <i>E. cylindricus</i>
<i>Roegneria</i>	<i>R. ciliaris</i> , <i>R. kamoji</i>
<i>Agropyron</i>	<i>A. trachycaulum</i> , <i>A. smithii</i> , <i>A. podperae</i> , <i>A. caespitosum</i> , <i>A. campestre</i> , <i>A. distichum</i>
<i>Criteston</i>	<i>C. bogdanii</i> , <i>C. chilense</i> , <i>C. pusillum</i>
<i>Psathyrostachys</i>	<i>P. huashanica</i>
<i>Hordeum</i>	<i>H. vulgare</i> , <i>H. spontaneum</i> , <i>H. bogdanii</i> , <i>H. chilense</i> , <i>H. bulbosum</i>

From one of the combinations between wheat with its relatives, (*Triticum aestivum* (6X) x *Agropyron elongata* (10X)), we have obtained four kinds of hybrids, octoploid, addition lines, substitution lines and translocation lines. The basic crossing formula is ((*T. aestivum* x *A. elongatum*) x *T. aestivum*) x *T. aestivum*, as showed in Figure 1.

Figure 1. The Procedure of a Cross, *T. aestivum* x *A. elongatum*



The wild species, *A. elongatum* (10X) which has 70 chromosomes, is a large living gene pool for wheat breeding. The research results which have been used in wheat production and genetic researches from this combination are as follows:

Superior Varieties

A series of superior wheat varieties have been developed from the hybrid between *Triticum aestivum* and *Agropyron elongatum* and used in production, such as Xiaoyan N°s. 4, 5, 6, 107, 168, etc. (Li, 1986).

Xiaoyan N°6 is a translocation line having 5 wheat chromosome arms (1AL, 2AS, 5AS, 6AS, and 7BS) exchanged with *Agropyron* chromosomes. In 1985, it has been grown in 10

million mu (667,000 ha), distributed in 10 provinces along the Yellow River banks and was awarded the First Class National Invention Prize.

Up to now, it is still the key variety in the Shaanxi province for it has maintained the positive characteristics, high yield, good quality, resistance to multiple diseases (stripe, stem and leaf rusts, scab, leaf blotch and powdery mildew) and wide adaptability.

Blue-Grained Monosomics

This is a completely new system which is absolutely impossible to be obtained by the traditional intraspecific or interspecific hybridization in the *Triticum* family, but an intergeneric outcome. It revealed the special role of biodiversity used in crop improvement.

The original blue-grained wheat was derived from a hybrid between *T. aestivum* and *A. elongatum*. Monosomic analysis showed that an *Agropyron* chromosome carrying a gene for blue aleurone had been substituted from chromosome 4D of *T. aestivum*. Further crossing of this substitution line to euploid of *T. aestivum* gave plants with 20 wheat bivalents, a wheat (4D) univalent and an *Agropyron* univalent. In the selfed progeny of this 42 chromosome plant, a plant with 41 chromosomes and blue grain color was isolated. This plant is the first blue-grained monosomic with 40 wheat chromosomes and one *Agropyron* chromosome substituted a pair of 4D wheat chromosomes (Li *et al.*, 1986).

The blue-grained monosomic is fertile and vigorous. In addition the blue-grained gene exhibits a clear Xenia effect. Selfing this monosomic produces four kinds of distinct phenotypes in the seed color of progeny: deep blue with 42 chromosomes, medium and light blue with 41 chromosomes and white with 40 chromosomes. Thus it can be seen that the blue grained monosomic can easily be maintained and used without recourse to cytology (Table 2).

There are two practical applications that can be accomplished with this type of material. First, it can be used in monosomic analysis after developing the complete system of blue-grained monosomics. Second, it can produce nullisomic lines used in chromosome engineering breeding in wheat.

Table 2. The percentage of various gametes and the percentage of the various types of offspring derived from selfing blue-grained monosomic.

	Male Gametes	
	20 W + 1 Ag*	20 W
Female Gametes 20 W + 1 Ag 25% blue	42 W + 2 Ag deep blue 22%	42 W + 1 Ag medium 3%
20W 75%	42 W + 1 Ag light blue 65%	40 W white 10%

*Ag=Agropyron chromosome; W=Wheat

Self Fertile Nullisomics

Many of the nullisomic seeds are easy to separate from the blue-grained monosomic progeny selfed and then selfings allow the selection of fertile nullisomic lines with high percentage of seed set.

Using self fertile nullisomic lines to cross with rye, backcrossing the same self fertile nullisomic line to the F1 plants treated by colchicine and selfing, we selected many new substitution lines from the hybrid with 42 chromosomes. It opens the possibility of nullisomic breeding.

Conclusion

In China, chromosome engineering has been playing an increasingly important role in wheat improvement. A considerable number of new wheat varieties have been bred through alien gene transfer and haploid breeding, many being cultivated in large scale operations in different regions of the country. Apart from its practical usefulness, chromosome engineering also plays a significant role in basic studies of wheat genetics.

The above mentioned results are important not only in obtaining improved wheat varieties, but in providing a good example on how understanding, protecting and utilizing biodiversity is of great importance in serving mankind. Stronger efforts should be made in order to achieve this goal.

References

- LI Zhensheng, RONG Shan, CHEN Shuyang, ZHUONG Guanchang, & MU Sumei. 1985. *Wide Hybridization in Wheat*. Scientific Publishing House. pp. 10-14.
- LI Zhensheng. 1986. Breeding of Intergenetic Hybridization between Triticum and Agropyron. *Proceedings of the 1st Int'l Symposium on Chromosome Engineering in Plants, Xian, China*. pp.179-180.
- LI Zhensheng, MU Sumei, ZHOU Hanping, & WU Jingke. 1986. The Establishment and Application of Blue-Grained Monosomics in Wheat Chromosome Engineering. *Cereal Research Communications*. Vol. 14, N°2.
- SOLBRIG Otto T., *et al.* 1992. Biodiversity: An Introduction. *Biodiversity and Global Change*. IUBS Monograph °8:13-20.

The Commission for Biological Education: a conceptual framework

By Gerhard Schaefer
University of Hamburg, Hamburg, Germany

Historical Overview

The Commission for Biological Education (CBE) of the International Union of Biological Sciences was established under its present constitution in 1977, under the chairmanship of Professor Peter Kelly, University of Southampton, U.K. In 1984, the chairmanship was turned over to Professor Gerhard Schaefer of Hamburg, and in 1993 to Dr. Joe McInerney, Director, BSCS, Colorado Springs, U.S.A.

The Commission organizes annual meetings to bring members together for discussion and for work on special projects relevant to modern biology teaching. The first and the second meeting (1978, London, U.K.; 1979, Kiel, West Germany) were devoted to the general topic of "Biological Education for Community Development". A book with this title was published in 1980 (editors, Peter Kelly & Gerhard Schaefer), and contained a collection of country reports, fundamental papers, and specific examples showing both the global scope of the Commission's work and the interesting spectrum of expertise represented among its members.

After this encouraging start the Commission developed quickly, through continuous "differentiation and integration", growing in the number of members from the original 15 in 1978 to almost 25 (maximum) in 1984, as well as in the number of projects. At the 1980 Osaka meeting, a list of 15 possible future projects was discussed. From these, 4 projects were given top priority:

- "Biotechnology Education" (publication by A.N. Rao & R. Kille in 1986);
- "Overcoming Constraints on Effective Biology Teaching World-Wide" (publication by Rex Meyer in 1988);
- Health Education Through Biology Teaching" (publication by G. Schaefer in 1985);
- "Contribution of Biology to the Quality of Life" (no publication).

At the Singapore meeting in 1981, a fifth project was added, influenced by a conjoint conference with the International Council of Associations for Science Education (ICASE): "Out-of-School Biology Education" (publication by R. Meyer & A.N. Rao in 1984).

While different project groups worked simultaneously upon these 5 projects in forms of both theoretical and empirical studies, new challenges were being brought out at the meetings of Vancouver, Canada (1982), Amman, Jordan (1983), Colorado Springs, U.S.A. (1984), Bangalore, India (1985), Helsinki, Finland (1986), Bangkok, Thailand (1987 - only part of the Commission), Sidney, Australia (1988), Moscow, U.S.S.R. (1989); Nairobi, Kenya (1990); Amsterdam, Netherlands (1991), and again in Colorado Springs, U.S.A. , in 1992. Thus, the additional following projects were discussed in specific international seminars held in conjunction with these annual meetings, published in a quick and economical form, and disseminated worldwide:

- "Undergraduate Biology Courses for Non-Biologists" (R. Kille., ed., 1987);
- "The Use of Computers in Biology Teaching" (T. Crovello, ed., 1988);
- "Field-Work Teaching in Tropical Countries" (P. Kelly, ed., 1988);
- "Teaching Biotechnology in Schools" (J. McInerney, ed., 1990);
- "Bioethics in Education" (Rex Meyer, ed., 1990);
- "Basic Human Needs" (G. Schaefer, ed., 1992);
- "Taxonomy and Biodiversity as Topics of Biology Teaching" (not yet published, convenor: Jorge Crisci);
- "Bioliteracy: A Global Aim of Education" (not yet published, convenor: Saber Selim);

Current Projects

In the meetings of Nairobi (1990), Amsterdam (1991), and Colorado Springs (1992), the Commission decided to launch three new projects in line with recent developments in educational or biological research: (1) "How to Train Biology Teacher Trainers?"; (2) "Teaching Basic Biology Through Basic Concepts"; and (3) Neurobiology and Human Behaviour".

How to Train Biology Teacher Trainers?

Whereas teachers, after they enter school as graduates, very soon know what students should learn and how they have to be trained, teacher-trainers in the university are mainly concerned about their own scientific field and normally do not accentuate what their students should learn for their later teaching profession, and how they should be trained for this purpose. In most countries (paradoxically enough) the teacher-trainers are not appointed because of their teaching qualifications, but on their scientific ones alone. This leads, as a rule, to a good formation of students in scientific methods, i.e., research, but on the other hand, to a considerable lack of actual teaching abilities.

The project group, under the leadership of Professor André Giordan, just started work at the Colorado meeting in 1992, in trying to obtain an overview of the present situation in pre-service teacher-training in the various countries, and to discover methods of how this training can be improved by "training" (which possibly means advising) the trainers themselves.

Teaching Basic Biology Through Basic Concepts

This project was initiated after the 1990 Nairobi meeting by a contract made between the CBE and UNESCO, within the UNESCO programme on "Teaching Basic Science". The first product submitted was a collection of papers written by G. Schaefer, A. Giordan, and E. Rugumayo on the concept of formation in biology teaching. The authors felt, however, the need to enlarge and continue this important project and to prepare a more elaborated and sophisticated book for practical use in teacher training and in school teaching. So at the 1991 Amsterdam meeting, it was expanded to a larger scale with more members, and a special seminar was organized in Colorado in 1992 on "Basic Concepts in Biology Teaching". Professor Timothy Goldsmith from Yale University gave a stimulating introduction to the question on "What the World's Students Should Know About Biology?", followed by Professor Schaefer's (who is working in the field of concept research in science teaching) lecture on "What is a Concept?". The subsequent discussions of parallel working groups were not able to define a set of basic biological concepts as outlined by the introductory speakers, therefore no consensus was established on which concepts are truly

"basic" for the whole of biology. The question was returned to the CBE project group, to be worked out in 1993/94.

The hypothesis so far is that on one hand, basic properties or "principles" of life can be found on all levels of organization and defined as "basic concepts", e.g., order/ structure/ chaos/ entropy, feedback/ regulation/ homeostasis, information storage /replication/ reproduction, complexity, diversity/ variability, etc.

On the other hand, however, many other biological terms may appear of high importance, but looking at the great variety of biological sub-disciplines, they turn out to be of relative significance only. According to the particular field of study, and for the purpose for which they are used (research, teaching, economy, politics), these terms' importance varies, and are more or less "basic".

The project group is preparing a book in which theoretical reflections about what a concept generally is (in the sense of "model of reality"), combined with practical teaching advice about specific concepts and the way in which they can be conveyed to the learner.

Neurobiology and Human Behaviour

This project was based on combining an earlier proposal on human behaviour ("The Biological Basis of Human Behaviour and Its Role in Education") made by Professor Csanyi in 1990, and a recent proposal on "Neurobiology". Because of the great causal distance between elementary neurobiological processes and the final outcome, the human behaviour, this synthesis of two different projects is experimental, and the result is unknown. In any case, there was no question as to the educational importance of both proposals, and the Commission unanimously agreed upon this new project.

Future Challenges and the General Role of the Commission

In Colorado Springs, as in the Osaka and Nairobi meetings, a long list of possible new projects was discussed by the Commission. These subjects originated from the abundance of challenges to modern biology education expressed by educators, international organizations, mass media, politicians, economists, and all those who feel concerned about education. The list is as follows:

- a polar structure of curriculum design for biology teaching;
- a policy of post-graduate biology education;
- an ethical code for biology teachers;
- mathematical approaches to biology teaching;
- the use of computers in biology teaching (2nd project);
- the psychological basis of learning biology;
- biology and the philosophy of science;
- new trends in biological research and their relevance for education;
- global change as a common challenge for biology teaching;
- the role of sociobiology for education;
- teaching the biology of forests, oceans, arid lands, etc.;
- environmental education in cities;
- environmental and health education merging into one common need education;
- biology education and its relation to other disciplines;
- a school syllabus without biology?;

- "biopolitics": what is it?;
- biocentric approaches to education.

The spectrum of themes gives an idea on how the Commission for Biological Education of IUBS has lived and worked over many years now. Three or four parallel projects are usually simultaneously underway, with some members working on one, some on others, and a few even contributing to several projects at the same time. All members, while working hard on their currently-chosen topic(s), are continuously overrun by the constant new challenges arising from both within and outside of the Commission, therefore necessitating a new project being launched before the last one has been finished, leaving the project leader to collect the data and papers, revise the manuscript, and finally edit a book, and complete the project.

The situation of CBE, in contrast to other Scientific Members of IUBS, is characterized by a comprehensive and interdisciplinary demand, whereas most other Members are specializing in a certain area of biology (e.g., fungi, mammals, botanical gardens, biometry, etc.). The Commission has to deal with the education aspect of all these areas, thus facing an unlimited task and scope of topics.

Cooperating with other international organizations like UNESCO, ECBA (European Communities Biologists' Association), AABE (Asian Association for Biology Education), ECASE (International Council of Associations for Science Education), ICSU-CTS (Committee on the Teaching of Science of the International Council of Scientific Unions), and others, the Commission is an important platform of international exchange of ideas on biological education, with a "clearinghouse function", and acts in a consultative capacity whenever needed. Its major role and philosophy is a) to reflect the theoretical background of biological education, both with respect to the self-understanding of biology as a subject of teaching, and of education in general, and b) to elaborate and communicate practical methods of teaching biological sciences and allied fields.

The title of the Commission expresses its demanding goal in a subtle way. It is not only the teaching of "biology" as a school or university subject that is relevant (for such a purpose it could just be called "Commission for Biology Teaching"), but the type of general education that has a strong biological component - an education which is based on a correct and comprehensive understanding of life in general, and human life in particular.

Thus, the Commission for Biological Education, although a commission within IUBS, is transcending the borders of biology and building bridges to the humanities.

DIVERSITAS

IUBS / SCOPE / UNESCO Programme on Biodiversity

Progress Report for 1992

by Jane Robertson Vernhes, UNESCO
and Talal Younès, Executive Director, IUBS

1992 witnessed good progress with the IUBS-SCOPE-UNESCO Programme on Ecosystem Function of Biodiversity. A leaflet explaining the programme (baptized *Diversitas*), and its objectives was published in English, French and Spanish. It was thus widely distributed to individuals, institutions, and at pertinent international meetings, such as the Scientific Round Tables organised by Brazil and UNESCO in June 1992 as part of the *RIO CIENCIA* activities in Rio de Janeiro to "put science into UNCED". The proceedings (edited by O.T. Solbrig, H.M. van Emden and P.G.W.J. van Oordt) of the symposium "Biological Diversity and Global Change", organised within the framework of the 24th IUBS General Assembly held in Amsterdam (the Netherlands) in September 1991, were published this year.

Also, the Coordinating Committee for *Diversitas* met for the second time at IUBS Secretariat on 23-24 April, to review the status of the planning and implementation of the three programme areas: ecosystem function of biodiversity, origins, loss and maintenance of biodiversity, and inventorying and monitoring of biodiversity, as well as the cross-cutting marine and micro-organism biodiversity. Financial aspects were also discussed, especially regarding support from the Commission of the European Community (CEC) and the Global Environmental Facility (GEF).

Very enthusiastic responses were received as to the scientific approach of *Diversitas*, and a large number of countries, including Brazil, Chile, France, Japan, Mexico, Russia, the UK and the USA have expressed a deep interest in involvement and cooperation. The CEC has furthermore adopted *Diversitas* as a basis for research in the European countries. The private sector has also shown its interest, as the International Chamber of Commerce and in companies such as Total, Rhône-Poulenc (France), Petrofine (Belgium) and Repsol (Spain).

Theme 1: Ecosystem Function and Biodiversity

Following the "general state of knowledge" meeting held in Bayreuth (Germany) in October 1991 (for which the resulting book is expected to be published by Springer-Verlag in early 1993), this theme has entered its second phase, made up of a series of meetings focusing on specific biotic regions of the world, to address the following issues:

- natural diversity of system;
- impact of change on biodiversity;
- assessing the role of biodiversity in ecosystem function;
- reconstructing and maintaining diverse systems; and
- refining our knowledge through explicit experiments and long-term observations.

Symposia are planned for the following systems: arid zones; estuaries, lagoons and mangroves; islands; Mediterranean; temperate forests; tropical forests; tropical savannas; tundra; upwelling systems; and coral reefs.

In 1992, two meetings were held on "Upwelling Systems", convened by Juan Carlos Castilla, and "Temperate Rainforests" (Convenor Jane Lubchenko), both organised by AMIGO

(America's Interhemispheric Geo-biosphere Organisation) in Victoria (Canada) on 21-26 September. A workshop on Mediterranean Ecosystems was convened by B. Huntley, and held in Cape Town (South Africa) on 7-8 September, and a symposium on Land/Inland Water Ecotone Biodiversity was held in Barcelona, Spain on 23-30 August.

A series of meetings are planned for 1993, and include: 'Savannas' (Convenor: O. Solbrig), in Brazilia (Brazil) on 24-28 May, 'Estuaries, lagoons and mangroves', (Convenor: Pierre Lasserre) Guadeloupe 14-20 Mars, and 'Coral reefs' (Convenors: John Ogden and B. Salvat), in Moorea, Tahiti (French Polynesia), in September.

Theme 2: Origins, maintenance and loss of biodiversity.

An Advisory Group has been established for this theme comprising: O.T. Solbrig (Chair), R. Barbault (France), K. Bawa (USA), P.H. Guyon (France), T. Hodgkin (USA), J. Naranjo (Argentina), B. Schaal (USA) and A. Templeton (USA). This group will work with the conceptual framework outlined in the book of the Harvard Forest workshop "From genes to ecosystems: a research agenda for biodiversity", focusing on the genetic and population levels. A special emphasis will be put on the modelling approach to understand how species or genetic variability can effect the dynamics of species and population extinctions.

A series of four symposia are to be organised in the period 1993-94. The first will be organised in Paris in early 1993 in collaboration with the CNRS of France. Other meetings will follow in Japan or Taiwan, South America and the USA.

Theme 3: Inventorying and monitoring of biodiversity.

On 30-31 January 1992, a small expert meeting was held in UNESCO HQ to outline the approach to inventorying and monitoring of biodiversity. The report was published as *Biology International* Special Issue N° 27 under the title "Inventorying and monitoring of biodiversity: a proposal for an international network", edited by F. di Castri, J. Robertson Vernhes and T. Younès. The notion of a network for inventorying and monitoring of biodiversity was further developed in a paper by the same editors on "The network approach for understanding global biodiversity", published in *Biology International* N° 25 in mid-1992.

These reports addressed the question of scale in time and space for inventorying and monitoring of biodiversity. It advocated a network approach to enable the comparison of comparable sites (in the same ecosystem type, for example) in terms of species composition and function, and their dynamics over time. It was recognised that it was impossible to undertake such labour-intensive and long term work in all parts of the world. Accordingly, the notion of intensive and extensive studies was recommended, whereby a larger number of sites would undertake a minimum package of inventorying and monitoring using selected taxa or guilds and only a restricted few would undertake intensive, comprehensive studies. Five biomes were selected for the establishment of the network: tropical rainforests, tropical savannas, temperate rainforests and temperate deciduous forests, temperate grasslands, and tundra. The idea of a pilot network of 25 terrestrial sites was recommended, of which 15 would be in developing countries and only 3 would be the sites for intensive studies. This would be complemented by a network of marine sites.

In order to refine this approach and adapt it to the actual field situation, a meeting was organised in La Selva Biological Station (Costa Rica) on 1 to 3 October, 1993, with the research scientists from 25 terrestrial sites representing the five biomes identified at the January workshop, as well as directors of marine stations or laboratories for the marine component. This meeting made it

possible to refine the scientific questions to be addressed by a global system for inventorying and monitoring biodiversity, establish a preliminary list of potential sites within the five biomes, plus define other important habitats (tropical mountains, arid zones, for example), refine the notion of extensive and intensive study sites, and lay a plan for the next steps to be taken. The report of this meeting is being edited by B. Huntley, P. Risser, P. Lasserre and J. Roberston Vernhes and will be published in early 1993 as a special issue of *Biology International*.

The La Selva meeting also identified the need to convene a small committee for this theme as soon as possible (in early 1993) to define, amongst others, a set of initial activities to launch the operational phase using appropriate funding.

Marine Biodiversity

A meeting of the Steering Committee on marine biodiversity was held at UNESCO-Paris on 13-17 April, 1992, the results of which served as a basis for a parallel meeting on inventorying and monitoring of the biodiversity of marine ecosystems during the October La Selva meeting.

Biodiversity of Micro-organisms

An *ad hoc* meeting on "Initiatives in tropical mycology" was held at the University of Liverpool (UK) on 6-9 April 1992 and the recommendations were forwarded to the *Diversitas* Coordinating Committee for consideration.

In collaboration with the International Union of Microbiological Societies (IUMS), a series of meetings were organized to discuss *Diversitas* in the context of microorganisms diversity: an *ad hoc* working-group on microorganisms diversity met in Barcelona (Spain) in September, 1992, followed by a workshop organized within the framework of the 7th International Congress on Culture Collections, held in Beijing (China) on 12-16 October, 1992 (*Cf.* pages 24-25).

Moreover, a Workshop on the "Needs and Specifications for a Biodiversity Information Network" held at the Tropical Data Base, Campinas, Brazil, 26-31 July, 1992, was attended by 35 people from a number of international organisations. It was made available online through a variety of electronic networks which were accessed by some 200 people, 30 of whom sent contributions to the discussions.

The Biodiversity Information Network (BIN/21)

Within the context of *Diversitas*, an international group established a Biodiversity Information Network to solve the problem of managing global diversity information. The network will disseminate and facilitate access to biodiversity information worldwide. It will encourage the active involvement of all regions of the world. The first mission of the initiative is to ensure participation of the entire biodiversity community.

The purpose of the Network is to support and encourage protection of the environment and conservation of the genetic resources inherent in its biodiversity. In order to pursue this objective and support the Biodiversity Convention and Agenda 21 (Chapters 15 and 40), the following recommendations were agreed upon. These will be distributed widely so that the biodiversity community has the opportunity to comment and express its interest.

Recommendations

1. The initiative will be known as the Biodiversity Information Network 21. The network will facilitate access to all levels of information (from molecular to biosphere) and will combine the knowledge within each discipline, furthering the understanding of biodiversity of living systems. Such an effort will identify and seek to fill the gaps, leading to new research and more informed policy decisions.
2. The goal will be to exchange information by electronic means whenever possible, but to include other ways of communication as needed by the network participants. To achieve a global electronic access, support should be provided to regions where facilities do not exist.
3. It will be a distributed network that will link many different sources of information across the world and will operate on a not-for-profit basis. Such a design is scientifically, economically, and politically practical, allowing effort and resources to be shared.
4. The network will be open to a wide range of user groups including, but not limited to, scientists, teachers, natural resource managers, policy makers, regulatory and legislative agencies and public interest groups. The needs of the user community will be actively sought to enable their requirements to be met more effectively.
5. The network will actively encourage the free exchange of information on a worldwide basis and will also encourage the standardisation of information and methodology.
6. A Secretariat will be established as a focal point and clearing house to facilitate and coordinate the flow of information among those with an interest in biodiversity.
7. Cooperating groups will be established with the purpose of encouraging participation and regional development. Collaboration with existing centres will be encouraged in order to prevent duplication of efforts already underway and to promote efficient use of funds. Support for developing countries to ensure global participation will be an important element.
8. Initially, an interim Steering Committee will be set up to coordinate immediate activities and seek funding. It will be supported by a number of working Groups. These working groups will advise in areas such as: Technical Issues, Outreach, Training and Editorial/Moderating Functions.
9. An initial activity will be to design and develop a Directory of Biodiversity Information Resources, drawing on existing directories. It will be made widely available by all possible means.
10. The involvement and support of other organisations and initiatives working within biodiversity will be solicited.

For further information concerning BIN 21 please contact:

Vanderlei Canhos, Base de Dados Tropical, Fundacao Tropical de Perquisas e Tecnologia "Andre Tosello", Rua Latino Coelho, 1301 Parque Taquaral, 13087-010 Campinas, Brazil (Tel:55-192-427022; Email: dora*bd.t.fpt.ansp.br);

John McComb, World Conservation Monitoring Centre, 201 Huntingdon Road, Cambridge CB3 0DL, U.K. (Tel: 44-223-277314; Email: johnm*wcmc.co.uk; BT Gold 75:DBI0710)

Barbara Kirsop, Biostrategy Associates, 10 Waterside, Ely, Cambs. CB7 4AZ, U.K. (Tel: 44-353-663562; Fax: 44-353-663436; Email: b.kirsop*cgnet.com; or BT Gold 75:DBI0005)

Anthony Whitworth, Association for Progressive Communications, 2284 Railroad Drive, Fairbanks, AK 99709, U.S.A. (Tel: 1-907-4798129; Email: anthony*igc.apc.org or anthony*gis.lter.alaska.edu)

Hideaki Sugawara, World Data Center for Microorganisms, The Institute of Physical and Chemical Research, RIKEN, Saitama, Japan (Tel: 81-48-4621111; Email: r35118*rkna50.riken.go.jp)

VIIth International Congress on Culture Collections

The 7th International Congress for Culture Collections was held in Beijing, China, on 12-16 October, 1992. It was sponsored by UNEP and UNESCO, who also supported associated training courses. The Congress was organised by the World Federation for Culture Collections (WFCC) and the China Committee for Culture Collections of Microorganisms. It was attended by over 300 people and incorporated symposia, round table sessions, posters and special evening events.

During the Congress the WFCC appointed the new Executive Board and Officers, as well as a new committee on biodiversity as follows:

Executive Board

President	Dr. L. Sly, Queensland University, Australia;
Vice President	Dr. V. Canhos, Tropical Database, Brazil;
Secretary	Dr. D. Fritze, DSM, Germany;
Treasurer	Dr. van der Mei, CBS, Netherlands;

Members

Dr. D. Hawksworth, IMI, U.K.; Dr. C. Kurtzman, NRRL, U.S.A.; Dr. T. Deak, NCAIM, Hungary; Ms. B. Brandon, ATCC, U.S.A.; and Dr. A. Ventosa, Univ. Seville, Spain;

Ex-Officio

Dr. H. Sugawara, WDC, Japan (WDC Director); Dr. K. Paknikar, MACS Institute, India (Editor Newsletter); Ms. B. Kirsop, Biostrategy Associates, U.K. (Immediate Past President).

WFCC Biodiversity Committee:

Ms. B. Kirsop (Chair), Dr. D. Hawksworth, Dr. R. Colwell, Dr. V. Canhos, Dr. M. Goodfellow, Dr. Shimitzu.

Resolutions

At the Seventh International Congress on Culture Collections delegates noted with great concern that the Convention on Biological Diversity signed in Rio de Janeiro, Brazil, in June 1992, failed to fully appreciate the fundamental importance of microorganisms to the maintenance and functioning of global ecosystems. They also recognised that the diversity of microorganisms and cell lines (e.g., viruses, bacteria, fungi, yeasts, algae, and protozoa) represents a vast, largely untapped source of new genes and organisms essential for developments in medical, industrial, agricultural and environmental biotechnology.

The following areas of concern should be addressed as matters of urgency:

I. Delegates resolved that government and non-government agencies at both the national and international level be asked to strengthen their commitment to the following:

- a) the support of interdisciplinary studies for the search and discovery of new microorganisms and novel products necessary for the advancement of medicine, industry, and agriculture;
- b) the support of national and international data exchange through the development of data bases, computerized networks and other appropriate systems;
- c) ensuring that microbial diversity features prominently in all future national and international policies on the sustainability and conservation of the natural resource base; and

d) support for the inventory and conservation of microbial resources.

II. The decline in the number of microbial systematists is and will be detrimental to a full expression of biodiversity and the delegates resolved that:

a) universities in particular be encouraged to increase the number of positions and facilities for the training of microbial systematists which is vital for the continued development of applied strategies for biodiversity;

b) research in microbial systematics and ecology as fundamental sciences necessary for the understanding and exploitation of biodiversity should be encouraged and supported.

III. Financial support to realize all these objectives is required, especially for culture collections which are the conservators of the living gene pool.

First World Congress on Medicinal and Aromatic Plants for Human Welfare (WOCMAP)

Maastricht, the Netherlands, 19-25 July, 1992

The First World Congress on Medicinal and Aromatic Plants for Human Welfare (WOCMAP) was held on 19-25 July, 1991, in Maastricht, the Netherlands. It was organized by the IUBS Section on Horticultural Sciences following the recommendation of the IUBS Executive Committee to continue with the Union's long standing interest in medicinal plants. The congress was co-sponsored by IUBS/ISHS, IUPHAR, FIP, UNIDO, UNESCO, CIHEAM, CEC, FAO and WHO.

The 350 participants from 56 countries took the opportunity to exchange research results as well as opinions. These individuals, representing the various disciplines such as botany, agronomy, pharmacology and medicine, expressed the need to promote scientific studies in all of these fields.

Through the one hundred lectures, posters, and well-attended workshops, with topics such as genetic resources of medicinal plants, industrial aspects, raw material production, biotechnology, pharmacology and international cooperation, a common understanding was reached. Also highlighted was the overall setting in which production, trade and usage of medicinal plant material takes place.

Currently, 1500 species of the estimated total of 300 000 higher plants are known to contain pharmaceutical active compounds. Only 95 species are used therapeutically worldwide. The production of these commercially handled medicinal plants is still largely gained by indiscriminately collecting from the wild, even when the crude drug will be eventually used for industrial purposes. Domestication and breeding programmes are needed to assure the survival of many useful plants as well as to meet quality requirements based on pharmaceutical standards.

A recognized source of market-information concerning medicinal and aromatic plants was observed to be lacking. Participants of WOCMAP expressed the need to safeguard the free

exchange of genetically high-rating material together with provisions to transfer benefits also to the countries of origin.

Education in and regulation of phytotherapy was another point of major concern of the participants from both developing and developed countries.

During the Congress more than 80 recommendations were drafted. The following are felt to be the most conclusive by members of the Organizing Committee.

Recommendations

- 1) Genetic resources and diversity of medicinal and aromatic plants must be classified and conserved through protection of natural sites and through development of tissue culture and other preservation techniques.
- 2) A new legal and ethical framework that will protect and regulate the use and management of genetic material of medicinal and aromatic plants needs to be established.
- 3) Quality plant material from sustainable production systems should be assured through the development and use of "Good Agricultural Practices".
- 4) A standardized "way-bill" for medicinal and aromatic plants needs to be developed and utilized to provide a verifiable record of plant material.
- 5) More financing and research should be directed towards enabling producer countries to locally process medicinal and aromatic plant material.
- 6) National acceptance and approval of herbal medicines should be based on the "Guidelines for the Assessment of Herbal Medicines" as developed by WHO.
- 7) Pharmacological and clinical trials should be conducted according to the directives outlined in the "Good Laboratory Practice" and the "Good Clinical Practice" of WHO.
- 8) Phytopharmaceuticals available to physicians should be botanically and phytochemically defined.
- 9) The preparation and publication of national herbal pharmacopoeia and the location of information data bases pertaining to medicinal and aromatic plants needs to be supported.
- 10) An international board for medicinal and aromatic plants should be established to stimulate cooperation among various international organizations working with medicinal and aromatic plants.

PUBLICATIONS REVIEW

AN AGENDA OF SCIENCE FOR ENVIRONMENT AND DEVELOPMENT INTO THE 21ST CENTURY

Edited by J.C.I Dooge, G.T. Goodman, J.W.M. La Rivère, J. Marton Lefèvre, T. O'Riordan & F. Praderie. Published for ICSU by Cambridge University Press, 1992 (331 pages).

This volume, based on a Conference (ASCEND 21) held in Vienna, Austria in November 1991, brings together the understanding and the judgement of the world's scientific community on the issues of highest priority for the future of the environment and development. It looks beyond the state-of-the-art and formulates the environmental and development research agenda, and identifies the scientific knowledge base which will be needed for rational policy decisions during the coming decades.

CLIMATE CHANGE 1992 The Supplementary Report to the IPCC Scientific Assessment

Edited by J.T. Houghton, B.A. Callander & S.K. Varney. Published for WMO & UNEP by Cambridge University Press, 1992 (200 pages).

This report is a Supplement to the 1990 Report of the Scientific Assessment Working Group of the Intergovernmental Panel on Climate Change (IPCC). It reviews the key conclusions of the 1990 Report in the light of new evidence, focussing on five main areas:

- sources and sinks of greenhouse gases and the precursors of tropospheric ozone;
- radiative forcing of the atmosphere, with emphasis on Global Warming Potential;
- updated scenarios for emission of greenhouse gases up to the end of the 21st century;
- new developments in climate modelling and model validation; and recent observation data on

climate variability and change.

CLIMATE CHANGE- A THREAT TO GLOBAL DEVELOPMENT Acting Now to Safeguard the Future

Published by Economica Verlag, Bonn, & Verlag C.F. Müller, Karlsruhe, 1992 (235 pages).

This volume consists of a report of the Enquete Commission "Protecting the Earth's Atmosphere" of the German Bundestag. It introduces an up-to-date position on climate research, corresponding with the UNCED in Rio de Janeiro, Brazil, to an interested public. Scientifically based and understandably written, the report shows a comprehensive picture of the Greenhouse Effect, the depletion of the Ozone, and the impending climatic catastrophe. It is also an appeal to the politically responsible, and world wide public, to realize new ways of international cooperation and the overcoming of the North-South Conflict.

GREENHOUSE EARTH

By Annika Nilsson.
Published on behalf of SCOPE & UNEP by John Wiley & Sons, 1992 (219 pages).

This book is an attempt to capture the messages in the many scientific reports published since the greenhouse effect and global warming were first brought up on the international agenda of environmental problems. Its aim is to provide the non-scientific reader with a picture of the different factors that scientists consider in their scenarios of the future.

HUMAN GENOME RESEARCH AND SOCIETY

Edited by N. Fujiki & D. R.J. Macer.
Published by Eubios Ethics Institute, 1992, (227 pages).

This publication consists of the Proceedings of the Second International Bioethics Seminar on 'Ethical, Legal and Social Issues of Human Genome Research' which was held in Fukui, Japan, 20-21 March, 1992. It includes an overview of human genome research and a historical background on bioethics in medical genetics, some examples of clinical applications and social issues related to medical genetics. This volume concludes with an international perspective of scientific responsibility and social, legal and ethical aspects of the Human Genome Project.

HOMAGE TO RAMON MARGALEF or WHY THERE IS SUCH PLEASURE IN STUDYING NATURE

Edited by J. Ros & N. Prat.
Oecologia aquatica, 10 (a Special Issue), 1992 (439 pages).

This volume is a special issue of *Oecologia aquatica*, the Scientific Journal on aquatic ecology published by the Dept. of Ecology of the University of Barcelona, and, at the same time, a book in the series "Homenajes" of the University of Barcelona. This issue is dedicated to Prof. Ramon Margalef, the founder of the Journal, and contains a collection of articles on ecology, limnology and oceanography signed by his collaborators, colleagues and old and new pupils.

DIVERSIDAD BIOLÓGICA/ BIOLOGICAL DIVERSITY

Edited by F.D. Pineda, M.A. Casado, J. M. de Miguel y J. Montalvo.
Published by ADENA-WWF Madrid, SCOPE and Fundació Ramon Areces, 1991 (300 pages).

This volume consists of the proceedings of an International Symposium on Biological Diversity, held in Madrid in Nov.-Dec., 1989. It includes 60 papers, in English and Spanish, dealing with biodiversity and conservation, as well as its relevance in land management, ecosystem organisation and disturbance.

ENDANGERED CULTURE COLLECTIONS

Edited by Rita R. Colwell.
Published by Maryland Biotechnology Institute, 1992 (82 pages).

This volume consists of the Proceedings of the First and Second international Symposia organised by World Federation of Culture Collections (WFCC). The first symposium 'Present Status of Culture Collections' was held in Prague, June 1987, and the second one 'Rescue of Endangered Culture Collections' which was held in College Park, Maryland, in Nov. 1988.

3RD INTERNATIONAL POLYCHAETE CONFERENCE

Edited by D. J. Reish.
Published as a Special Issue of the Bulletin of Marine Science, 1991 (596 pages).

This issue contains the papers presented at the 3rd International Polychaete Conference, held on 6-11 August, 1989, at California State University, Long Beach, California, USA. These papers are arranged into five themes: systematics, ecology and biogeography, reproduction and development, biochemistry, and phylogeny.

TROPICAL GRASSY WEEDS

Edited by F.W.G. Baker & P.J. Terry.
Published in CASAFA Report Series N° 2, by C.A.B. International, 1991 (203 pages).

This book reviews our current knowledge of grassy weeds and the damage they cause to crop production in the tropics. It is based on the workshop held in Nairobi in 1990, and includes a general review of grassy weeds, their physiology in tropical agriculture, management by biological and chemical control, integrated weed management, and control in tropical cereals, grasslands and forage crops.



IX INTERNATIONAL CONGRESS OF PROTOZOOLOGY

25th July – 1st August 1993 * Berlin, Germany



The DEUTSCHE GESELLSCHAFT FÜR PROTOZOOLOGIE and the DEUTSCHE GESELLSCHAFT FÜR PARASITOLOGIE kindly invite you to participate in this congress to be held at the International Congress Center of Berlin. We ask you to offer for the contributed paper sessions communications of any kind (oral presentation, posters, video and/or films) belonging to the following topics dealing separately with free living and parasitic protists.

TOPICS OF CONTRIBUTED PAPERS

Action of external agents and drugs • Advances in microscopy • Chemotherapy and chemoprevention • Control of cell cycle • Cultivation • Cytoskeleton and patterning • Ecology of free living protozoa • Evolution and systematics • Genetics and genome organization • Immune evasion of protozoan parasites • Intracellular traffic • Metabolism of parasitic protozoa • Molecular biology • Morphogenesis and life cycles • Motility, orientation and behaviour • Opportunistic protozoa and AIDS • Paleo-protozoology • Physiology of flagella and cilia • Protozoa and pollution • Protozoa in anaerobic environments • Recognition and cell interaction • Sexuality • Signal transmission • Species concepts • Symbiosis • Taxonomy and nomenclature • Techniques in diagnosis • Toxic blooms • Ultrastructure and function of organelles • Vaccination

PLENARY LECTURES

Evolution and systematic D. J. PATTERSON (Australia)	Progress in antiprotozoan vaccination L. PEREIRA DA SILVA (France)
Cytoskeleton and molecular basis of patterning J. BEISSON (France)	Opportunistic protozoa and AIDS E. CANNING (UK)
Molecular genetics M.-C. YAO (USA)	Modern technologies in protozoology K. JOHNSON (Australia)

SYMPOSIA

Molecular perspective on protozoan evolution Chair: ADOUTTE (France), JOHNSON (Australia)	Motility, behaviour and orientation Chair: GREBECKI (Poland), WOOD (USA)
Protozoa in anaerobic environments Chair: MÜLLER (USA), FINLAY (UK)	Ecology: Pollution and toxic blooms Chair: CURDS (UK), BEREZKY (Hungaria)
Interactions in symbiosis Chair: SOLDO (USA), FOKIN (Russia)	Intracellular traffic Chair: ALLEN (USA), PECK (Switzerland)
Control of cell cycle Chair: WATANABE (Japan), BERGER (Canada)	Protozoan links in food chains Chair: CARON (USA), FENCHEL (Denmark)
Genomal organization Chair: CARON (France), JAHN (USA)	Molecular immunology and host-parasite interface Chair: NUSSENZWEIG, V. (USA)
Rapid signal transduction in motility and secretion Chair: NELSON (USA), NAKAOKA (Japan)	Vaccination Chair: NUSSENZWEIG, R. (USA), ECKERT (Switzerland)
Mechanisms of pathogenicity among parasitic protozoa Chair: CAPPUCINELLI (Italy)	Chemotherapy and chemoprevention Chair: MCDUGALD (USA)
Functional aspects of organelles in parasitic protozoa Chair: OPPERDOES (Belgium), DUBREMETZ (France)	Life cycles Chair: BEYER (Russia), CHOBOTAR (USA)
Recognition and cell interaction Chair: MICELY (Italy), MIYAKE (Italy)	Cultivation of parasitic protozoa Chair: BRUN (Switzerland), ROITMAN (Brazil)
Cytoskeleton Chair: GRAIN (France), BRUGEROLLE (France)	Techniques in diagnosis Chair: GOTTSSTEIN (Switzerland), MIRELMAN (Israel)

HISTORICAL EXHIBITION

175 Years of Protozoology in Germany

INDUSTRIAL EXHIBITION

Presentation of new and actual products

For further information, the 2nd announcement and the registration forms, please contact:
Prof. Dr. K. HAUSMANN, Secretary General, Department of Zoology, Division of Protozoology,
Free University of Berlin, Königin-Luise-Str. 1-3, D-1000 Berlin 33, Germany, FAX: +49-30-838-6477