United Nations Educational,
Scientific and Cultural Organization

Our closest relatives
on the brink of extinction p. 20

A World of SCIENCE

Natural Sciences
Quarterly Newsletter

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IN THIS ISSUE

EDITORIAL

Why **physics**? Why **now**?

One hundred years ago, a young man working in the Patent Office in Bern, Switzerland, published a series of scientific articles. These introduced revolutionary ideas on fundamental questions related to the existence of atoms, the nature of light, the concepts of time and space, energy and matter. They opened up a whole new world composed of the infinitely small (particles), the infinitely large (the cosmos) and the infinitely complex (the states of matter). The name of this young man was Albert Einstein and his theories would lay the foundations for transistors, computers, lasers, televisions, magnetic resonance imagery in medicine and space travel.

Ambassador Moleko of Lesotho evoked this Miraculous Year, as it is known, when presenting a resolution for an International Year of Physics in 2005 to the United Nations six months ago.

The International Year of Physics celebrates the genius of Albert Einstein. But the Year is as much forward-looking as commemorative. If anything, we have an even greater need of the physical sciences now than ever before. How else will we solve the major problems of the 21st century related to energy production, environmental protection and public health? But first, we will need to persuade dubitative politicians that the technologies they will need tomorrow are the basic research of today.

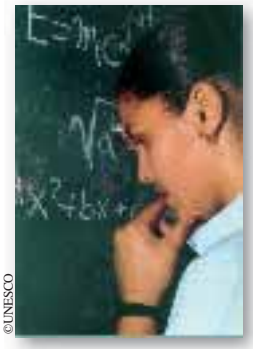
More than 60 countries around the world are preparing special events to celebrate the Year, of which UNESCO is lead agency and one of the co-ordinators within an international steering committee led by the European Physical Society.

The Year is being launched by a conference on the theme of Physics for Tomorrow from 13 to 15 January at UNESCO Headquarters. Open to the general public, the conference will focus on the role of physics in society and its impact on everyday life, the influence of Einstein on the science of the 20th and 21st centuries, the teaching of physics and its links with other disciplines.

Given the troubling – and in some cases growing – disaffection for physics among the younger generation, the lead story in this issue looks at how teaching methods are evolving towards activity-based tuition, a promising new approach.

A World Conference on Physics and Sustainable Development in Durban from 31 October to 2 November will round off the Year, sponsored primarily by UNESCO and its Abdus Salam International Center for Theoretical Physics, the South African Institute of Physics and the International Union of Pure and Applied Physics. Approximately 500 physicists and policy-makers from around the world will meet to discuss the ties between physics and economic development, health, energy, environment and education. The conference is expected to come up with an agenda for action that the international physics community can implement collectively.

W. Erdelen
Assistant Director-General for Natural Sciences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Physics without tears

Physics has never been a popular subject. Students tend to conclude that, on balance, physics requires too much work compared to the career options it promises. Most physics graduates, and especially those in developing countries, tend to end up as poorly-paid university or secondary school teachers. As a result, few students choose to major in physics. While data for most countries are incomplete, the available statistics do tend to show that the percentage of physics majors out of total university enrolment remains low.

The good news is that teaching methods are evolving. Today, the accent is being put on activity-based tuition that engages students in the learning process. Not only are there signs that students are enjoying physics more than before but recent studies also show a marked improvement in student performance when interactive teaching methods are applied.

Why is it so important to improve physics teaching at university? The answer is obvious. The physics students of today are tomorrow's scientists, engineers, medical doctors and teachers at the secondary and tertiary levels. Even future economists, psychologists and writers usually take an introductory course in physics. At Columbia University in the USA, this course has been affectionately dubbed 'physics for poets' by students. The fact is that a basic knowledge of physics is a key component of a well-rounded education. A university graduate who understands nothing of the forces behind natural phenomena like lightning or gravity goes through life with a handicap. He or she is equally handicapped when it comes to understanding the modern world. Herwig Schopper gives a poignant example of this (p.14) when he tells how doctors have had to drop the word 'nuclear' from the term of imaging with nuclear magnetic resonance to avoid scaring patients – whose misgivings are born of ignorance.

An article published by the Forum on Education of the American Physical Society in 2002 contends that the physics major in the USA is an endangered species. The authors write that, 'In 1999, … the absolute number of physics majors reached the lowest point since the end of the 1950s' (see box).

Edmund Zingu, President of the South African Institute of Physics, gives an idea of the situation in Africa in *Physics Today* (January 2004), when he writes that 'some of the poorest countries have gross enrolment rates [in science at secondary school] of between 5% and 10%. It is therefore not surprising', he concludes, 'that the development of a physics tradition, and the corresponding public investment in physics in those countries, is limited, or even nonexistent.'

José Luis Morán-López has divided Latin American countries into four groups based on the population of physicists and overall scientific output. The most developed group is in yellow, the intermediate group in blue, the third group in red and the few remaining countries, those with a negligible physics community, in grey

In Latin America, 'despite continued growth and improvement, the production of trained physicists remains low', regrets José Luis Morán-López in *Physics Today* (2000). Professor of physics at the University of San Luis Potosí in Mexico, he calculates that the region counts 'at most 40 000 physicists [with at least a Bachelor's degree in physics]' out of a population of 500 million. He concludes that 'clearly, several Latin American institutions offer very good undergraduate and graduate programmes but the number of graduates is insufficient to serve the needs of the region'.

Publish or perish!

It follows that, with few students majoring in physics, the numbers of physicists and physics teachers are also low. In the developed world, the few who do complete a degree and go on to become physicists usually find employment either in the university sector or in industry. In the South, most physicists are employed in universities. In developed and developing countries alike, those who do work in universities are expected to teach while at the same time conducting up-to-the-minute research, or research on a specific topic. For them, research is the key to a successful career, not teaching. 'Publish or perish' is a well-known maxim among physicists, whose success is generally measured in terms of publications; no such yardstick of success exists in teaching.

Moving away from the chalk-and-talk method

Does a degree in physics make a good physics teacher? 'Physics teachers generally teach as they themselves have been taught', comments Lillian McDermott, the multi-awarded pioneer in

Physics Education Research (PER) from the Department of Physics of the University of Washington (USA). 'In recalling how they were inspired by their own experience with introductory physics, many instructors tend to think of students as younger versions of themselves.' Moreover, McDermott has shown that university physics courses do not provide the preparation that teachers need. Many physicists have been taught by the chalk-and-talk or lecture method. PER studies have demonstrated that the traditional or lecture mode of teaching has been ineffective. The conceptual and problem-solving test results from a 6000-student survey of mechanics test data of introductory physics courses by Richard Hake at the Indiana University (Bloomington, USA) published in 1998 'strongly suggest that the classroom use of interactive engagement methods can increase mechanics-course effectiveness well beyond that obtained in traditional practice.' The traditional method of teaching is generally held responsible for the unpopularity of physics among students. The chalk-and-talk approach has failed to communicate the excitement and joy of discovery experienced by those who work in the field.

The situation in physics teaching in many countries, especially in the developing world, is a complex problem. Most physics teachers in universities and secondary schools either lack the appropriate educational background in physics or have only a tenuous hold on their conceptual understanding of physics. Science education experts believe that the high percentage of pupils who fail in physics and the growing aversion for the subject clearly demonstrate that teacher training means much more than simply lecturing future teachers in physics. The lack of a solid grounding in the subject also needs to be addressed. Many physics departments lack a consistent approach to developing and maintaining their undergraduate teaching laboratories. As a consequence of the 'publish or perish' dictate, research laboratories are given more importance and resources than those required for teaching. When physics teachers do invest the extra time and energy to make their teaching more interesting, their efforts often go unnoticed, earning them no appreciation and no recognition. To compound the problem, there are physics graduates who teach without ever having benefited from any laboratory experience themselves.

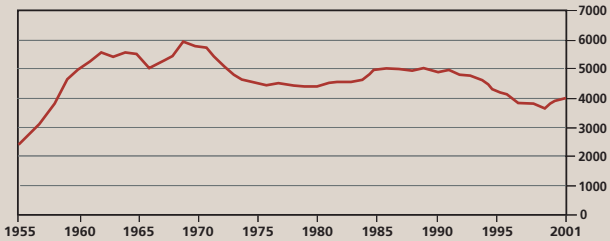
Notably in the USA, PER groups have been established over the past twenty years in several university physics departments to look into innovative approaches to teaching and student learning, including interactive engagement. Essentially, the method is activity-based to engage students in the learning process.

UNESCO has initiated a number of projects to regenerate university physics teaching. Regional physics education networks were established under the auspices of UNESCO in the 1980s. Among these, the Asian Physics Education Network (ASPEN) has been run over the years through support from UNESCO's Jakarta Office. ASPEN has organized various activities implicating countries in Southeast and East Asia, notably Japan, China, Republic of Korea, Thailand, Malaysia, Philippines, Australia, Laos and Vietnam.

The end of a downhill slide for physics majors in the USA?

If Bachelor's degrees have climbed steadily in the USA over the past half-century from quarter of a million in 1955 to 1.2 million in 2001, the progression in those majoring in physics has been a more bumpy ride. As can be seen from the graph below, numbers rose steadily in the 1950s and 1960s to a peak of 6000 in 1969 before falling off to fewer than 4000 by the end of the century. Numbers have begun picking up timidly again since but, even so, only 3.4 of every 1000 Bachelor's degrees were awarded in physics in 2001.

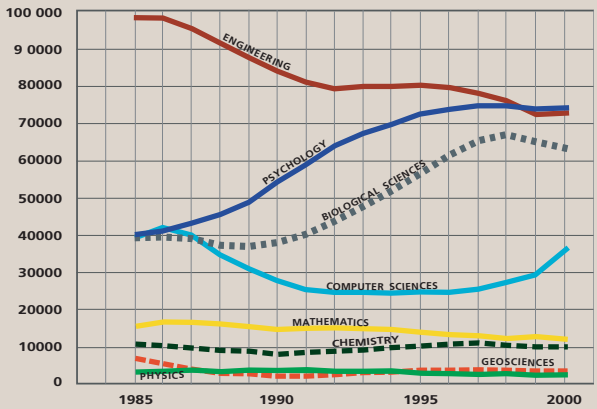
Bachelor's degrees awarded in USA in physics, 1955–2001



Source: American Institute of Physics Statistical Research Center, Roster of Physics Departments and NCES Digest of Education Statistics

From the graph below, we can see that the 1990s was a volatile decade in terms of undergraduate education. Many calculus-based fields, such as physics, engineering and mathematics, lost students at different points during the decade. This seems to be at least in part because of the ever-greater choice of course options. The two fastest-growing fields in the 1990s were biology and psychology, both of which were strongly popular with women (75% of psychology majors were women). In 1998, about 55% of all Bachelor's degrees were earned by women, a trend the US Department of Education projects will amplify, with women representing 58% of the Bachelor's class in 2010. In physics, however, women only passed the 20% mark for the first time in 1999. In 2001, they represented 22% of the physics undergraduate class.

Bachelor's degrees awarded in USA by discipline, 1985–2000



Source: American Institute of Physics Statistical Research Center, compiled data from National Science Foundation WebCASPAR Database System, March 2002.

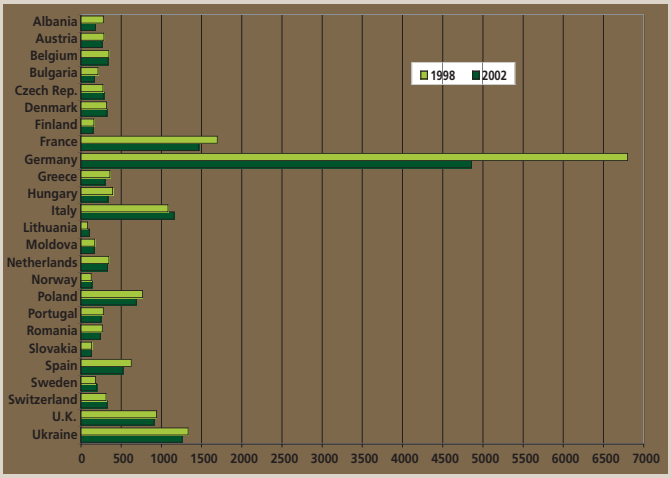
Europe's physicists of tomorrow

There is a general impression in Europe that the number of physics graduates is decreasing but is this really so? No Europe-wide statistical study had been conducted until the European Physical Society took it upon itself to determine whether there was indeed a disaffection for physics at the tertiary level.

The Mapping Physics Students Across Europe (MAPS) project submitted its first report to the European Commission in April 2004. The report shows that the number of physics graduates shrank by 15% across Europe between 1998 and 2002. Half of countries recorded a drop, notably the populous countries of Germany (-28%), Spain (-16%) and France (-14%) grouping 200 million Europeans (see graph below).

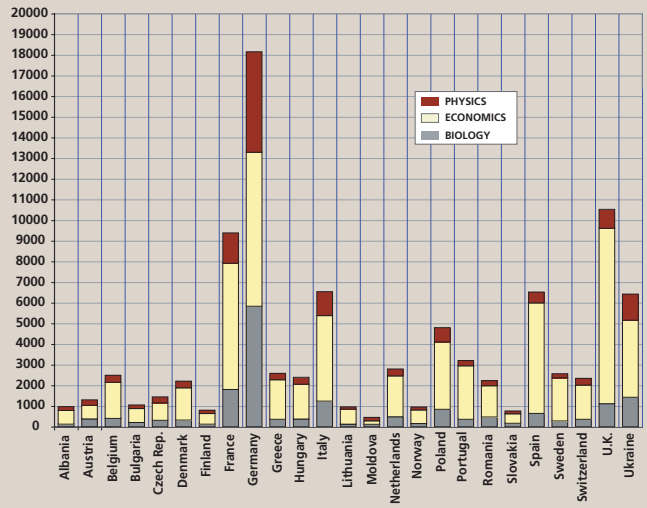
Yet, Europe will need an additional 500 000 scientists in all fields if it is to reach its target of a European Research Area spanning 30 countries or more by 2010.

Physics graduates in 1998 and 2002



Physics graduates in 2002

Compared to graduates in biology and economics



The MAPS report may be downloaded at: www.eps.org

In 1990, UNESCO launched the University Foundation Course in Physics (UFCP) to give first-year university teaching in physics a boost by pooling expertise from developing and developed countries alike to help universities – especially those in developing countries – improve the quality, effectiveness and relevance of their introductory physics courses. While emphasizing the need for more laboratory work and topics on contemporary physics, UFCP recognizes that not all topics can be taken up with equal rigour and effectiveness.

The project took off in Asia thanks to ASPEN, which provided experts from China, India, Japan, Australia and the Philippines. Their participation resulted in the production of a textbook and modules on selected topics in contemporary physics, as well as laboratory manuals and instructional materials on video and computer simulation software.

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Working in groups of two or three, participants in an active learning workshop in Sri Lanka are studying the motion of a falling object in real-time

UFCP was a pioneering effort to break away from the traditional approach to first-year physics teaching. One off-shoot has been for different countries to take advantage of the international collaboration to develop their own instructional materials.

Physics education networks established under the auspices of UNESCO in Latin America and in Arab and African countries have not fared as well as their Asian counterpart. But that could be about to change. Since the VIIIth Inter-American Conference on Physics Education co-sponsored by UNESCO in Cuba in July 2003, plans are afoot to revitalize the Latin American physics education network. On another continent, physics teachers from seven countries in Africa have formed an electronic group to facilitate the online exchange of news and information on the active learning method in the wake of the first UNESCO regional workshop on the technique in Ghana in October 2003 (see photo).

Hands-on learning in physics

UNESCO and ASPEN have been organizing hands-on workshops demonstrating the active learning technique

A bicycle wheel can be used to demonstrate rotational force or torque and its relation to angular velocity and momentum

©UNESCO

In a training course for resource persons in Manila (Philippines), trainees were presented with all kinds of locally available devices and materials, both computer and non-computer based

since 1996. Together, they have also developed innovative techniques in co-operation with PER experts from the USA and hands-on curriculum material. Workshops have been run in Laos, Australia, Malaysia, the Philippines, Republic of Korea, Sri Lanka and Vietnam.

Moreover, with UNESCO support and in co-operation with ASPEN, active learning modules on topics in mechanics have been developed and compiled for free distribution. These workshops have demonstrated that many physics teachers are keen to improve their teaching methods.

Building on the ASPEN experience, the recent UNESCO workshops in active learning organized in Africa in collaboration with the Society of African Physicists and Mathematicians have fostered the use of laboratory work and hands-on activities in physics classes to improve conceptual understanding of physics and promote innovative modes of content delivery, especially those developed in the USA by McDermott, Priscilla Laws of Dickinson College, Ronald Thornton of Tufts University and David Sokoloff of the University of Oregon.

UNESCO has put together a team of resource persons to run the workshops who identify with physics teachers and understand conditions in developing countries. ASPEN members play a key role in the team, which is developing learning materials and activities with emphasis on South–South collaboration. Resource persons from farther afield are also being primed to run workshops in other languages; they undergo training and evaluation in using and developing active learning materials, including designing hands-on activities and formulating probing discussion and assessment questions.

Caring about students

The active learning method, or 'interactive engagement', endeavours to match the teacher's strategy with the student's learning style. The active learning environment is generally characterized as being student-centered and activity-based with recourse to computers and other equipment.

Students are actively engaged in the learning process. They work in groups with materials and equipment, making predictions and observations, exchanging ideas with classmates and teacher, asking and answering questions. They use the results of their work to make mathematical descriptions and construct theories. In the process, they are developing scientific reasoning skills and learning the underlying principles and concepts. They then cease to be mere receivers of information.

It falls to the teacher to prepare the learning environment by choosing the experiments, exercises and discussion questions. By keeping lectures to a minimum and asking the students questions, the teacher guides the class through the reasoning necessary to construct concepts. In so doing, the teacher acts as facilitator, giving up her/his role as the source of all information.

The Asian Physics Education Network

ASPEN was established in 1981 on the recommendation of the UNESCO Consultative Committee Meeting in Khon Kaen (Thailand) attended by representatives from Afghanistan, Australia, China, India, Indonesia, Korea (Rep.), Malaysia, Papua New Guinea, Philippines, the former USSR and Thailand.

ASPEN promotes the overall development of university physics education in Asia and has established a programme of co-operation among members, to whom it disseminates information.

ASPEN operates through a network of National Points-of-Contact (NPCs) nominated normally by the National Commissions for UNESCO. The network collaborates closely with UNESCO's physics programme at Headquarters and in the field through UNESCO's regional offices for science and technology in Jakarta and New Delhi.

The Co-ordinating Board is headed by a Chair and Vice-Chair and made up of NPCs of seven member countries and a UNESCO representative. Every five years, the ASPEN General Assembly meets to take stock and elect new officers to the Board. At the last General Assembly in Sri Lanka in December 2002, membership comprised Australia, China, India, Indonesia, Japan, Korea (Rep.), Laos, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

A simple apparatus can be used to demonstrate image formation by curved mirrors. The curved mirror above is made from aluminium and the ray box has been built using the periscope principle

A demonstration of an electric circuit in series or in parallel can be constructed using a wooden board, electric bulbs, batteries and a switch. The apparatus can be used as an interactive demonstration in a lecture. By comparing the brightness of the bulbs connected in series or in parallel, students can see for themselves the difference between series and parallel circuits in terms of current and voltage, and the effect of switching the circuit on or off. This demonstration gives the student a real experience of electric circuits beyond the blind note-taking and copying of diagrams

Assessment and evaluation are an essential part of the active learning approach. It is important to determine how well the students are taking in physics concepts. The development of active learning curricula through physics education research has gone hand in hand with the design of standardized assessment instruments to probe conceptual understanding. Three tools of note are the Force Concept Inventory, the Force and Motion Conceptual Evaluation, and the Conceptual Survey of Electricity and Magnetism. These assessment tools differ from the usual approach of requiring students to manipulate formulae or answer questions on the basis of memorization.

One size does not fit all

There can be no 'one size fits all' approach. To be effective, active learning modules in physics need to take into account the resources available in the university and the cultural context. This does not mean that materials that have been developed to date and evaluated overseas are not valuable but some adaptation will be necessary. The Force and Motion Conceptual Evaluation, for example, which is used to probe conceptual understanding of

Teenagers tackle their country's energy problem

Energy is one of the scientific concepts most frequently found in school science courses, even at the primary level. This is only natural, given that we are surrounded by energy in one form or another. One of the first things children learn at school is that energy cannot be created or destroyed but only changed into another form. They learn that the sun emits solar energy but that we can only make use of that energy by converting it into electrical energy using solar panels, or that coal contains chemical energy that can only be converted into heat energy by burning the coal. In other words, they learn that any form of energy is only as useful as our ability to harness it. Yet, when pupils are taught about the concept of energy without being able to put theory into practice, the lesson tends not to sink in.

Here, pupils at the Instituto Ariel Hebreo Uruguayo are using an ammeter and a voltmeter to observe the changes in current and voltage in a simple DC-powered electric circuit

In Uruguay, the prolonged drought of 2004, in a country where hydroelectric power is normally sufficient to cover 80% of the country's electrical demand, inspired teachers at the Instituto Ariel Hebreo Uruguayo to design a practical, even topical, project for their third-year classes. The idea was to show the 16-year olds how important it was for a country to develop a contingency plan within its energy policy to prepare for unforeseeable extreme weather events like drought. Incorporated in the school project were elements taken from physics, chemistry and biology. The teachers encouraged pupils to explore the concept of energy, helping them in particular to grasp as abstract a concept as the definition of capacity.

The teachers organized a debate using a didactic approach developed by the Organization of Ibero-American States and Oviedo University in Spain. In this case, the debate centred on Uruguay's recent energy crisis. The fictional controversy the teachers chose concerned a proposal by an enterprise to install a nuclear power plant. Pupils were asked to play different roles and defend conflicting points of view. They were asked to develop arguments based on information in real and fictional handouts from their teacher, together with any other details they could unearth on the costs, risks, etc. of this means of generating electricity. They were then asked to present alternatives. The group arguing against the nuclear power plant came up with proposals for solar cells, biogas and windmills. Once both sides had presented their arguments, the floor was thrown open to questions before the class voted to decide which side had won.

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For details of UNESCO's science education programme in Latin America, contact Beatriz Macedo: bmacedo@unesco.cl; or Raquel Ejgenberg: arielej@movinet.com.uy

Helping girls shake off gender-stereotyping

Ms Koech has been teaching physics at Pangani Girls' High School in Nairobi (Kenya) for the past five years. Physics is Koech's passion. Yet teaching physics is a daily struggle to combat the real and perceived fears of physics among girls. Koech believes that girls can succeed and even enjoy physics. Drawing on everyday life experiences, Koech is never at a loss for physics examples: she uses walking upright to explain gravity, lifting an object to explain mass, the distance moved to explain force and so on. 'Physics is so practical and real', she enthuses. 'You explain what you see. In fact, with an understanding of basic concepts, learners can explain and analyse observations according to principles and laws of physics.'

Girls at Pangani High School

Koech speaks of the phobia for physics among girls, especially when it comes to mathematical equations. This fear is fuelled by misconceptions vehicled by family and friends. 'In our family, we believe that girls cannot perform well in sciences,' one pupil sighs. The girls' negative attitude towards science starts at home, where they are discouraged from taking science subjects. One third-year pupil recalls, 'I was being discouraged by my family and friends that physics was a hard course with so many graphs and calculations. My family wanted me to take history or geography instead'.

Girls tend to dissociate themselves during practical sessions, considering mechanics, electronics and electricity to be masculine domains. 'Parents encourage their young boys to make little cars and construct things while encouraging their girls to play "mum" by cooking and taking care of the baby. This affects girls' development and attitude towards science', regrets Koech.

'If learners can relate concepts from mathematics to principles in physics, they tend to overcome their fear of physics and perform better', says Koech. A third-year pupil confirms this. 'Physics is fun and interesting once you are able to relate it to mathematics'.

Inspired by their teacher's love of physics, the girls have started a school Physics Club which is enjoying growing popularity.

For details of UNESCO's science education programme in Africa (in Nairobi): Susan.Nkinyangi@unesco.unon.org

Newton's Laws of Motion, was developed originally in a temperate country and in American English; it is currently being adapted to the context of tropical countries, where teachers' first language is not English. The original version describes a sled on ice and refers to a person wearing spiked shoes standing on the ice and applying a force to the sled, which pushes it along the ice. The 'tropical' version begins as follows:

> A woman works in an ice-making factory. She moves a large block of ice around the factory by sliding it along a very smooth polished floor. The friction between the ice block and the polished floor is so small that it can be ignored. The woman wears non-slip rubber-soled shoes when standing on the floor, so that she can apply a force to the ice block and push it along the polished floor.

Computer use is desirable, where possible, since computers enable students to acquire data and draw graphs providing a real-time picture of a physical event that is computer-automated. In the study of Newton's laws of motion, for example, the use of computers enables the student to control the motion of an object and observe and understand the changes in its motion.

However, as computers are not yet a familiar sight in physics-teaching laboratories, non-computer-based activities using simple, locally available materials have been developed, some of which are shown on these pages. These activities will be compiled in a training manual and disseminated before the end of 2005 both online through the ASPEN website and in printed form.

It will take a concerted, consistent approach to collaboration with committed partners to make the paradigm shift in physics teaching. Recent UNESCO activities in physics education, including those of its centre in Trieste, the Abdus Salam International Centre for Theoretical Physics, have thus brought on board the International Society of Optical Engineering, the Ateneo de Manila University (Philippines) and the University of Oregon (USA).

Rising to the challenge

Introducing the active learning method to physics teachers in developing countries will require a tremendous effort and a commitment to change. The shift from a passive learning environment to an active learning one will not be easy. Most of the hurdles on the path ahead are a consequence of the pervading traditional culture in physics teaching. These should evaporate, however, as teacher (re)training progresses and we begin to see improvements in physics education. Since collaboration among physics teachers will be central to this process and they will need to pool their ideas and experiences, the key to success will lie in whether or not physics education networks can rise to the challenge.

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Reform of **Nigeria's science system** gets under way

The International Advisory Board for the Reform of the Science, Technology and Innovation System of Nigeria met for the first time on 27 and 28 October. The reform programme will pave the way for Nigeria to call a donors' conference to fund implementation of a multi-year plan of action on science, technology and innovation. A total of US$1 million has already been provided in equal shares by the Government of Nigeria and UNESCO/Japan Funds-in-Trust to finance the system-wide review and other preparatory work for the donors' conference.

Nigeria's Minister of Science and Technology, Professor Turner T. Isoun, described the first Board meeting as an 'epoch-making event in the history of the relationship between Nigeria and UNESCO'. Established by UNESCO at the request of the government of Nigeria, the Board is presided over by Jo Ritzen, President of the University of Maastricht, former Science Minister of the Government of the Netherlands and former Vice-President of the World Bank.

In inaugurating the Board before nearly 60 participants, including a 19-strong delegation from Nigeria, the Director-General committed UNESCO to putting together the international consortium that will underpin the revitalization of the Nigerian science system. Both he and Professor Isoun invited the Canadian International Development Research Centre to join the initiative as a technical and funding partner.

The Board decided to launch a joint review of investment, industry and innovation in Nigeria involving UNESCO, UNCTAD, UNIDO and WIPO. Other international agencies attending the meeting included the United Nations Economic Commission for Africa, the World Bank and the International Association of Universities.

Professor Isoun announced that his country would be establishing, within UNESCO, a US$1 million Nigeria Special Funds-in-Trust for Science. This Special Fund will 'not only benefit Nigeria but also assist other African countries in designing project proposals for the reform of their national science systems and in developing managerial capacities', he said.

The meeting offered an opportunity to expose the strengths and weaknesses of the Nigerian science system. The sectoral studies presented by different parties all emphasized the country's potential in terms of human resources and the 'reasonable number' of research bodies: Nigeria counts 60 universities, 44 polytechnics and 65 research institutes for a population of 133 million. Speakers also noted insufficient funding of research and development, poor management, inadequate macro-level co-ordination and a lack of linkages between industry and research institutes or universities.

The need for reform is patent after four decades of military rule – following independence in 1960 – blighted by state corruption and spiralling foreign debt. Since the transition to civilian rule in 1999, consolidated in 2003 with the election of the second Obasanjo government, Nigeria has initiated public policy reform programmes like the National Economic Empowerment and Development Strategy (NEEDS) to address some of the highest levels of poverty in the world.

The irony is that Nigeria is potentially a wealthy country. It is the world's 13th largest oil producer and the 6th largest in OPEC. Nigeria also has gas reserves which, when fully exploited, will place it among the world's top ten gas producers. However, 'in the 1980s, the country failed to use productively the oil windfall to improve social conditions and encourage the non-oil economic sector', writes the UK Department for International Development (DFID) in its *Nigeria Draft Country Assistance Plan (2004).* 'Between 1980 and 2000, Nigeria's per capita income plummeted to about US$290, well below the Sub-Saharan average of US$490'.

The reform comes at an auspicious time. After sluggish growth initially following the end of military rule, GDP rose by nearly 10% in 2003, driven by strong oil receipts and agricultural growth of 7%. Total public spending has also climbed markedly, from 19% of GDP in 1997 to 50% in 2001 (DFID).

One aim of the science system reform will be to use this growth to diversify Nigeria's economy, in order to reduce the country's dependence on fluctuating oil prices: oil exports accounted for 95% of foreign earnings in 1998, compared to 58% in 1970 (UNDAF).

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A Decade to educate

The Decade of Education for Sustainable Development kicks off on 1 January. It will target people of all ages, helping them to understand the world they live in and the complexity and interconnectedness of such problems as poverty, wasteful consumption, environmental degradation, urban decay, population growth, health hazards and conflict.

The Decade is a process, not a programme. It will act on four fronts: improving basic education, reorienting existing education at all levels to address sustainable development, developing public understanding and awareness of sustainability, and training. Key themes will be biodiversity, freshwater

management, environmental conservation and protection, rural transformation, better health and sustainable production and consumption. During the Decade, UNESCO will be developing quantitative and qualitative indicators within its Education for All programme to measure progress.

Development and effective management of the environment go hand in hand: access to safe drinking water and decent sanitation reduce child mortality, for example; better drainage limits the incidence of malaria and flood damage. This is why 'ensuring environmental sustainability' figures among the eight Millennium Development Goals for 2015 adopted by the United Nations in 2000, along with achieving universal primary education, eradicating extreme poverty and hunger, reducing child mortality and combating HIV/AIDS, malaria and other diseases, etc.

Hence also why the World Summit on Sustainable Development in September 2002 recommended to the United Nations General Assembly that 'it consider adopting a Decade of Education for Sustainable Development starting in 2005', which it did just three months later. As lead agency for the Decade, UNESCO has developed an implementation scheme on the basis of a broad 12-month consultation, which it presented to the General Assembly in 2004.

UNESCO is producing an array of educational products that will be showcased in coming issues of *A World of Science*. One example is the desertification kit prepared for schools by UNESCO's Man and the Biosphere Programme (MAB) in tandem with the United Nations Convention to Combat Desertification (UNCCD), with funding from the governments of Italy, Switzerland and Monaco. The kit targets teachers and their 10–12-year old pupils. It comprises a teacher's guide, a compilation of case studies, a classroom poster showing desertification in the world and comic book. Part I of the teacher's guide explains the causes of desertification and consequences on climate and geography, biology and on the socio-economic sphere. Part II introduces the UNCCD and describes activities for combating desertification. The kit includes case studies of solutions employed in Algeria, Chile, China, Ecuador, Gambia, India, Italy, Kenya, Niger, Peru, Spain and Uzbekistan.

In a first phase, the kit was distributed last year among selected primary schools in English-, French- and Spanish-speaking countries affected by desertification[2], principally through the UNESCO Associated Schools Project network (ASPnet) and the UNCCD Secretariat. When teachers were invited to rate the kit's usefulness on a scale from 1 to 10, they gave it an average score of 8.5. The kit has been distributed even more widely since being translated into Arabic, Russian and German. A Chinese version is nearing completion.

Co-publishing deals have been concluded between UNESCO Publishing and publishers working closely with the Ministry of Education in various countries to translate, print and distribute the kits. UNESCO itself has printed 5000 copies, most of which have been distributed to ASPnet schools. The kit has also been put on sale recently (see p. 24), although developing countries are still entitled to complementary copies.

A similar kit on the importance of wetlands is being developed by MAB in the form of a game. Testing of The Goose Game will begin in 700 ASPnet schools in January 2005. UNESCO's partners in this endeavour are the Ramsar Convention on Wetlands and the private Danone Group.

In parallel to education *per se*, other UNESCO activities will attempt to influence policy-making processes. One example is the Consultative Group of Experts on Biodiversity Education and Public Awareness set up by UNESCO and the Convention on Biological Diversity in 2000. Perhaps its greatest merit thus far has been to convince governments that conventional approaches to education simply do not work for the environment, especially in the case of biodiversity-related issues, and that a whole new educational discipline is necessary if one is to use education successfully to conserve biodiversity, utilize it sustainably and share the benefits arising from its utilization equitably.

For details of the Decade: www.unesco.org/education/desd
To request the kit: www.unesco.org/mab/capacity/EEKOD/EekodEng.htm

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An extract from the comic book in the desertification kit, 'The school where the magic tree grows'. The story was inspired by the case study submitted by an NGO in Chile on the work by pupils to create a nursery in their primary school. The comic book extends the case study and sees the young Chileans travelling to Europe and Africa to meet local populations also suffering the effects of desertification, with whom they exchange experiences

Water Co-operation
Facility launched

An international mediating mechanism to help resolve problems over shared water resources was launched by UNESCO and the World Water Council at the UNESCO-IHE Institute for Water Education in Delft (Netherlands) on 26 November.

The new Water Co-operation Facility (WCF) will include representatives from international organizations, national governmental institutions and NGOs active in water conflict management. It will advise conflicting parties on ways to reconcile their differences before resorting to expensive and often unproductive approaches such as litigation or continued struggle. The WCF will act only upon request of the parties involved in each situation.

The need for such a body arises from the growing demand and competition for the planet's limited freshwater resources, and the diverging interests of water users. Furthermore, achieving co-operation among riparian countries of an international basin requires years of effort and is a costly process, requiring long-term commitment from the states concerned as well as from external donors and professionals.

UNESCO's Director-General first mooted the creation of the WCF on 21 March 2003 during the closing session of the Third World Water Forum in Kyoto, in keeping with one of the recommendations adopted in the Forum's session on Water and Peace.

Now a reality, the Facility will provide support for the management of shared water resources, based on an underlying principle of 'solidarity'. It offers realistic options and helps parties to implement conflict resolution processes, under the guiding principles of willingness, consent, self-determination, impartiality and neutrality, and confidentiality.

The WCF will comprise an Advisory Board of approximately 10 members elected from among the Facility's partners, and a Core Staff. The Advisory Board will be responsible for selecting the cases to be dealt with, assigning a Response Team to each of them and evaluating the Team's progress. Among other functions, the Core Staff will be in charge of creating, managing and updating the databases of experts and professional institutions involved in shared water management issues. Upon receipt of the requests of parties, the Staff will conduct a preliminary investigation on their positions and interests, objectives and expectations.

For details: c.gonzalez@unesco-ihe.org; www.unesco-ihe.org

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Cat Ba Biosphere Reserve is an archipelago in the north of Vietnam adjacent to the Ha Long Bay World Heritage site. It is home to the threatened endemic monkey species, the golden-headed Langur (belonging to the 'leaf monkeys'). A major coastal fishing zone, the area has tremendous potential for agri- and aquaculture

Nineteen new biosphere reserves

A total of 19 new sites in 13 countries have been added to UNESCO's World Network of Biosphere Reserves, bringing the Network to 459 sites in 97 countries. One extension and one change to the borders of an existing biosphere reserve have also been approved.

The additions and changes to the biosphere network were approved by the International Co-ordinating Council of UNESCO's Man and the Biosphere (MAB) Programme meeting at UNESCO Headquarters in Paris from 25 to 29 October (see table). The MAB Council also examined the case of the Dunaisky Biosphere Reserve in Ukraine, part of the Danube Delta Transboundary Biosphere Reserve with Romania, where construction of a navigation canal to the Black Sea has been the cause of controversy. The Bureau expressed concern over the way in which the zones have been changed without local, national or international consultations and encouraged the Ukrainian authorities to increase bilateral discussions with Romania, its partner in the transboundary biosphere reserve. The MAB Bureau is to make a decision on this issue once Ukraine submits its official final zoning for the Biosphere Reserve.

The extension concerns the Wadden Sea of Schleswig Holstein Biosphere Reserve (Germany). A Biosphere Reserve since 1990, the site comprises a national park and Ramsar International Wetland of Importance. This extension has been inspired by the communities of the Hallig Islands, which plan to use the extension to foster a regional identity in the form of local products and services. The change in zonation applies to the Menorca Biosphere Reserve (Spain), where the original core area has been expanded to broaden its marine zone.

For details: www.unesco.org/mab

The new biosphere reserves

Taza Biosphere Reserve (Algeria)	spectacular cliffs, beaches, mountains and valleys; home to the Barbary macaque (*Macaca sylvanus*), a threatened species of monkey endemic to Algeria and Morocco; tourism opportunities abound
Gouraya Biosphere Reserve (Algeria)	picturesque coastal and inland landscapes, diverse ecosystems; ideal for ecotourism; agricultural development for local communities envisioned
Pribuzhskoye–Polesie Biosphere Reserve (Belarus)	in vast wetland transborder region of Polesie; pine forests, bogs, meadows, extremely rare floodplain forests; complements adjacent West Polesie Biosphere Reserve in Poland and Shatsky Biosphere Reserve in Ukraine; possibility of trilateral transboundary biosphere reserve in future
Georgian Bay Littoral Biosphere Reserve (Canada)	in eastern part of Lake Huron, includes headwaters of St Lawrence River; one of world's largest freshwater archipelagos
Foping Biosphere Reserve (China)	one of China's three major habitats of giant panda; abundant medicinal plant species; potential for ecotourism and scientific research
Qomolangma Biosphere Reserve (China)	home to the world's tallest mountain, Mount Everest (*Qomalangma* in Chinese); extremely rare alpine ecosystems; reflects the rich history and culture of Tibet
Nanda Devi Biosphere Reserve (India)	in the Himalayas; Nanda Devi National Park/World Heritage site and Valley of the Flowers National Park are situated in core zone; local communities in Lata–Tolma–Malari and Pindari areas are benefiting from alternative sources of income like ecotourism and from improvement of agricultural activities
Selva Pisana Biosphere Reserve (Italy)	in coastal area in western Italy; connects Migliarino–San Rossore–Massaciuccoli Regional Park with Municipality of Pisa; the focus is on sustainable agriculture, forestry, tourism and a practical experiment in reducing the ecological footprint (or human imprint) of the area
Mount Kuwol Biosphere Reserve (People's Democratic Republic of Korea)	on West Sea; heritage dating back to origins of Buddhism and Korean culture; important rice-growing area, balances conservation of essential ecological and hydrological functions with sustainable food production; the foot of Mt Kuwol is abundant in medicinal herbs, widely used for traditional Koryo medicine
Ría Celestún Biosphere Reserve and Ría Lagartos Biosphere Reserve (Mexico)	coastal areas of Gulf of Mexico on Yucatan Peninsula; include important wetlands under Ramsar Wetlands Convention; may be joined together in future
Kedrovaya Pad Biosphere Reserve (Russian Federation)	on Pacific coast, protects endangered species like the Far East Leopard by blending conservation and opportunities for sustainable income generation
Kenozerskiy Biosphere Reserve (Russian Federation)	in northwest; virgin taiga forest ecosystems; globally important migratory bird habitat; contains unique swamp and forest ecosystems; sustainable forestry techniques in buffer zone; revival of tourism and traditional trades and crafts
Valdaisky Biosphere Reserve (Russian Federation)	in Valdai Highlands in northwest; created around national park; will focus on new employment opportunities while encouraging environmentally friendly natural resource use
The Karst Biosphere Reserve (Slovenia)	the Skocjan caves in core area are a World Heritage site and Ramsar Wetland of International Importance; sustainable agriculture, preservation of caves and local hydrological processes, control of surface and subsurface pollution from fertilizers and wastewater
Babia Biosphere Reserve Unit, Gran Reserva de Biosfera Cantabrica (Spain)	in Castilla y León Autonomous Region in north, addition to multi-unit Biosphere Reserve across Cordillera Cantabrica Mountains
Kanneliya–Dediyagala–Nakiyadeniya Biosphere Reserve (Sri Lanka)	covers lowland and mountain tropical forests; an important watershed feeding many rivers and streams vital to agriculture and energy production
Cat Ba Biosphere Reserve (Vietnam)	(see photo)
Red River Delta Biosphere Reserve (Vietnam)	in north; Ramsar Wetland of International Importance in core area; valuable mangrove habitats; demonstration area for sustainable fishery systems

IPSO determined **'to make peace happen'**

Sari Nusseibeh and Menahem Yaari are respectively President of Al Quds University in East Jerusalem and Chair of the Israeli Academy of Sciences and Humanities. They were at UNESCO Headquarters in Paris on 15 November to present the Israeli-Palestinian Science Organization (IPSO) to the international community at a ceremony organized by UNESCO to commemorate World Science Day for Peace and Development.

IPSO's co-founders were accompanied by fellow members of the Organization's International Scientific Council (ISC)[3], seven of whom are Nobel Laureates and one an Abel Laureate (the Nobel equivalent for mathematics).

In his presentation, Menahem Yaari addressed the question of whether science can succeed where politics has failed. 'The advantage with scientists over politicians', Menahem Yaari commented, 'is that scientists tend to agree on what the issues are. Science is also free of historicity; it matters where you are and not how you got there'. 'Menahem and I believe that peace is not only possible but inevitable', Sari Nusseibeh added. 'It is only a question of how much pain both sides are prepared to bear to get there. We wish to shorten the pain'.

To an audience made up of the Israeli and Palestinian Ambassadors to UNESCO, among others, as well as representatives of different scientific institutions, Sari Nusseibeh explained that IPSO[4] was a determined effort to get peace back on the rails in a troubled part of the Middle East by using science 'to make peace happen'. He explained that, by fostering scientific co-operation, IPSO would be improving the lives of Palestinians and helping to create a more balanced relationship between the two communities.

'The lives of Palestinians and Israelis are closely entangled', he observed, '95% of the Palestinian economy is dependent on the Israeli economy'.

Since 2000, the restrictions in the occupied territories on the mobility of people, but also of goods and services, have accentuated the economic gap between Palestinians and Israelis. According to the World Bank, half of the 3.4 million Palestinians today live beneath the poverty line, their average annual income having dropped by 40% over the past four years to US$925, compared to US$16,500 for the 6.7 million Israelis. Infant mortality is four times higher in the Palestinian Territories than in Israel.

'IPSO offers the promise of co-operation that will be beneficial to the Palestinians', Sari Nusseibeh said. Israel was a highly developed society, he noted, with much to offer both Palestinian science and Palestinian society.

It was hoped that IPSO would create a climate in which Palestinian scientists were able to obtain permits to circulate more easily. At present, even collaboration between Palestinian scientists was often impeded by restrictions on mobility in all but Jerusalem. These restrictions explain why 40% of the 58 projects IPSO has received since its call for proposals last August originate from Al Quds University.

One of the criteria for proposals is that these must involve both Israeli and Palestinian scientists. The proposals cover research in agriculture, health – where a majority of projects involve genetics – nanotechnology, environment and political science. Several target problems common to both the Palestinians and Israelis, such as the study of psychosocial problems in both communities born of the violent climate, or that of environmental stress in the shared biome.

IPSO has undertaken to finance 30 new projects every year. To do so, it needs an annual budget of US$2.5 million, 10% of which will go to cover overheads. At this stage, the available funds fall far short of this total. 'Our credibility is on the line', Sari Nusseibeh cautioned. 'We must not disappoint all those who are counting on us'. One of the more urgent missions of the ISC is to raise funds, a mission for which IPSO can look forward to UNESCO assistance. 'UNESCO stands ready to fundraise on behalf of IPSO and to serve as the channel for this support', the Director-General told the gathering.

For details: www.ipso-jerusalem.org
Director-General's speech: http://unesdoc.unesco.org/images/0013/001374/137479e.pdf

A half-century **for CERN**

Europe's first intergovernmental research organization is fifty. Better known by its acronym of CERN, the European Organization for Nuclear Research was established by Treaty on 29 September 1954, in the culmination of a series of UNESCO-sponsored meetings that had begun with the setting-up of an international board of consultants by UNESCO in May 1951.

'When the 12 founding Member States ratified the CERN convention,' says CERN's Director General Robert Aymar, 'they gave the new organization a mission to provide first-class facilities, co-ordinate basic research in particle physics and to help reunite the countries of Europe after two world wars.' The original members were Belgium, Denmark, Federal Republic of Germany, France, Greece, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom and Yugoslavia.

CERN has built its reputation on basic research but it is also an important source of new technologies, particularly ICTs. The World Wide Web was invented at CERN and the Organization is today in the vanguard of the effort to develop a globally distributed computing system known as the Grid. CERN not only fosters an interchange of scientists, international collaboration and training but is also mandated to make its research results freely available.

In CERN's golden jubilee year, the focus is on the Large Hadron Collider (LHC), which will be the world's largest and most complex scientific instrument when it switches on in 2007. Experiments at the LHC will allow physicists

The Large Electron-Positron Collider (LEP), measuring 27 km in circumference, came into operation in 1989. Only two months after the first collisions in LEP, extremely accurate measurements of the Z particle showed that the fundamental building blocks of matter consisted of three, and only three, families of particles

to complete a journey that started with Newton's description of gravity. Gravity acts on mass but so far science has been unable to explain why the fundamental particles have the masses they do. Experiments at the LHC may provide the answer. They will also probe the mysterious missing mass and dark energy of the universe: visible matter seems to account for just 5% of what must exist. The experiments will investigate the reason for nature's preference for matter over antimatter and probe matter as it existed at the very beginning of time.

CERN is headquartered in Geneva (Switzerland). Its membership today stands at 20, with the addition of Austria (1959), Bulgaria (1999), Czech Republic (1993), Finland (1991), Hungary (1992), Poland (1991), Portugal (1985), Slovak Republic (1993) and Spain (1961–1969, rejoined in 1983) and the withdrawal of Yugoslavia in 1961. India, Israel, Japan, the Russian Federation, Turkey and the USA are Associates, whereas the European Commission and UNESCO enjoy Observer status.

'It is no accident,' says Aymar, 'that many of the countries [which join] the European Union are already members of CERN. Scientific collaboration has proved to be a valuable step on the way to collaboration at the political level.'

For details: www.cern.ch

Trieste Science Prize to celebrate science from South

The Academy of Sciences for the Developing World (TWAS) and Illycaffé Ltd have launched an annual Trieste Science Prize to give international recognition to outstanding research from the developing countries. The deadline for nominations is 31 March.

Two Trieste Science Prizes worth US$50,000 each will be awarded annually to individuals. The prizes will rotate among the various fields of science, beginning with the two categories of physics and astronomy, and biological sciences in 2005. Only candidates who are nationals of developing countries and both working and living in the South will be eligible for the award. Candidates may be proposed by science academies, national research councils, universities and research institutes but self-nominations will not be accepted.

The Prize takes its name from the Italian city of Trieste where TWAS is headquartered, as a tribute to the role the Trieste System of scientific institutions plays in promoting science and technology in the developing world.

The Director of UNESCO's Regional Bureau for Science in Europe, Howard Moore, welcomed the Prize at the TWAS General Meeting on 23 November. 'TWAS has been a close collaborator of UNESCO over the years', he said, 'and the links are strong. We have been pleased to provide administrative support in recent times'. UNESCO, TWAS and the International Council for Science (ICSU) are involved jointly in exchanges of teachers and researchers between centres of excellence. TWAS has also given freely of its advice in the development of UNESCO's new International Basic Sciences Programme, which seeks to build national capacities in basic research through collaborative projects.

In 2006, there will be a call for nominations for the Trieste Science Prize in the twin categories of mathematics and medical sciences.

For details: www.unesco.org/venice; Nomination forms available from: www.twas.org; or info@twas.org

A second UNESCO–Cousteau Chair for the USA

A UNESCO–Cousteau Ecotechnie Chair in Coastal Resources was launched on 1 December at Rutgers, the State University of New Jersey, in the USA.

'This is the second UNESCO–Cousteau Chair since the return of the USA to UNESCO a year ago,' UNESCO's Director-General said at the signing. 'The help of Francine Cousteau has been essential in establishing these Chairs in the important area of coastal management'. The first Chair in the USA was set up on 30 September at the University of Rhode Island in the field of Global Coastal Assessment.

The UNESCO–Cousteau Ecotechnie Chair at Rutgers will develop programmes, workshops and information services to improve management of fisheries and other economic activitites. It will also organize interdisciplinary courses, seminars and field experience for students on related issues. Fred Grassle, Director of the Institute of Marine and Coastal Sciences at Rutgers, said, 'We look forward to strengthening co-operation with UNESCO to enhance our international activities'.

The UNESCO–Cousteau Ecotechnie Programme was established in 1994 by the late Jacques-Yves Cousteau (see also p. 17) and UNESCO's MAB Programme. The Ecotechnie Chairs break down barriers to change by providing future decision- and policy-makers with integrated, multidisciplinary education, training and research in the field of environment and development. This approach gives future decision-makers the broad, long-term perspective they need to tackle the complexity of development problems, including a familiarity with not only local but also regional and international issues. The network now numbers 12 participating Ecotechnie Chairs in Argentina, Bahrain, Belgium, Egypt, India, Lebanon, Moldova, Romania, Sweden, Vietnam and the USA. A thirteenth Chair is due to be launched in Sudan on 16 December.

For details: www.unesco.org/mab/capacity/ucep/ucepmab.htm

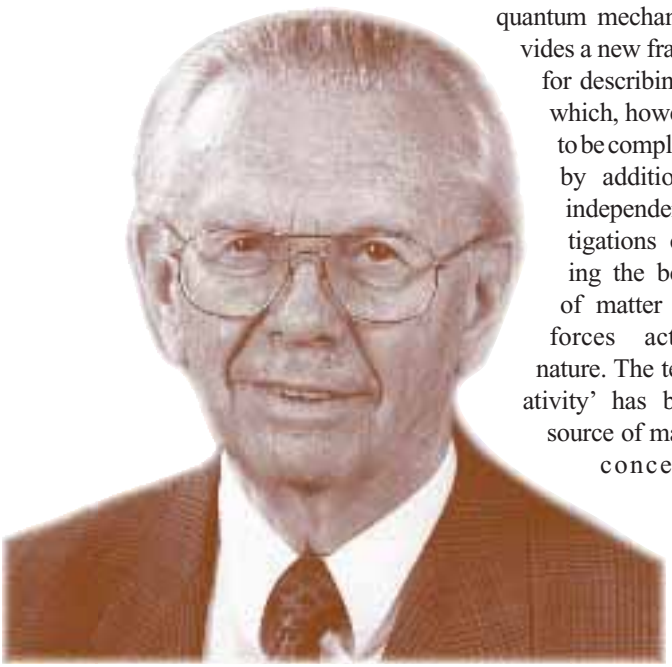
HERWIG SCHOPPER

Einstein's Legacy

Last June, the United Nations declared 2005 the International Year of Physics and invited UNESCO to take the lead in celebrating the hundredth anniversary of Albert Einstein's legendary articles on relativity, quantum theory and Brownian motion.

Herwig Schopper is former Director-General of the European Organization for Nuclear Research (CERN, 1981–1988) and a recipient of UNESCO's Gold Albert Einstein Medal, in 2004, for services rendered to physics and international co-operation. He is also current President of the Council governing the new SESAME research centre for the Middle East, founded under the auspices of UNESCO. Here, he describes how Einstein's theory revolutionized ideas on fundamental questions and how this breakthrough has itself revolutionized society as we know it. As he explains, the adventure is far from over.

Einstein formulated two theories of relativity: the first of these, the **special** theory, extends Newtonian mechanics to situations that come close to reaching the highest possible speed, the speed of light. This theory has some consequences which appear completely contradictory to common sense. They have, however, been confirmed by innumerable experiments. For example, experiments have proven that clocks tick differently in systems moving relative to each other or that the mass of a body depends on its velocity. Another consequence is the possible transmutation of energy into matter and vice versa. This recognition originating from pure basic research was to become the basis for the peaceful and military application of nuclear physics for energy production. Special relativity like quantum mechanics provides a new framework for describing nature which, however, has to be complemented by additional and independent investigations concerning the behaviour of matter and the forces acting in nature. The term 'relativity' has been the source of many misconceptions.



The special theory does not throw scientific results into doubt; on the contrary, it is based on 'invariants' which do not depend on the position of the observer.

The **general** theory of relativity tries to explain the gravitational force in terms of the structure of space-time. The effect of relativity on daily life is negligible; however, relativity does have to be taken into account for the global positioning system of navigation – another example of how certain effects of basic research can offer the unanticipated bonus of becoming important for applications.

This view is completely unfounded for a number of reasons. Apart from the use of nuclear power, nuclear physics has found many other applications. Diagnostics in modern medicine is unthinkable without the exploitation of nuclear effects. The most important application is probably imaging with nuclear magnetic resonance, which is at the origin of scanners used in medicine. Ironically, the term 'nuclear' has been suppressed to avoid scaring patients, an indication of a public attitude towards nuclear issues that is somewhat biased and irrational!

X-rays have become an indispensable tool in medicine since their discovery by German physicist Wilhelm Roentgen in 1895. They are now used particularly in tomography, a method of producing cross-sectional images of the body. Particle accelerators, such as betatrons and linear accelerators, are

used in almost every hospital to treat cancer with X-rays and synchrotron radiation sources are becoming a precious tool for many other applications in research and industry. Radioactive isotopes are widely used for therapeutic purposes in medicine but also for material testing. The PET diagnostic annihilates matter with antimatter to obtain information on the metabolism inside the brain. Protons and other heavy particles are explored as a tool to treat particular forms of cancer like brain cancer. These are only a few examples of how humankind benefits from applications of nuclear physics.

Unfortunately, the public associates nuclear physics with the atomic bomb to a large extent. The latter has become discredited owing to the fact that the physical processes for making an atomic bomb and producing energy for peaceful purposes are very similar; both entail converting mass into energy according to the famous Einstein formula: $E = mc^2$, or, put into words, energy is equal to mass times the square of the speed of light.

Of course, nuclear power, like any other source of energy, involves risks which have to be taken into consideration. Future developments like the use of fusion rather than of fission will reduce the risks. The difference between the two is that nuclear fusion joins two light elements, forming a more massive element, whereas nuclear fission splits a massive element into fragments. Both release energy in the process but, in fission, the fragments are very radioactive with long lifetimes, whereas, in fusion, the 'ashes' are not radioactive.

It seems unlikely that we will be able to avoid the environmental problem of excess CO_2 without recourse to nuclear power. Of course, alternative energy sources should be developed and exploited as much as possible but it will be impossible to satisfy the justified energy demands of the Third World without taking advantage of all energy sources, including nuclear power. Indeed, countries like China are considering that nuclear power is necessary for their economy.

UNESCO could make an essential contribution by helping to give the discussions on energy production a rational and pragmatic basis.

For many centuries, a high standard of living was reserved for the nobility, an extremely small, privileged layer of human society. This situation began to change drastically around the mid-nineteenth century when modern technologies like steam engines, railways and electricity evolved, progress which we are still building on today. Only with modern technologies has it been possible to increase production to the point where the majority of the population benefits from it[5], albeit in industrialized countries for the most part. Without this technical revolution, open or hidden slavery could not have been abolished, no new social idea could have solved the problem of providing sufficient food, shelter and time for cultural activities. Indeed, even democracy could not have been developed under conditions that forced people to spend practically all their time struggling for survival.

The technological applications which have completely changed our daily lives were all based on the results of basic research but, in many cases, these results were considered completely useless at the time. It was only much later that their relevance for certain applications was discovered. A famous example is that of Michael Faraday[6], who worked on various phenomena to do with electricity. When a representative of the Treasury complained that this kind of research held little promise of benefiting society, Faraday retorted that he might not be able to tell the future but was nevertheless sure the Treasury would one day levy high taxes on his research. And he was right! His work became the basis for modern electrical applications. As for the personal computer, who could imagine it would have such a deep influence on our daily lives? Who would have dreamed that the Web invented at CERN in 1990 for the needs of particle physics, that most abstract of sciences, would revolutionize communication?

Of course, the high standard of living in industrialized countries is not without its negative side-effects, in particular the endangering of the environment. Such problems will only be mastered by more advanced technologies. The main challenge will be to introduce these modern technologies into developing countries, in order to limit environmental damage there too. If this can be achieved, we shall see another golden age – one that is not limited to a few privileged nations – appear on the horizon.

Physics research is progressing on various fronts. In basic research, particle physics and nuclear physics are penetrating deeper into the microcosm to solve the riddles of the building blocks of matter and the forces which act between them. Do we know all forces in nature? The strong and weak nuclear forces were discovered only in the last century. The unification of the magnetic and electric forces has led to the modern electrical industry, to radio, telephone, television and computers. The study of atoms[7], molecules, condensed matter and research in optics have revealed new phenomena, such as high-temperature superconductors or the so-called Bose-Einstein condensate phenomena lasting less than a billionth of a second; it has also forged a deeper understanding of quantum mechanics. As in the past, new knowledge will result in unexpected applications.

In addition, basic research is now aiming directly at applications, as the boundary between basic and applied research becomes more blurred. Nanotechnology, which deals with objects far smaller than a human hair, has components belonging to both basic and applied research.

Perhaps the most important service basic research has provided to society in the past 200 years is a completely new picture of nature, the cosmos and the position of humankind in all of this, a cultural benefit which is equally valuable as the material progress. If thunder is no longer considered an angry expression of the gods, if superstition has been abolished, if we agree that the Earth is not the centre of the cosmos and that the kind of matter we are made of is not the most prevailing in the Universe (as shown recently), it is thanks to modern science. This has great implications for the self-comprehension of humankind.

I have been asked this question several times by politicians. Developing countries are facing urgent issues, such as the provision of food and water, infrastructure-building and education reform. Huge sums provided by governmental development programmes or humanitarian bodies are being spent on remedying these short-term deficiencies. Despite this, the gap between industrialized and developing countries is in danger of widening in many instances.

In order to catch up, developing countries will have to find a short-cut in the transition from a mainly agricultural or trading society to an industrialized economy. This process took today's industrialized nations about 150 years. To close the gap, developing countries will need to devote a few percent of their available funds to promoting science, research and higher education. Without some investment in such long-term issues, developing countries will come up against other problems, such as unemployment, as they industrialize. In industrialized countries, employment in agriculture has fallen from 60–70% of the adult population 150 years ago to a meagre few percent today. Third World countries will have to establish some industrial activities based on new technologies. That this can be achieved over a relatively short span of time has been demonstrated by the likes of the Republic of Korea and Taiwan (China), among others.

In many respects, technologies are based on science and particularly on physics. Physics also provides the fundamentals for other sciences, such as chemistry and biology. The key to many problems, be they environmental issues, energy-saving and production, or better diagnostics in medicine, to mention but a few, will require intensified physics research. Indeed, interdisciplinary co-operation between physics and other fields not only holds great promise but will become essential in the coming decades.

Predictions are always difficult, especially when they concern the future! Who could have predicted 30 years ago the advent of personal computers, of communication technologies, of quantum leaps in health care or the new possibilities for human recreation and entertainment, such as satellite television, compact disks, mobile phones or the current volume of air traffic. Science and research hold new surprises for us but the big question will be whether the moral and ethical attitude of people progresses at the same pace as the technology. The responsibility for whether we use future progress for the benefit or detriment of humankind will lie with politicians. The greatest challenge of all will be to ensure that the less fortunate also reap the rewards of an industrially developed world.

Interview by Susan Schneegans

Today, we can explore the ocean depths with remote-controlled vehicles but, at the time of the Conshelf II project, the diving saucer was the only way humans could observe the ocean floor and study the creatures lurking in its dark corners

The **silent world** revisited

Fifty years ago, Captain Jacques-Yves Cousteau set out on his first expedition to the Red Sea. A decade later, he would build the world's first village under the sea at Sha'ab Rumi. The object of the exercise was to learn more about the sea, obviously, but Cousteau also wanted to gain a better understanding of how human beings react to a prolonged stay under water. That experiment paved the way for the conquest of the continental shelf. With support from UNESCO, Francine Cousteau, the late Captain's widow, decided to celebrate the expedition's 40th anniversary by returning to four countries bordering the Red Sea to see how things had changed. The expedition set sail in November 2003. Towards the end of the three-month voyage, two crew members give a vibrant account of what they have seen.

A month in an underwater village

On 14 July 1963 at Sha'ab Rumi, situated some 45 km north of Port Sudan, seven divers surfaced under the watchful eye of Captain Cousteau and his long-time friend, Captain Alinat, after surviving successfully underwater for a month. The seven men had just set a world record. Never before had divers stayed underwater for so long.

With this experiment, Cousteau had set out to demonstrate that human beings could live and work underwater for a prolonged period, withstanding physical pressures that were much greater than on land. The idea was to measure how individuals would react physiologically to an underwater stay of unprecedented duration and at depths never before achieved. Cousteau also wanted to see how individuals behave in a compressed-air medium composed of a different mixture of gases.

Professor Raymond Vaissière, head of the marine biology unit of the Oceanographic Museum in Monaco, had come along to study marine life. He ended up being the first scientist to live underwater and observe the marine environment *in situ*.

The Conshelf II village is assembled on the surface before being submerged. The oceanauts' star-shaped house is in the water, ready to be sunk to a depth of 10 m. On the quay, the bathyscaphe hangar has just been completed

Diving deeper than humans had ever gone before

The first step in this project, revolutionary for the time, was to construct an underwater village. The main structure was the star-shaped 'big house' anchored 10 m below the surface, a temporary home to Claude Wesly, the head diver, Professor Raymond Vaissière, Pierre Guilbert, the cook, and André Folco, Raymond Kientzy, Pierre Vanoni and André Portelatine, the divers. The second building was a hangar for storing the diving saucer, a small bathyscaphe used to make scientific observations at a depth of over 300 m. The third building was a small garage to house the sea scooters. Last but not least was the 'small house', anchored at 25 m below

Forty years separate these two photos! The diver on the top spent one month under the sea as part of the Conshelf II experiment in 1963, the diver at the bottom several hours in 2003, in a tribute to his colleague and to commemorate the historic event

The dissolution of gas in liquids makes it essential for divers to wear watches to calculate their diving time to the second. They use watches to determine where to stop and for how long on their way back to the surface to rid themselves of excess nitrogen and thereby avoid the bends or another decompression incident

As canaries are more sensitive than human beings to toxic levels of gas, miners used to take canaries with them into the mines. Forty years ago, Claude Wesly brought along a parrot to alert the oceanauts to dangerous levels of gas in their sea home

the sea, in which two of the seven *oceanauts* would spend a week at a time, diving to depths of 110 m, deeper than humans had ever gone before. Completing the scene were shark cages in which divers could take refuge if they felt threatened.

The scientific findings from Conshelf II

Forty years on, the Cousteau team went back to Sha'ab Rumi, where the diving saucer hangar remains intact, with the support of UNESCO and the International Watch Company (IWC). Claude Wesly, the head diver, was there to share his memories and emotions with Captain Cousteau's children, Diane and Pierre-Yves.

Jacques-Yves Cousteau aboard the Calypso

Claude Wesly tells his story. 'This experiment was a first step towards conquering the undersea world. Our team demonstrated that humans could work under a degree of pressure ten times greater than that of the atmosphere. We also tested new gaseous mixtures to replace oxygen and nitrogen, which become toxic at high-pressure levels. The physiologist Jacques Chouteau and the physician Jacques Bourde monitored our physical condition through a series of daily clinical tests. There were also the unexpected findings, such as what I would call the dawning of 'oxygen inhalation therapy'. We noticed that, whereas any injuries to our team members on the surface took a long time to heal, our cuts and scratches healed like a charm, owing to higher partial oxygen pressure.

We were also there to observe the psychological effects of living in a confined space under hyperbaric conditions or, in other words, under increased atmospheric pressure. Here, too, we made some highly important observations, some of which still hold true for space flights today. For example, a team living in isolation inevitably becomes more and more self-absorbed. We found that, as the days went by, we became less and less keen about receiving visitors or any contact with 'earthlings'.

Professor Vaissière used to go diving every day to observe the Red Sea's prolific marine life. He also inventoried the coral and studied plankton in a tiny laboratory installed in the big house.'

Discovering a Red Sea at risk

In the three months we have been back here, we have seen just how much 40 years of exploitation of its resources has changed the Red Sea. The coastline and different marine environments are threatened by tourism, growing maritime traffic, urban and industrial development, the transportation and production of hydrocarbons, and over-fishing. The consequences of this onslaught are only too well known: the destruction of coastal and marine habitats, greater marine and freshwater pollution, and the extinction of species meaning declining biodiversity.

Those are the facts. Still, all those we met who have a say are aware of the situation and, more importantly, seem keen to find solutions and take measures to conserve the environment in the Red Sea.

This is what we observed in all four countries we visited. North of the Gulf of Aqaba, Jordan and Israel have only 26 km and 7 km of coastline respectively. Urban and industrial development may be in full swing along the coast but both countries have set aside space for reef conservation and have established marine stations for training scientists and monitoring the marine environment.

Using artificial reefs to protect coral

In Jordan, the installation of artificial reefs has mitigated the impact of tourism on the natural environment and, in Israel, two recreational centres – one providing a safe natural habitat for dolphins – have been opened. Israel's two

In the Gulf of Aqaba, there are nearly 200 reef-building corals like this Porites. Surrounding a fire coral, it is identifiable by its clay-like ochre colour and the white tip of its branches. Every year, tens of thousands of divers explore the underwater splendours of the Red Sea. Many of the Gulf of Aqaba's coral reefs are still in a satisfactory condition, partly because the Gulf is less vulnerable to the climatic conditions that bleach coral elsewhere and partly thanks to the measures taken to protect them, including protected marine zones, artificial reefs and law enforcement. A transboundary biosphere reserve in the Gulf would be an effective way of boosting regional co-operation for the preservation of coral reefs

fish farms have limited their expansion to minimize any environmental impact.

The picture is of course far more complex in Egypt, with its 1941 km of coastline which were practically untouched only a score of years ago. In the past 20 years, Sharm el Sheikh and Hurgada have become unrecognisable; hotel complexes have sprung up like mushrooms, platforms have been anchored offshore, cities have been built and hundreds of diving boats ferry hordes of divers out to discover the marvels of the Red Sea. At Sharm el Sheikh alone, divers take the plunge 8000 times a day in the high season! To prevent this boom from destroying the Red Sea, Egypt has passed a swath of laws to regulate human activities, limit the number of boats and create protected marine sites.

Sudan has not yet been hit by the economic boom. There is, for example, a single urban centre along its 650 km coastline, Port Sudan. Only 5000 divers visit Sudan's shores each year. But this new *Eldorado* is starting to attract attention and the recent construction of the Port Sudan oil terminal is just the beginning. The officials Francine Cousteau met say they are aware of the risks of uncontrolled coastal development but hopeful of keeping Sudan's economic development within bounds. Will they succeed?

©UNESCO

The Hilton Hotel at Port Sudan on the Red Sea

©The Cousteau Society

Shipwrecked vessels provide an ideal base for the first link in the food chain and an adequate solution for the proliferation of flora and fauna. They are also an excellent way of diverting divers away from natural coral reefs and towards a man-made habitat that offers great scope for diving enthusiasts

All countries would like to adopt an integrated coastal zone management policy but the lure of quick profits to be gained from exploiting resources to the limit tends to thwart any real move towards sustainable development.

A regional approach to the Red Sea

One way of coping with the many environmental threats to the region which pay no heed to borders has been to set up the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). The PERSGA Strategic Action Programme offers a regional framework for protecting the environment and developing coastal and marine resources in a sustainable manner. Moreover, a transboundary biosphere reserve may one day be established in the Gulf of Aqaba within UNESCO's Man and the Biosphere programme. The idea was mooted at UNESCO's General Conference a few years ago as an effective way of boosting regional co-operation to protect coastal and marine resources.

Fifty years after Captain Cousteau's first expedition, there is definitely a heightened awareness of environmental issues, an 'awakening' that can arguably be traced back to the 1992 Earth Summit in Rio. Be that as it may, there is no denying that things *are* being done to preserve the environment of the Red Sea. But we have our work cut out for us if we are to persuade people they should weave environmental concerns systematically into every human activity. That the careful use of natural resources is the best guarantee of a sustained income over the long term still seems to be an alien notion to many.

Grégoire Koulbanis[8] (with Claude Wesly)

For details: www.cousteau.org; redaction@cousteau.org

Our closest relatives on the brink of extinction

This infant chimpanzee on sale in the bushmeat market in Libreville (Gabon) is doomed to end up as a pet

Time is running out for the world's remaining gorillas, chimpanzees, bonobos and orangutans, say UNESCO and the United Nations Environment Programme (UNEP), co-ordinators of the Great Apes Survival Project (GRASP). 'If we lose any Great Ape species', UNEP Executive Director Klaus Toepfer warns, 'we shall be destroying a bridge to our own origins and with it part of our own humanity'. The Great Apes share more than 96% of their DNA with humans. To lift the threat of imminent extinction, UNESCO and UNEP are rallying a wide range of partners, including NGOs and private interests, to channel human and financial resources into establishing areas where ape populations can stabilise and increase. The challenge will be to conserve both the Great Ape populations and their habitat.

UNESCO and UNEP fear that, if urgent action is not taken, the next wave of country-level extinction could take place in Senegal, where a mere 200–400 wild chimpanzees remain. Other countries where the fate of the western chimpanzee hangs in the balance include Ghana, which has just 300–500 individuals left, and Guinea Bissau where the population is down to less than 200 individuals.

However, all the Great Apes – the chimpanzee, gorilla, orangutan and bonobo – are under serious threat, the victims of habitat destruction (through logging, deforestation and mining), the illegal trade in live specimens and bushmeat hunting – Great Apes are shot or fall victim to snares placed in the forest to capture bushmeat. Injuries from snares resulting in limb-paralyses and even death from infection have been observed in many chimpanzee communities, such as that of the Sonso in the Budongo Forest in Uganda.

'Saving the Great Apes and the ecosystems they inhabit is not just a conservation issue but also a key action in the fight against poverty', UNESCO Director-General Koïchiro Matsuura recalls. 'The forests they inhabit are a vital resource for humans everywhere and for local people in particular a key source of food, water, medicine as well as a place of spiritual, cultural and economic value'.

Tala Tala logging camp in northern Congo Brazzaville

Great Ape habitat shrinking fast

According to a recent UNEP report, *The Great Apes – the road ahead*, less than 10% of the remaining forest habitat of the Great Apes of Africa will be left relatively undisturbed by 2030 if road building, construction of mining camps and other infrastructure developments continue at current levels. The report looks in detail at each of the four Great Ape species to assess the current, remaining habitat deemed relatively undisturbed and thus able to support viable populations of apes. The experts have then mapped the likely impact and area of healthy habitat left in 2030 at current levels of infrastructure growth.

The study estimates that around 28% of remaining gorilla habitat can be classed as relatively undisturbed. If infrastructure growth continues at current levels, the area left by 2030 will have shrunk to just 10% in low-impacted gorilla habitat in countries which include Nigeria, Gabon, Rwanda and Uganda.

Around 26% of remaining chimpanzee habitat can be classed as relatively undisturbed. If infrastructure growth continues at current levels, the area left by 2030 will be just 8% in low-impacted chimpanzee habitat countries, including Guinea, Côte D'Ivoire and Gabon.

The study estimates that about 23% of remaining bonobo habitat can be classed as relatively undisturbed but this could drop to just 4% by 2030 if infrastructure continues to spread at the current pace in the Democratic Republic of Congo (DRC), the only country in which they are found.

The outlook for the orangutan is bleakest of all. Its 36% of remaining habitat could shrink to less than 1% by 2030. This amounts to a 5% annual loss of low-impacted orangutan habitat from the islands of Sumatara (Indonesia) and Borneo (Kalimantan in the Indonesian part and Sarawak and Sabah in the Malaysian part).

Still a long way to go

A meeting organized by UNEP and UNESCO in November 2003 came up with a blueprint for conserving Great Ape populations. This strategy will be submitted to governments for adoption at an intergovernmental meeting on Great Apes and GRASP to be hosted by the DRC from 5 to 9 September 2005.

The meeting in 2003 drew representatives from the 21 Great Ape home 'range states' in Africa[9] and the two 'range states' in Southeast Asia (Indonesia and Malaysia), as well as donor governments, UN agencies and NGOs like the International Conservation Union (IUCN) and Conservation International.

Funding levels remain too low to remove the immediate threat to the Great Apes. Things are looking up, at least, for the Great Apes in the DRC. A Donor Conference held at UNESCO last September has raised more than US$50 million to protect and preserve the extremely rich Congolese biodiversity.

Although the scope of the Donor Conference was limited to one country and did not target Great Apes specifically, the chimpanzees, gorillas and bonobos in the DRC's National Parks will obviously all benefit from the heightened protection this funding will bring, along with all the other threatened species (see *Preserving Congolese Heritage*).

The DRC has more kinds of Great Ape than any other nation on Earth, two of which – the eastern lowland gorilla and the bonobo – are found nowhere else. Others include the eastern chimpanzee, the mountain gorilla, probably the central chimpanzee and possibly the western lowland gorilla. The uncertainty lies in the fact that war has prevented surveys in these areas in recent years.

A race against time

Within the 'Built environment for gorillas' (BeGO) project launched in April 2003, UNESCO is working with the European Space Agency to use satellites or remote sensing to better monitor the rate of habitat destruction. The project has begun by mapping in 2003 the habitats of the remaining 704

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*The bonobo (*Pan paniscus*) is found only in the Democratic Republic of Congo. It was identified as a separate species from the common chimpanzee (*Pan troglodytes*) only in the late 1920s. The identification was made from observations of a chimpanzee skull at the Royal Museum for Central Africa in Belgium. The bonobo is the closest living relative to Man*

Great Apes in the Democratic Republic of Congo

or so mountain gorillas[10] in Uganda, Rwanda and the DRC, which live in inaccessible mountain areas at an altitude of up to 5000 m.

©UNESCO/WHC

Young chimpanzees rescued from the pet trade are housed in sanctuaries, like the Lwiro Sanctuary, left, which re-socialize them and prepare them for possible re-introduction into the wild. The Pan-Africa Sanctuary Alliance[11] co-ordinates the liaison among the many sanctuaries present in Africa, such as Ngamba Island in Uganda, Kitwe Point in Tanzania and Pandrillus in Nigeria

At the same time, UNESCO is working with local rangers to help improve law enforcement and monitoring in all five of the DRC's World Heritage Sites: the National Parks of Virunga, of Garamba, Kahuzi-Biega and Salonga, and the Okapi Wildlife Reserve.

'Law enforcement is an essential but single element in any conservation effort. We cannot just put up fences to try and separate the apes from people,' says Samy Mankoto of UNESCO. 'Great Apes play a key role in maintaining the health and diversity of tropical forests, which people depend upon. They disperse seeds throughout the forests, for example, and create light gaps in the forest canopy which allow seedlings to grow and replenish the ecosystem.'

To better understand Great Apes, studies are underway in several UNESCO biosphere reserves that are home to the chimpanzee, gorilla and orangutan. One of the most important populations of wild chimpanzees lives in the Taï

Preserving Congolese Heritage

Over the past decade, the Democratic Republic of Congo (DRC) has lived through one of the darkest periods in its history. Rwandans fleeing the genocide perpetrated in their country in 1994 took refuge in the eastern reaches of the DRC, home to four of the country's five natural sites inscribed on the World Heritage List. In 1996, the Great Lakes Conflict spread to the DRC, where war broke out involving half a dozen African countries.

The five DRC sites inscribed on the World Heritage List are home to exceptional biodiversity, including rare animal species, many of which are endemic, such as the bonobo, the chimpanzee, the white rhino in the north, mountain gorillas and okapis. The increase in poaching – which saw numbers of white rhinoceroses fall dramatically before stabilizing at 30 – and other serious infringements on the integrity of the five sites, like land squatting, led to their inscription on the list of World Heritage in Danger.


©Carlos SCHULER

A guard from the Institut Congolais pour la Conservation de la Nature holds a chimpanzee

Garamba Park is the last refuge in the world of the northern white rhinoceros. The Park is vulnerable to incursions by the Sudanese People's Liberation Army, which crosses the border to engage in large-scale commercial poaching. Thanks to the strengthening of guard controls, there was a substantial drop in poaching between 2000 and 2003. Unfortunately, there has been an upsurge since June 2003, with large-scale poaching operations targeting specifically elephants and rhinoceroses. In September 2004, the European Commission donated US$150,000 in emergency aid to save the Park's last remaining white rhinoceroses


©Kes & Fraser Hillman-Smith

In 2000, UNESCO launched a joint programme with the United Nations Foundation, the Government of the DRC and several conservation bodies, for Biodiversity Conservation in Regions of Armed Conflict: Conserving World Heritage Sites in the DRC. Within this project, field staff from the *Institut Congolais pour la Conservation de la Nature* (ICCN) received direct support in their desperate battle to conserve the sites; a second prong of the project employed 'conservation diplomacy' to heighten awareness among the belligerents of the importance of preserving the World Heritage sites.

In September 2002, as peace 'broke out' in the DRC, nearly 200 representatives from regions deeply divided by civil war joined international conservationists and government ministers in Kinshasa to prepare the country's first national plan for Great Ape survival. The first nation to successfully develop gorilla tourism back in the 1970s, the DRC was eager to welcome ape enthusiasts once again as soon as their security could be assured. The experts present included government officials, members of parliament, the police and the army – the DRC Army has an environmental cell –, academics, lawyers, community and environmental NGOs, UNEP, UNESCO and UNDP.


©Gilman International Conservation

The Okapi Wildlife Reserve occupies one-fifth of the Ituri forest. It harbours about 5000 of the estimated 30 000 okapi surviving in the wild, as well as the largest forest elephant population of the DRC

The meeting recommended urgent surveying of little-known areas to establish which Great Apes were surviving where, in particular in the Mayumbe Forest in the Bas-Fleuve, contiguous with forests in Angola's Cabinda Enclave. The neglected Maiko National Park, home to sizeable populations of eastern lowland gorillas and chimpanzees, was also in need of urgent rehabilitation. In rebel hands at the time, 90% of the Kahuzi-Biega National Park needed reclaiming and surveying without delay to establish whether any large mammals had survived the onslaught of bushmeat hunters feeding the coltan miners. The meeting also recommended creating jobs in poor rural areas, such as around the village of Lomako in bonobo habitat, to gain community support for the conservation of Great Apes. Participants called for tougher laws to protect Great Apes and launched a campaign to build awareness among law enforcement agencies. They also appealed for urgent resources for sanctuaries caring for infant apes.

In September 2004, the UNESCO World Heritage Centre and UNESCO scientists from the Man and the Biosphere Programme organized the First International Donor Conference and Technical Workshop on Promoting and Preserving Congolese Heritage. The conference developed an Emergency Action Plan and launched a global partnership to support the sustainable development of Congolese heritage in the DRC, including in World Heritage sites.

Of the US$50 million raised at the conference, $12 million was provided by the European Union for immediate use, $5 million of which has been earmarked for the Virunga and Salonga National Parks. The UNDP put another US$6 million on the table for immediate project implementation. Other donors pledged generous support, including USAID/CARPE ($15 million), the World Bank ($10 million) and Belgium ($1.2 million).

The conference was planned to coincide with an exhibition for the general public at UNESCO Headquarters from 10 to 24 September. Designed by the Royal Museum for Central Africa in Tervuren (Belgium), the exhibition highlighted the links between human populations and nature through ethnographic objects, videos, maps, panels and stuffed animals.

Military and other armed groups have settled in the Virunga National Park. Very often unpaid but better equipped than the guards, they have engaged in poaching large mammals, elephants and hippopotamuses in particular, and have taken possession of several houses of ICCN guards. It is urgent to remove the armed groups from the site, cancel fraudulent property titles and win over the local communities. More heartening is the fact that the gorilla population has increased from 324 individuals in 1989 to 384 in 2003 in the Virunga Massif, thanks to the restoration of guard patrols and a programme which has reclaimed, with community participation, some 220 km² of encroached areas within the park


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Biosphere Reserve in Côte d'Ivoire, where a team of zoologists has been studying their behaviour since 1979. Much of what we know today about orangutan toolmaking comes from studies in the Tanjung Puting Biosphere Reserve in Indonesia. These studies are combined with a variety of projects to reconcile conservation with the needs of local communities. To stimulate scientific research, GRASP is currently developing a small grant scheme, in collaboration with Conservation International.

Since GRASP's inception in May 2001, 16 of the 23 Great Ape range states have applied new conservation measures specifically designed for these species. Policy-making workshops have been held in six of these countries, bringing together stakeholders from government, academia and private industry, as well as NGOs and the United Nations.

It is anything but fortuitous if some of the countries chosen to host these workshops are politically unstable or emerging from conflict, as in the case of Rwanda and the DRC. On the contrary, the national plans are considered an important tool for rebuilding war-torn countries. As the Head of the GRASP Technical Support Team, Ian Redmond, put it, there is 'evidence that a common concern for conservation in general and apes in particular can bring people together despite war and political differences'.

These workshops have led to the drafting of national plans that show exactly how the necessary funds can be applied to make a real difference to ape numbers on the ground.

Samy Mankoto, Lucilla Spini and Amy Otchet

For details: www.unesco.org/mab/grasp.htm and www.unep.org/grasp; s.mankoto@unesco.org

Download The Great Apes – the road ahead*: www.globio.info*

©Ian Redmond

*Adult and baby orangutan (*Pongo pygmaeus)

How well do you know your apes from your monkeys?

The tail is the tell-tale sign. No apes have tails, whereas almost all monkeys do. Monkeys also tend to have a smaller body. Another, more subtle difference, is that apes are generally more intelligent than monkeys. Apes are capable of language and culture, can use tools and solve problems. *(Source: www.conservation.org)*

The World Heritage Convention to the rescue of the Great Apes

©Guenay Ulutuncok/laif/GTZ

Fruitful negotiations were conducted with the armed factions involved in the conflict to preserve the gorilla families in the high altitude sector of Kahuzi-Biega National Park

Adopted by UNESCO's General Conference in 1972, the World Heritage Convention encompasses 178 State Parties. The World Heritage List comprises a number of natural sites that are crucial for the conservation of Great Apes. Approximately 90% of the range of the mountain gorilla, through the work of Diane Fossey, is included in the World Heritage sites of Virunga National Park in the DRC and Bwindi Impenetrable National Park in Uganda. Efforts are currently underway to turn the Virunga National Park into a transboundary World Heritage area to include the Volcanoes National Park in Rwanda and Mgahinga National Park in Uganda. This would place the entire range of the Mountain Gorilla under the protection of the World Heritage Convention.

The other Great Ape species also benefit from the Convention: the Kahuzi-Biega National Park (DRC) covers approximately 70% of the remaining population of the Grauer's Gorilla, whereas the Salonga National Park (DRC) is the only protected area in the world to harbour the bonobo, the closest living relative to man. Chimpanzees are also well represented in a number of World Heritage sites. So far, lowland gorillas are only covered by one World Heritage site, the Dja National Park in Cameroon, but the World Heritage Centre is currently working with Cameroon, Gabon, Central African Republic, Congo and a number of other partners to establish new transborder sites in their range in the Congo Basin.

With the recent addition of the Tropical Rainforest Heritage of Sumatra, which comprises three National Parks, some of the habitat of the orangutan is now finally also represented on the List. Another transborder nomination to protect key parts of the Borneo rainforest is being developed between Indonesia and Malaysia.

Inscribing Great Ape habitats on the World Heritage List is only the first step towards improving their conservation. Programmes are also underway in the Congo Basin and in Sumatra to improve the management of the inscribed sites. In spite of the extremely difficult working conditions, tangible progress has been achieved over the past four years. A recent survey shows that the population of the mountain gorilla in the Virunga national Park, for example, has remained at its pre-war numbers, in spite of the fact that the Park is situated in the heart of the war zone.

10–14 January
Small islands, big stakes
10-year review of UN Barbados Plan of Action. UNESCO: panel on Culture and Sustainable Island Development', special event on Youth Visioning for Island Living, two side events: Small Islands Voice (CSI) and Ocean Issues (IOC). Mauritius: *www.un.org/smallislands2005/*

13–15 January
Physics for tomorrow
Conf. launching Intl Year of Physics. Co–sponsors: UNESCO, European Commission, IUPAP, European Physical Society, ICTP, CERN, CEA, etc (see p.1). UNESCO HQ: *m.alarcon@unesco.org*; *www.wyp2005.org; www.unesco.org/science/bes*

18–20 January
Education for a sustainable future
Regional forum for govts, educators, NGOs etc. Organized by Centre for Environment Education (India) with Govt of India, UNESCO, UNEP. On role of education and communication in any successful strategy for a sustainable future. Ahmedabad (India): *www.ceeindia.org/esf*

18–22 January
Disaster reduction
UN World Conf. UNESCO organizing three sessions: education for sustainable development: towards effective disaster reduction and enhancing human security; cultural heritage risk management; and capacity-building through Intl Programme on Landslides and Intl Flood Initiative. Kobe (Japan): *www.unisdr.org/wcdr; b.rouhban@unesco.org*

24–28 January
Biodiversity: science and governance
Conf. on curbing biodiversity loss by 2010; UNESCO and French Ministry for Research co-sponsors: *www.recherche.gouv.fr/biodir2005paris; biodiv2005paris@recherche.gouv.fr*

22–25 February
S&T governance for parliamentarians
1st ECOWAS/UNESCO sub-regional workhop to develop framework for West African states. Directorate of Technical Cooperation in Africa implementing agency. (DTCA): Dr Bassi: *dtcadg@dtca-ng.org*; Dr Ogun: *drdaogun@dtca-ng.org*; UNESCO Abuja: *a.maduekwe@unesco.org*; UNESCO HQ: *f.osotimehin@unesco.org*

2–5 March
Harnessing science for society: further partnerships – World Conf. on Science follow-up intl symposium organized by UNESCO/ ICSU/TWAS. UNESCO Venice: *roste@unesco.org; www.unesco.org/science/bes*

3 March
For women in science
Award ceremony for five L'Oréal-UNESCO Prizes and 15 fellowships: *r.clair@unesco.org*

7–10 March
S&T policy: future challenges in the context of globalization
NISTADS-CRRID Intl Conf. UNESCO and Dept of S&T (India) co-sponsors. Parliamentarians, research scholars, industrialists, academicians from South Asia to share knowledge and research. Chandigarh (India): *mohsinuk@yahoo.com*

22 March
World Water Day
On theme of UN Decade "Water for Life" (2005–2014) *www.unesco.org/water*

New

Mediterranean Basin Water Atlas
By Jean Margat, UNESCO Publishing/Commission for the Geological Map of the World (Paris) /Blue Plan, Exists in English and French, €15.00, 46 p., ISBN: 92-3-103963-6
In maps and figures, shows the extreme diversity of water resources, the specific needs of Mediterranean countries and the impact of water usage on the environment.

Status of the Coral Reefs of the World
Ed. Clive Wilkinson. Prepared by 240 experts from 98 countries. 4th edition. In English with summary in French. ISSN: 1447-6185. Sponsors: IUCN, UNESCO-IOC, Govts of France and Australia, UNEP, TOTAL Foundation, etc.
Some 20% of the world's reefs have been destroyed and show no sign of recovery; half the 16% of reefs damaged by bleaching 1998 have totally recovered or nearly so; 24% of all coral reefs are in danger of destruction from human activities and another 26% are at risk of future damage. Download: www.aims.gov.au

Arthropods of Economic Importance
Agromyzidae of the World (CD-ROM containing drawings, photos, maps, Version 1.0, Format: Mac – PC) — By M. Dempewolf, UNESCO Publishing /Expert Center for Taxonomic Identification (ETI). Exists in English only, €129.95, ISBN: 92-3-103974-1
Should enable entomologists working in agriculture, horticulture and plant quarantine inspection to identify the most important species, including mining flies; provides access to taxonomic and biological data, reviews literature and presents numerous new digital images.

…. for

Education Kit on Combating Desertification
UNESCO/UNCCD. Now on sale. UNESCO Publishing. Contains teacher's guide, photos, maps, comic book and poster. Second edition. Exists in English, French, Spanish, Arabic and Russian. Chinese version available soon. €30.00, ISBN :2003, 92-3-103892-3. (see p.9 for details)

Explaining Biosphere Reserves
By Christine Sourd, translated from French by Barbara Thompson, €4.60, ISBN: 92-3-103844-3, exists in English, French and Spanish, 40 p.
For young readers aged 10 and over, their parents and teachers. UNESCO's Biosphere Reserves belong to a World Network of sites where conserving biological diversity is emphasized for the benefit of local communities. Explains how these protected areas can slow down or halt bio-diversity loss.

UNESCO Space Calendar 2005
UNESCO/Norwegian Space Centre/EURISY. Portrays the 29 winning entries in the Living with Space drawing/painting contest for 6-10 year-olds which attracted over 1500 entries. Has been distributed to institutions. Some 100 copies are available upon request on a first-come, first-served basis. Schoolchildren and their teachers will be given priority. Request a calendar from *y.berenguer@unesco.org* or via the Editor.

bodies

UNESCO's programme and budget for 2006–2007 dominated discussions at the Executive Board's October session.

The Board recommended that the principal priorities for the next biennium be: (a) basic education for all, with special emphasis on literacy, HIV/AIDS preventive education and teacher training in Sub-Saharan Africa; (b) water and associated ecosystems; (c) promoting cultural diversity, with special emphasis on the tangible and intangible cultural heritage; (d) the ethics of science and technology with emphasis on bioethics; and (e) empowering people through access to information and knowledge, with special emphasis on freedom of expression.

Secondary priorities of relevance to science are: science and technology education at the secondary level; higher education; oceans; capacity-building in the basic and engineering sciences, the formulation of science policies and the promotion of a culture of maintenance; the application of science, engineering and appropriate technologies to sustainable development, natural resource use and management, disaster preparedness and alleviation, and renewable sources of energy; and , lastly, advancing the use of ICTs for education, science and culture.

The Board requested the Director-General to present a single budget proposal for its consideration at the next session of the Board, which begins on 18 April (170 EX/Decisions).


UNESCO Space Calendar 2005

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