United Nations Educational,
Scientific and Cultural Organization

What future for open science? *p. 2*

A World of SCIENCE

Natural Sciences
Quarterly Newsletter

Vol. 1, No. 4

July–September 2003

IN THIS ISSUE

EDITORIAL

Thank you, Mr Berners-Lee

The Severe Acute Respiratory Syndrome (SARS) had barely become public knowledge this year before scientists the world over were scrambling to identify the new ill. And it was thanks largely to the information and data exchanged via Internet that they were able to isolate the agent causing SARS in record time. The SARS outbreak has highlighted the key role Internet can play in a global health emergency. But 'virtual' scientific collaboration is nothing new. Ever since the World Wide Web was invented ten years ago, international scientific collaboration has grown tremendously.

In a shrinking world where air travel and the Web have made real and virtual nomads of us, major environmental and health problems have also become globe-trotters. Ensuring affordable high-speed Internet connections and equally affordable access to electronic scientific information and data for all the world's universities and research institutions has become indispensable for informed decision-making and knowledge production. The information society is here; what we need now are knowledge societies.

This will take political will, of course. The digital divide is alive and well. If Internet users are expected to double to close to 1 billion by 2005, according to the UNDP *Human Development Report 2002*, it is hard to see how the imbalance in favour of developed countries is going to be redressed in the foreseeable future without strong political motivation. Some 72% of Internet users still live in the high-income OECD countries which make up only 14% of the world's population.

The World Summit on the Information Society being organized by ITU in co-operation with UNESCO and other UN agencies in December this year, with a second round in 2005, will need to tackle head-on the problem of inequitable access to telecommunications and the handicap this poses for global development.

The Intergovernmental Drafting Group is meeting at UNESCO Headquarters on 15–18 July to refine the working documents for the *Draft Declaration of Principles* and *Draft Action Plan* before the final preparatory meeting for the Summit in September. At this late stage, the documents are almost totally bereft of any reference to science, despite the fact that science is a prolific producer and user of information and knowledge.

A symposium organized by UNESCO and several science partners in March this year expressed concern at the growing restrictions in the digital environment on open access to publicly funded research. These concerns are discussed in the current issue.

Now, as we prepare for the World Summit on the Information Society, we might spare a thought for Tim Berners-Lee, the scientist who gave us the World Wide Web.

W. Erdelen
Assistant Director-General for Natural Sciences

What future for **open science**?

On 30 April 1993, the European Organization for Nuclear Research (CERN) announced it was placing a little-known piece of software called the World Wide Web in the public domain. This gesture opened the floodgates to Web development around the world. Ten years on, the Web is one of the most spectacular examples of publicly funded science in the public domain today. Yet it might never have happened. A growing temptation to privatize or commercialize government-funded, public-interest science is imposing restrictions of all kinds on open science. Why is this happening and what are the consequences for science? And how do we preserve and promote access to open (i.e. public) science without unduly restricting commercial opportunities and the moral rights of authors?

The Web has become an indispensable feature of the modern communications landscape – but it might have been a very different story. Web inventor Tim Berners-Lee explains. 'CERN's decision to make the Web foundations and protocols available on a royalty-free basis, without additional impediments, was crucial to the Web's existence. Without this commitment, the enormous individual and corporate investment in Web technology simply would never have happened and we wouldn't have the Web today'.

The economic spin-offs have been giddying. The Web has generated billions of dollars in e-commerce earnings over the past decade, mostly in the North. It has even spawned a new stock exchange, the Nasdaq. Many of the economic spin-offs are the last link in a chain beginning with scientific information and data, and ending in innovative products and services.

E-networking the world's universities and research institutes

In addition to being a formidable communication tool, the Internet is an extremely rich vehicle of information and data for education, research and, ultimately, innovation with its economic returns.

The isolation of scientific communities in the Third World can, in part, be broken through unbridled access to scientific information and data, and through international collaboration. North–South and South–South networking is a powerful tool for capacity-building and development. Many such examples already exist. Following the devastation caused by Hurricane Mitch in Honduras and Nicaragua and the earthquake in El Salvador, for example, the three countries have set up Disaster Information Centres[1]. UNESCO's environmental programmes in the hydrological, oceanographic, ecological and geological sciences rely heavily on both types of networking[2]. One example is the UNESCO Network for Application of Remote Sensing for Sustainable Development in Africa, made up of regional African bodies like the West Africa Regional Centre for Training in Aerospace Surveys, in Nigeria. The network counts European bodies, the Brazilian Space Agency and Indian Space Research Organization among its partners[3].

Virtual research laboratories, libraries and university campuses are spreading. UNESCO examples are the Avicenna Virtual Campus involving 15 countries of the Mediterranean basin[4] and the Virtual University of Science and Technology launched with ASEAN[5], which is currently expanding into virtual research and development with engineering institutes and private companies in the region. UNESCO is also promoting open access to data and information through projects like SANGIS and ODINAFRICA (see pp. 4 and 5). In parallel, UNESCO affirms the necessity of rigorous conformity with international conventions on intellectual property[6].

In the USA, the prestigious Massachusetts Institute of Technology[7] announced last year that it would be posting 2000 courses and related contents on the Internet free of charge for all the world's higher education institutions and students. MIT is willing to provide information on how to adapt these courses, in response to concerns from people like Abdulaye Diakité of Guinea's Conakry University that 'some laboratory experiments done at MIT won't be possible in universities in developing countries'.

Good news indeed – but universities and research institutes in the South will only be able to take full advantage of these various programmes if they are equipped with affordable and reliable high-speed Internet connections.

Growing pressures on open science

Digital information and data in the 'public domain' may be accessed freely without infringing any legal rights. An international symposium on open access and the public domain in digital data and information[8] for science has noted that, insidiously, restrictions are eating away at open science. Data and information produced by government-funded, public-interest research are increasingly being privatized or commercialized. And the growing difficulty for authors to protect their work from uncontrolled access is leading to calls for tighter intellectual property protection of information on the Internet.

What would the consequences have been for global health research if the human genome project had been commercialized? Initiated by the US government in the late 1980s, the project was threatened by a corporate rival in 1998. At that point, the Wellcome Trust[9], a UK charity, teamed up with the US government, increasing massively its investment in the project so that its own Sanger Institute could decode one-third

of the three billion letters that make up 'the code of life'. Today, the sequences – completed in April 2003 – are freely available to the world's scientific community.

So where do you draw the line? Robin Cowan of the University of Maastricht in the Netherlands notes that, 'there is a tension and all of the economic literature on intellectual property rights is about resolving that tension or finding the optimal balance … so that people can use the knowledge and [not] the expression of it'.

This tension is illustrated by a current Chinese dilemma. In May, the e-journal SciDev.Net[10] reported the Chinese State Intellectual Property Office as having advised researchers to patent their SARS-related research following media reports that some Canadian, US and Hong Kong research institutes were preparing to apply for local and international patents on research that included sequencing of the SARS genome and a diagnostic test for SARS. China has ploughed millions of US dollars into SARS-related projects. Although many Chinese researchers are refusing to apply for patents, citing concerns that it might impede co-operation, Lin Jianning, director of the state-owned China Southern Pharmaceutical Institute, warns that, 'without sufficient patent protection, the Chinese successes could become sources of profit for international pharmaceutical firms'. Sri Lankan-born virologist Malik Peiris and his team at the University of Hong Kong were the first to isolate the agent causing SARS, in mid-March.

Cowan points to the paradox by which easy access to knowledge fosters innovation through providing data and information for research, even as intellectual property rights limit the spread of this new knowledge until it falls into the public domain at the expiration of the patent.

The breaking of a taboo

Funding for open science has been shrinking in the North for the past twenty years. 'The Bayh–Dole Act in the USA, which took effect in 1981, broke a taboo', Cowan recalls. 'It was one of the first government measures to begin eroding open science'. It was intended to facilitate technology transfer from the academic to business worlds by enabling federal-funded universities to license their new inventions to businesses which then manufactured the end-products. 'In the USA', he notes, 'this has led to an explosion in the number of university patents'. Universities in Europe, Canada, India and elsewhere have sought to emulate the Bayh–Dole approach by commercializing public research results in the university sector.

Treating public research as a commodity can have perverse effects. Peter Weiss of the US National Weather Service comments that, when one government research institute has to pay a sister institute to recover scientific information or data using the same taxpayer funding, it makes for 'false economics'.

Preferential pricing for paying publications

All information production and dissemination has a cost. But for poorer countries, this cost is frequently prohibitively

Internet users per 100 population in 2001

In countries of 30 million or more inhabitants

Republic of Korea	52.11
USA	50.15
Canada	46.66
Japan	38.42
Germany	37.36
United Kingdom	32.96
Italy	26.89
France	26.38
Spain	18.27
Argentina	10.08
Poland	9.84
South Africa	6.49
Turkey	6.04
Thailand	5.77
Brazil	4.66
Mexico	3.62
Russian Federation	2.93
Colombia	2.70
China*	2.57
Philippines	2.56
Indonesia	1.91
Kenya	1.60
Iran	1.56
Morocco	1.37
Vietnam	1.24
Ukraine	1.19
Egypt	0.93
India	0.68
Algeria	0.65
Pakistan	0.34
United Republic of Tanzania	0.30
Sudan	0.18
Bangladesh	0.14
Nigeria	0.10
Ethiopia	0.04
Democratic Republic of Congo	0.01
Myanmar	0.01

*Hong Kong = 38.68

Source: http://unstats.un.org/unsd/mi/mi_goals.asp (this indicator falls under Goal 8 of the Millennium Development Goals)

---

1. With FundaCRID (an NGO), PAHO and US National Library of Medicine
2. IHP, IOC, MAB, IGCP: www.unesco.org/science
3. j.ahanhanzo@unesco.org
4. http://avicenna.unesco.org
5. In Jakarta: s.hill@unesco.org
6. www.unesco.org/culture/copyrightbulletin
7. http://ocw.mit.edu
8. Co-organized in March 2003 by UNESCO, ICSU, ICSU's Committee on Data for Science and Technology (CODATA), US National Academy of Sciences and International Council for Scientific and Technical Information
9. www.wellcome.ac.uk/
10. www.scidev.net

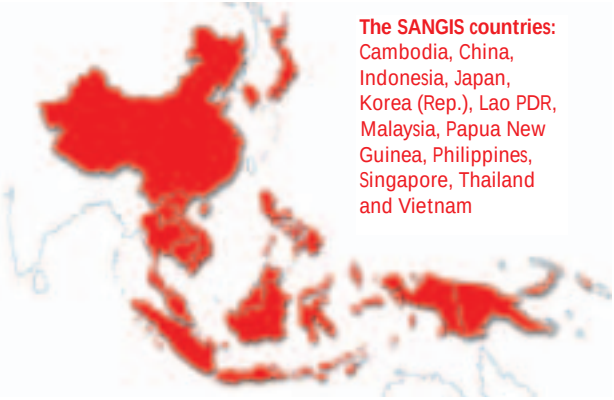
Simplifying geological information exchange

The Southeast Asian Network for a Geological Information System (SANGIS) is a UNESCO project involving national geological surveys and governments. Through the Internet, the regional network simplifies the exchange of data both within and beyond Southeast Asia. The aim is to make data easily available and accessible to all participating geological surveys and to decision-makers for more effective socio-economic and environmental planning.

The participating countries are grouped into the Co-ordinating Committee for Geoscience Programmes in East and Southeast Asia, based in Bangkok (Thailand). The International Centre for Training and Exchanges in geoscience (CIFEG, *Centre international pour la formation et les échanges en Géosciences*) is UNESCO's partner in developing the architecture of the system and in organizing training courses in data handling and other topics. Within the framework of SANGIS, CIFEG is partly funded by the French Ministry of Foreign Affairs.

Two years down the road, many countries of the region have already stored the geological referenced information in both their national inventories and in the regional network. Some have adopted SANGIS as a standard, converting their previous archives into the new inventories (as in the case of Malaysia), or creating a country network between different departments and scientific academies (as in the case of China). China has also translated the thesaurus containing 6,000 geological terms, which will allow the Chinese data to be shared with the rest of the Southeast Asian countries and the international scientific communities.

SANGIS database:
www.cifeg.org/sangis/sangisbase.htm



The SANGIS countries: Cambodia, China, Indonesia, Japan, Korea (Rep.), Lao PDR, Malaysia, Papua New Guinea, Philippines, Singapore, Thailand and Vietnam

expensive if borne by the user. The question is, how do you tailor the cost to the user to make sure information remains affordable? Preferential pricing is one solution. Many commercial publishers are interested in providing their works electronically under preferential conditions for science and education, particularly to users in developing countries, provided their copyright is strictly respected.

Like private publishers, professional societies are searching for an optimum balance between open access and financial viability. Some professional societies and other groups have embraced the open access model, although the majority still tend towards a more protective approach.

Numerous international programmes are now showing that affordable access to commercial publications in developing countries is possible. One example is the Programme for the Enhancement of Research Information[11] of the International Network for the Availability of Scientific Publications, created by UNESCO and ICSU in 1991, which offers the full-text of more than 8,000 journals on-line. Another is WHO's Health InterNetwork Access to Research Initiative[12], which provides over 2,000 high-quality medical journals free of charge (or nearly so) to users in developing countries. There is also the Electronic-journals Delivery Service[13] provided by the Abdus Salam International Centre for Theoretical Physics. Many publishers make their publications available at no cost to developing countries, such as the *British Medical Journal*.

UNESCO is looking carefully at ways of promoting this type of initiative, for example through frameworks of voluntary permission by which publishers and other rights-holders could assign specific rights to users in developing countries, either definitively or on a limited time basis.

Borders in cyberspace

Researchers from the South regularly run into what Weiss calls 'borders in cyberspace' when trying to access information and data in the North. The prices charged by some governments are far beyond the means of poor countries and the data often come with onerous restrictions on use. This naturally deals a blow to public-interest research that may have the potential to generate knowledge of national, regional or even global importance, such as in the field of meteorology.

Weiss notes that US government agencies are not only forbidden to charge more than cost to disseminate scientific information but are even urged to take advantage of private, academic and other channels to do so. The reason for this, Weiss insists, is 'based on a hard-headed economic understanding that government information is a valuable national resource, just like gas, coal or water, and an input to the economic process. The economic benefits to society are maximized when government information is available in a timely and equitable manner to all. For this reason, he foretells, 'the USA does not have a sui generis database protection regime, nor is it likely to have any such regime in the near future'.

As much as 90% of research is conducted in the developed countries where the private sector finances up to two-thirds.

A step closer to owning facts

The European Union has had a database protection regime since March 1996. 'The implications of the European Directive on the Legal Protection of Databases from a science

and technology perspective', notes CODATA[14], 'are that it creates an unprecedented, absolute exclusive property right for the contents of databases that contradicts the underlying premise of classical intellectual property law which says no-one should own factual data as such; it conveys an exclusive property right to the content of all databases even if these do not qualify for copyright protection. This right lasts for an initial period of 15 years and can be extended indefinitely whenever updates or substantial investments are added'.

According to CODATA, 'even though the European Directive permits fair use of data for research and education as an exception, the exception is narrowly drawn and not all Member States have enacted a fair-use provision into their domestic law'.

One aspect stressed by Thomas Dreier from the University of Karlsruhe in Germany is that 'whereas, within copyright law, patent applications from researchers in France, Germany or Italy are subjected to the same conditions by the European Patent Office, the European Directive has been interpreted by national laws in different ways. The Directive has thus not done away with national discrepancies. This', he notes, 'is leading to court battles'.

In 2002, the European Commission initiated a review of the Directive, to which ICSU and CODATA responded. The report was submitted to the European Commission in 2003. The next step will be for any recommendations for modification to be submitted to the European Parliament.

'Original database' is not an easy term to define. Alan Story of the University of Kent Law School in the UK cites the example of his own country where the definition of an 'original database' is so broad that even street directories and television schedules are being protected, despite their being simple compilations!

Intellectual property not working for South

The development of special limitations, restrictions, negotiated agreements and cost-recovery policies is making it more difficult for some scientists to gain access to data and information than others. Most threatened by this trend of course are the scientific communities in developing countries and countries in transition.

As Clemente Forero-Pineda of the Universities of Andes and Rosario in Colombia points out, 'While the 1994 Trade-related aspects of Intellectual Property (TRIPS) agreement protects original databases, the protection of non-original databases is granted in the European Union, some northern European countries and Mexico. The main concern is that even information in the public domain could be simply reorganized and included in proprietary databases… Preliminary analyses for Latin American countries show that most non-original databases are produced elsewhere'. He

11. www.inasp.info/peri/resources.html
12. www.healthinternetwork.org
13. www.ejds.org/
14. www.codata.org

Sharing Africa's Ocean Data

The oceanographic institutions of 20 countries in Africa are networking to develop their capacity to manage and disseminate oceanographic data and information required by decision-makers and the private sector to manage and use sustainably coastal and marine resources.

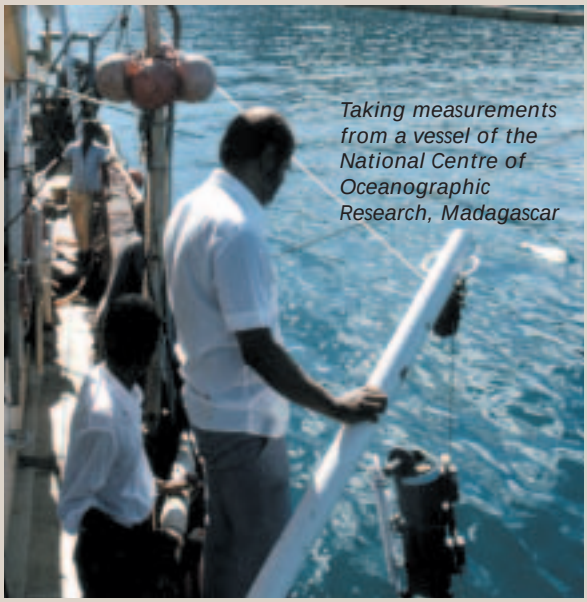
The Ocean Data and Information Network for Africa (ODINAFRICA) is being supported by the Government of Flanders (Belgium) and the IOC's International Oceanographic Data and Information Exchange programme (IODE). The project assists the participating countries to establish and operate National Oceanographic Data Centres and develop a wide range of data and information products that cover both the individual countries and Africa as a whole. All data and information are made available freely and openly, in full accordance with the IODE Data Policy. In addition, all ODINAFRICA partners have full access to data hosted by other data centres of the global IODE family.

The twenty members of ODINAFRICA are: Benin, Cameroon, Comoros, Côte D'Ivoire, Gabon, Ghana, Guinea, Kenya, Madagascar, Mauritania, Mauritius, Morocco, Mozambique, Nigeria, Senegal, Seychelles, South Africa, United Republic of Tanzania, Togo and Tunisia.

The ODINAFRICA website is co-ordinated by the Kenya Marine and Fisheries Research Institute in Mombasa but maintained jointly by all partners. The project publishes a Newsletter, *WINDOW*, available free of charge to those without Internet access.

In the 40 years since IODE was launched by UNESCO's IOC, Member States have established over 60 oceanographic data centres in as many countries. The network has been able to collect, control the quality of, and archive, millions of ocean observations which it makes available to Member States. The worldwide service-oriented network works through designated national agencies and both world and national oceanographic data centres.

For further information, go to: www.odinafrica.net or www.iode.org



Taking measurements from a vessel of the National Centre of Oceanographic Research, Madagascar

©UNESCO/D. Roger

Data-handling principles for IGOS Theme Teams

In 2000, the Integrated Global Observing Strategy (IGOS) partners adopted a set of principles for data and information systems and services. These principles apply to all IGOS activities, including those of the 'Theme Teams', as they are known: the Ocean Theme Team, Geohazards Theme Team, Global Carbon Theme Team, Atmospheric Chemistry Theme Team and Global Water Cycle Theme Team. A Sub-theme Team on Coral Reefs is currently being put together as the first component of an ultimate Coastal Theme.

The 14 IGOS partners are free to complement or interpret the principles as they see fit within the contours of their own individual data policies, which are sometimes legally binding. The 11 principles apply to both short-term and long-term observation.

The first principle underlines the need for a 'continuing commitment ...by participating national governments and international bodies to data management systems and services to ensure the establishment, maintenance, validation, description, accessibility, reliability and distribution of high-quality data'. These bodies include the Committee on Earth Observation Satellites[16], WMO and the Global Climate Observing System and World Climate Research Programme, UNESCO and the Global Ocean Observing System hosted by the IOC, FAO and the Global Terrestrial Observing System, UNEP, the International Council for Science (ICSU) and the International Geosphere–Biosphere Programme. UNESCO and NOAA are currently co-chairing IGOS.

Another principle states that the 'full and open sharing and exchange of data and products for all users in a timely fashion is a fundamental objective'. The Partners also consider that 'metadata should be assembled and maintained so that they are easily and fully accessible to users.' These metadata include information on calibration, long-term quality assessments and guidance for locating and obtaining the data records.

For the full list of principles, go to: **www.igospartners.org**

goes on to say that, 'Were this trend towards stronger legal protection of databases to prosper, … the role of researchers from developing countries in global science would diminish in relative terms as a consequence of the narrower availability of scientific information'. WIPO's Standing Committee on Copyright and Related Rights is currently discussing the establishment of international protection for non-original databases.

Under TRIPS, computer software is protected as a literary work as defined by the main international instrument in the field of copyright, the Berne Convention for the Protection of Literary and Artistic Works. Both agreements presume a proprietary model of software.

Many aid agencies and governments in the North pride themselves on helping developing countries gain wider access to data and information. In that case, notes Story, they 'should

© UNESCO/P. Lissac

A young woman in Penang, Malaysia

cease privileging intellectual property protected proprietary software in their computer aid programmes to poor countries'. Story cites the Co-ordinator of the Leland initiative run under the USAID programme, which ships PCs equipped with Microsoft products to poorer countries, as saying that 'on balance, we are for the cheapest and most affordable approach which would be open source.' According to Story, countries in the South are rapidly expanding use of free and open source software because they cannot afford proprietary systems (see *UNESCO encourages free software*).

Countries wishing to become members of the World Trade Organization must also become signatories to TRIPS which, in turn, requires that they must abide by all of the key provisions of the Berne Convention. All three are 'minimum rights' agreements, 'which means that all signatory countries must provide protection up to a certain minimum level' (50 years from the death of the database author in the case of TRIPS).

'This means', explains Story, 'that a country of the South could not decide that, because of its strong economic reliance on agriculture and the damage caused to its agricultural sector by insects and other pests, copyright protection on insect-related databases and encryption of such databases would be forbidden, even if the aim of such a ban were to promote scientific research. Nor is there any public health exemption that would allow access to data on HIV/AIDS for researchers for example. Although database legislation states that the protection 'does not extend to the data itself', the encryption of databases can prevent any access whatsoever to the data and hence operates to prevent lawful uses of that data, such as "fair dealing" or library/archive exemptions'.

Latin America and the Caribbean accounted for an estimated 0.2% of all existing databases in the world in 2001.

Alan Story

One aspect of the 1996 WIPO Copyright Treaty is the absence of a maximum term or duration of protection for copyrighted material, making it quite legal for countries to make the protection permanent.

Story ironises that overprotection of intellectual property rights is not considered as trade-distorting, despite the

evidence to the contrary. 'In the name of non-discrimination, countries of the South are assimilated to countries of the North, despite the fact that their needs and means are different'.

'The one shoe fits all law breeds inequality rather than the reverse', concludes Story. 'We need to challenge the presumptions of intellectual property because, overall, intellectual property does not work for the benefit of countries of the South in the current conjuncture'.

Biopiracy and the Net

The South is vulnerable both to knowledge monopolies and to excessive patenting. When indigenous groups place their traditional knowledge in the public domain, the question is whether they have the financial resources and legal know-how to counter the patenting of this knowledge or to profit from it. States like India are able to muster the means to question and overturn inappropriate patents. Indigenous groups are not.

The Turmeric case was a turning-point. It cost the Indian government US$10,000 in legal costs, notes a recent report[15], and 'was the first time that a patent based on the traditional knowledge of a developing country had been successfully challenged.' Turmeric *(Curcuma longa)* is a member of the ginger family. The Indian plant is used as a colouring, food flavouring and as a medicine.

Some 90% of the world's biological resources are found in the developing world.

In 1995, two Indian nationals at the University of Mississippi Medical Centre were granted a US patent on "use of turmeric in wound healing". The Indian Council of Scientific and Industrial Research (CSIR) argued that Turmeric had been used for thousands of years for healing wounds and rashes, and therefore its medicinal use was not novel. Fortunately, their claim could be supported by documentary evidence of traditional knowledge, including an ancient Sanskrit text and a paper published in 1953 in the Journal of the Indian Medical Association. The US Patent and Trademark Office upheld the CSIR objections and revoked the patent.

In 1999, following the Turmeric challenge, the Indian National Institute of Science Communication and the Department of Indian System of Medicine and Homoeopathy established a Traditional Knowledge Digital Library. 'By ensuring ease of retrieval of traditional knowledge-related information by patent examiners, the Library will hopefully prevent the granting of patents on the grounds that the subject matter is already in the public domain', notes the report.

A number of countries are in the process of developing national sui generis systems to protect traditional knowledge and the G15 Group of developing countries recently recommended the establishment of an international sui generis system. WIPO, the CBD, UNCTAD, WTO and other bodies are discussing the issue.

Susan Schneegans

For further information, go to: www.unesco.org/wsis

UNESCO encourages free software

How many people know that, less than 20 years ago, 'no one was allowed to share software freely with fellow computer users and nearly all users were blocked from changing software to fit their own needs', as Richard Stallman, Founder and President of the Free Software Foundation, puts it.

In 2001, UNESCO began lending its support to the Free Software and Open Source movements. In the software computer science field, these movements play a key role in extending and disseminating knowledge. The UNESCO Free Software Portal was published in November 2001. It gives access to local and remote documents which are reference works for these movements, as well as to websites hosting the most popular and useful open source/free software packages in UNESCO fields of competence.

The portal links up to software in astronomy, chemistry and biology, mapping tools and physics. Scientists will find there UNESCO's Virtual Laboratory Toolkit containing information and free software tools for creating a virtual laboratory. The Toolkit covers person–to–person and person–to–equipment communication to enable scientists to create or participate in a virtual laboratory.

There are also links to virtual libraries, such as the free African Digital Library for residents of Africa with its 8,000 full-text e-books[17]. UNESCO is also distributing through the portal and on CD-ROM an English–French–Spanish version of the open source Greenstone Digital Library software. Greenstone is produced by the New Zealand Digital Library Project at the University of Waikato and is being developed and distributed in co-operation with UNESCO and the NGO Human Info (Belgium).

UNESCO freeware[18] information processing tools are espousing the open source development model; these include WinIDAMS[19] for the validation, manipulation and statistical analysis of data and CDS/ISIS for the storage and retrieval of information.

So why is the 'open source' movement so important for knowledge-building? Historically, companies or developers of proprietary software have not made the source code (i.e. programme) available to users, but only the final executable module. With Free Open Source Software, each user can also access the source code and is granted autonomy rights which enable him or her to run, copy, distribute, study and change the software without having to ask permission from, or make fiscal payments to, any external group or person.

For further information, contact: **jc.dauphin@unesco.org**
or go to UNESCO Free Software portal:
www.unesco.org/webworld/portal_freesoft

15. Integrating IPRs and Development (2002)*: www.iprcommission.org/graphic/documents/final_report.htm*
16. UNESCO has been a member of CEOS since November 2002
17. www.africaeducation.org/adl/
18. Freeware is distributed for free but without the source code, whereas open source is not necessarily free but the source code is distributed with the executable module
19. www.unesco.org/idams

Abdul Waheed Khan
Towards knowledge societies

Abdul Waheed Khan explains how the concept of 'knowledge societies' differs from that of the 'information society' and why, in a world where 80% of people still lack access to basic telecommunications, knowledge societies are the key to a better tomorrow. Abdul Waheed Khan is UNESCO's Assistant Director-General for Communication and Information.

Can information and knowledge contribute to development?

We well know the central role that learning plays in sustainable development and its contribution in particular to poverty reduction and income generation, empowerment and consolidation of democracy, disease prevention and sustainable health and to the protection of the environment.

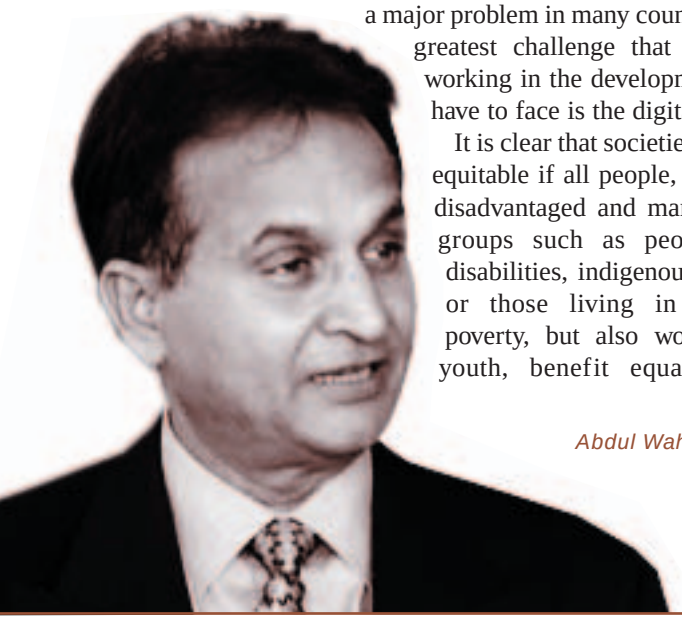
The access to information and the acquisition of knowledge and skills through education and learning have never been more central than they are today. For me, it is increasingly clear that our ability to cope with rapid changes will become the primary measure of success at both the micro and macro levels.

In this sense, information and knowledge are becoming central to development and to attaining the Millennium Development Goals. We indeed observe that the revolutions brought about by the new technologies, which are increasingly resulting from breakthroughs in the fundamental sciences, are a necessary – but insufficient – condition for the establishment of knowledge societies.

But are these tools really accessible to all?

We know that 80% of the world's population lacks access to basic telecommunications facilities, which are the key infrastructure of the information society and emerging knowledge societies, and that less than 10% has access to the Internet. Access to the information highways and to content, such as development data and information, is still a major problem in many countries. The greatest challenge that all those working in the development field have to face is the digital divide.

It is clear that societies are only equitable if all people, including disadvantaged and marginalized groups such as people with disabilities, indigenous peoples or those living in extreme poverty, but also women and youth, benefit equally from



Abdul Waheed Khan

ICTs[20]. They should be enabled to use ICTs for networking, information sharing, creating knowledge resources and developing skills that can help them to live and work in the new digital environment. In our daily work, we encourage and support the use of ICTs as a means of empowering local communities and helping them combat marginalization, poverty and exclusion, especially in the least developed countries, most of which are in Africa.

You are introducing here the term of 'knowledge societies'. How is this new concept different from that of the 'information society'?

Actually, the two concepts are complementary. Information society is the building block for knowledge societies. Whereas I see the concept of 'information society' as linked to the idea of 'technological innovation', the concept of 'knowledge societies' includes a dimension of social, cultural, economical, political and institutional transformation, and a more pluralistic and developmental perspective.

In my view, the concept of 'knowledge societies' is preferable to that of the 'information society' because it better captures the complexity and dynamism of the changes taking place. As I said before, the knowledge in question is important not only for economic growth but also for empowering and developing all sectors of society. Thus, the role of ICTs extends to human development more generally – and, therefore, to such matters as intellectual co-operation, lifelong learning and basic human values and rights.

What is the role of education in this process?

To my mind, education – both in traditional and in new settings – is the key to creating equitable knowledge societies. I would, however, like to identify two types of linkages between ICTs and education.

The first is the use of education and training, formal and informal, to create IT-literate societies. Enabling all citizens to use ICTs with confidence, in both their personal lives and working environments, is a declared policy in some countries.

The second type of linkage is the use of ICTs within education and training systems to achieve learning goals that do not necessarily have anything to do with ICTs

20. Information and communication technologies

themselves. After some years of mixed results from technology-driven strategies that focused on equipping educational systems with ICTs, we now need to exchange our experiences of education-driven approaches where the educational or training goal determines the use of ICTs rather than the other way around

I am certain that one conclusion of this exchange will be that age-old methods of educational delivery are unable to meet adequately the growing demand for learning. Initial signs of this incapacity have already led to several innovations: open learning, distance education, flexible learning, distributed learning and e-learning.

In many developing countries, open and distant learning is being mainstreamed as the political desire to increase the provision of learning develops and the economic need to cut the cost of education grows in tandem with participation levels. We are also observing mounting social pressure for democracy and the guarantee for equity and equality of opportunity. At the same time, there is a keenly felt need to improve the relevance and quality of the curricula and to move towards lifelong learning.

Therefore, education – and I am speaking here of both traditional and modern delivery methods – is the condition sine qua non of knowledge societies.

Are sciences of a similar crucial importance in this process?

Yes, absolutely. The impact of ICTs in the production, use and dissemination of scientific knowledge is immense. I see many opportunities for them to bridge the science gap, for example by improving networking among scientists locally and internationally, and by providing scientific information and knowledge to decision-makers for better governance.

It is also evident that ICTs are excellent tools for facilitating access by scientists in developing countries to scientific journals, libraries, databases and advanced scientific facilities. Another positive aspect is their potential to improve the collection and analysis of complex scientific data.

However, despite this potential, I am concerned by the danger of a widening scientific knowledge divide. This has immediate consequences for achieving sustainable development and the Millennium Development Goals to which science, technology and innovation can so greatly contribute. This is true not only for basic and applied research, but also for education, health, agriculture, technology, economic development and government. In order to achieve this, universities and research institutions worldwide need affordable networking infrastructure, information-processing equipment and training.

There is an essential role for science and scientists to play in building knowledge societies and we must facilitate equitable access to scientific knowledge.

Interview by
Axel Plathe *and* Jean-Gabriel Mastrangelo

Deal clinched for **UNESCO–IHE Institute** for Water Education

The IHE Institute in Delft is a world-class scientific institution in the water sciences which has for years excelled in its field and in providing training for scientists from developing countries in particular. On 18 March, it formally became the UNESCO–IHE Institute for Water Education.

The March ceremony marked the culmination of negotiations to clinch the hand-over and set in motion the new operational procedures. The agreements were signed by UNESCO's Director-General, Koïchiro Matsuura, representatives of the Netherlands Government, of the IHE Institute and of the Institute's administrative arm, the Foundation.

'This is the first time that the Organization has taken over an already existing and highly reputable institution within its policy of extending the impact of UNESCO's work through a network of institutes and centres to which the Organization associates its name', Koïchiro Matsuura said on the day. 'The coming into being of this new Institute during the International Year of Freshwater sends out a strong signal about the importance of water issues and UNESCO's determination, with the excellent and welcome support of the Netherlands and its scientific community, to assist all countries around the world in building up their own scientific capacity to address those issues'.

In 2000, during the 2nd World Water Forum in The Hague (Netherlands), UNESCO agreed to a proposal from the Netherlands to make the Delft Institute an integral part of UNESCO in a bid to further promote and internationalize the Institute's work, while simultaneously complementing UNESCO's own water sciences development programmes. At the time, the issue of water was steadily moving up the international agenda in the face of the very real prospect of a looming world water crisis. In 2002, the new institute's statutes were endorsed by UNESCO's Executive Board.

A meeting is to be held on 17–18 July at the UNESCO–IHE Institute on 'Challenges in Water Education: Towards the UN Decade of Education for Sustainable Development'. Eight months after a UN Resolution established UNESCO as the lead agency for preparation of the Decade (2005–2014), UNESCO is inviting partners to meet with representatives of the new institute to brainstorm over challenges facing tertiary-level water education. Discussion will cover issues brought to light by the 3rd World Water Forum in March of this year, the donor's perspective on capacity-building and sustainable development, and the ethical imperatives for knowledge-sharing. The new GOUTTE of Water (Global Observatory of Units for Teaching, Training and Ethics) project will be inaugurated on this occasion.

Amy Otchet[21]

For further information, contact: ihp@unesco.org
or go to: www.ihe.nl/vmp/contentsHomePage.html

21. UNESCO Bureau for Public Information

UNESCO creating facility to **mediate water disputes**

A new facility to help nations prevent and resolve freshwater disputes is to be created by UNESCO with the World Water Council, the Permanent Court of Arbitration and the Universities Partnership for Transboundary Waters. UNESCO's Director-General announced the Facility's creation on 21 March at the 3rd World Water Forum in Kyoto (Japan).

Based at UNESCO Headquarters, the new facility will 'react to crises, assist or intervene in crises – when requested by the parties – and anticipate and prevent water conflicts,' said Mr Matsuura. States, private parties and intergovernmental organizations will be able to turn to the facility to help resolve conflicts or problems over international water resources or local disputes with international ramifications – be it a dispute over a new dam project on a shared river or the pollution of an international aquifer.

Depending on the nature of the conflict and the requests made by the parties involved, the facility will provide a range of services from technical and legal advice to training in water negotiations, conciliation, fact-finding missions and the provision of 'good offices' or favourable conditions for high-level negotiations.

'UNESCO will provide the 'water community' with the necessary resources, the favourable environment, political backing, professional support and judiciary mechanisms to anticipate, prevent and resolve water conflicts,' said Mr Matsuura. UNESCO's International Hydrological Programme (IHP) will use its networks of experts around the world to help facilitate discussions and co-ordinate research between countries, while helping these governments to improve their institutional and technical capacities to manage water resources better.

The new facility is a joint initiative between UNESCO and the World Water Council, the foremost international think-tank on water policy. The Council will help to mobilize political backing for the facility while providing policy advice to the parties in dispute.

In addition, the Permanent Court of Arbitration, based in The Hague, will provide legal advice and a neutral forum for parties seeking conciliation, fact-finding missions over international water disputes and other forms of assistance, upon request.

'The facility opens up a new dimension in the efforts of the Permanent Court of Arbitration to peacefully resolve disputes pertaining to natural resources,' said Tjaco van den Hout, Secretary-General of the Permanent Court of Arbitration.

The Universities Partnership for Transboundary Waters, which involves ten universities on five continents, will help to develop educational tools and training programmes on water negotiation.

'We do not need any more declarations, what we need now is action,' said Mr Matsuura. About one-third of the world's 263 international river basins are shared by more than two countries and 19 basins involve five or more. A good part of Africa and the Middle East depend on water resources originating from other countries for more than half their own water, as does the southern tip of Latin America.

It is generally assumed that growing water demand will lead to rising conflicts or even wars over the resource. Yet, according to several studies published by UNESCO, scarcity need not mean catastrophe or conflict. The *World Water Development Report* published by UNESCO on behalf of 23 United Nations agencies within the World Water Assessment Programme highlights a study analysing every single water-related interaction between two countries or more over the past 50 years. The study was produced by Dr Aaron Wolf of Oregon State University and The Universities Partnership of Transboundary Waters. The study reveals that, of the 1,831 interactions, an overwhelming majority of 1,228 were co-operative. These involved the signing of about 200 water-sharing treaties or the construction of new dams. Of the 507 conflictive events, only 37 involved violence, 21 of them with military action.

Although water scarcity obviously increases tension among states, the real source of conflict or destabilization stems from the lack of treaties or institutional structures to manage shared resources jointly (see also the example of Afghanistan, p. 16). The study cites three warning signs for international river basins: the 'internationalization' of basins, or the creation of newly independent states (as was the case after the break-up of the Soviet Union); unilateral development projects, such as the

© UNESCO/R.Dominique

The Nile Falls in Ethiopia. The Nile basin countries are Rwanda, Burundi, Democratic Republic of Congo, United Republic of Tanzania, Kenya, Uganda, Ethiopia, Sudan and Egypt. By virtue of a 1959 treaty between Egypt and Sudan, nearly 90% of the river's annual flow is allocated to these two countries. Upstream nations are challenging Egyptian and Sudanese claims

© UNESCO/D. Riffet

A market in Kampong Chanang (Cambodia). The Mekong River Basin covers parts of China, Myanmar and Vietnam, nearly one-third of Thailand and most of Cambodia and Lao PDR. The Mekong River Basin is one of the most densely populated areas on Earth and one of the most productive. Only the Amazon River Basin has greater biodiversity. The Mekong River Commission estimates the basin's population will increase by 30–50% by 2025, accentuating pressure on natural resources (including iron ore, tin and natural gas) and demand for food, water and energy

construction of dams in basins lacking bilateral legal agreements and structures for negotiation; and lastly, general hostility over issues other than water.

According to these findings, the following basins have 'potential for dispute in the coming five to ten years': the Ganges–Brahmaputra, Han, Incomati, Kunene, Kura–Araks, Lake Chad, La Plata, Lempa, Limpopo, Mekong, Ob (Ertis), Okavango, Orange, Salween, Senegal, Tumen and Zambezi. A further four shared basins are in the midst of constructive negotiations: Aral, Jordan, Nile and Tigris–Euphrates.

Amy Otchet

For further information, contact: l.salame@unesco.org
or go to: www.unesco.org/water/wwap/pccp

UNESCO and WHO to join forces in **combating emerging diseases**

UNESCO and WHO are to strengthen collaboration in the field of emerging diseases. This is one recommendation of a meeting held on 17 and 18 May which has also called for greater collaboration between veterinary and human medicine, in view of the animal-to-human transmission of several important pathogenic factors such as the human-variant Creutzfeldt-Jakob Disease and SARS, which was identified only earlier this year.

The seminar on Basic Sciences and Emerging Pathogenic Factors was held at the Science Centre of the Polish Academy in Paris (France) and co-organized by UNESCO and the European Academy of Arts, Sciences and Humanities, with the participation of scientists from WHO, FAO and the International Office of Epizootics.

A roundtable led by Prof. Jeanne Bugère-Picoux, a French specialist in animal pathology, focused on what is commonly referred to as 'mad cow disease'. This is part of the larger family of transmissible spongiform encephalopathies (TSEs), or prion diseases. Researchers presented the latest findings on TSEs, which are a group of rare degenerative brain disorders characterized by microscopic holes that give the brain a 'spongy' appearance. 'Mad cow disease' crossed the species barrier to infect humans after animal remains were introduced into the cows' feed in the UK in the 1980s.

The group led by Dr Diego Buriot, Director of WHO's Lyon office in France, focused on emerging viral diseases like SARS and viral hemorrhagic fevers like Ebola. Viral fevers generally attack several organs while damaging the body's ability to regulate itself. The symptoms are often accompanied by bleeding. Many of these viruses cause severe, life-threatening diseases and most are zoonotic, which means that they 'jump' to humans from animal hosts, mainly rodents and insects like ticks and mosquitoes.

Emerging bacterial diseases were the focus of a second group led by Prof. Brugère-Picoux. Ticks are currently considered to be second only to mosquitoes as vectors of human infectious diseases in the world. In the USA, for example, more than 16,000 people contract Lyme disease each year after being bitten by infected deer ticks.

If vaccine development is a time-consuming and costly undertaking, the seminar considered that the development of new vaccines would prove to be a cost-effective way of preventing infectious diseases in the long term thanks to new advances in molecular biology. Since economic factors influence pharmaceutical companies in the North, new vaccines will only be developed if there is market for them in the developed world. This obviously poses a serious problem for poorer countries afflicted by 'orphan' diseases like Ebola or malaria which have no market value in the North. Currently, 80% of vaccines are produced by just four pharmaceutical companies.

In light of the importance of establishing and boosting local research and diagnostic capacities, the meeting identified UNESCO as an important player in promoting research into human and animal infections and the development of new therapeutic tools.

Are there more diseases today than a century ago? Possibly not. What is new is that environmental and climatic changes, coupled with overexploitation of natural resources, are augmenting human exposure to disease reservoirs and vectors in nature. Moreover, globalization has influenced the spread of infectious diseases throughout the world, as the spread of SARS has most recently demonstrated. It is thus vital to strengthen both the global surveillance system for infectious diseases and the open exchange of information concerning epidemics. UNESCO and WHO are keen to foster global networks in epidemiology and research into infectious diseases and emerging pathogenic factors.

UNESCO and WHO can play a role in educating and informing the public about infectious diseases and their means of propagation. There is also a need to address some cultural

practices which influence the spread of diseases in human and animal populations, such as traditional burial customs or practices for food and animal feed production.

Maciej Nalecz, Director of UNESCO's Division of Basic and Engineering Sciences, will be meeting Diego Buriot in July to discuss concrete measures for fresh collaboration.

For further information, contact: l.hoareau@unesco.org

Five outstanding women earn their just rewards

This year's L'ORÉAL–UNESCO Awards for Women in Science worth US$100,000 each have gone to five leading material scientists.

A further 15 women, all of them young life scientists, have received the annual UNESCO–L'ORÉAL fellowships worth $20,000 each. The fellowships encourage young women scientists to pursue their research projects in the laboratory of their choice.

The international jury of ten eminent scientists was presided over by Professor Pierre-Gilles de Gennes, Nobel Prize in Physics 1991.

Presented at UNESCO Headquarters on 27 February by the Chairman and Chief Executive Officer of L'ORÉAL, Lindsay Owen-Jones, and by UNESCO's Director-General, this year's awards recognized for the first time women from the five continents working in the material sciences.

Karimat El-Sayed (Egypt) is professor of solid state physics at Ain Shams University, Cairo. She has specialized in the detection of impurities in materials relevant to industrial metallurgy and semi-conducting materials.

Fang-Hua Li (China) is professor at the Institute of Physics of the Chinese Academy of Sciences in Beijing. She has specialized in electron microscopy. Her work has pushed back the limits of observation of crystalline structures through the elimination of interference.

Ayse Erzan (Turkey) is professor of physics at Istanbul Technical University. She has used the concepts of fractal geometry to study the collective phenomena of percolation, in which the interactions of simple constituents translate into behaviour on a large scale or over long periods.

Mariana Weissmann (Argentina) is a senior researcher at the Argentine National Research Council in Buenos Aires. She has helped to develop our understanding of quantum solids from a qualitative view to quantitative predictions. She has also been a pioneer in the use of computers to study the properties of solids.

Johanna M. H. Levelt Sengers (USA) is scientist emeritus at the National Institute of Standards and Technology in Gaithersburg in Maryland. She has contributed to a better definition of water and steam properties for scientific applications. Her work has aided industry in its search for cleaner and safer ways to dispose of hazardous and toxic waste.

The annual award ceremony is the highlight of an increasingly full programme of local initiatives being organized worldwide; these include activities in Austria, Belgium, China, Finland, Germany, Italy, Republic of Korea, Poland, Romania, Spain, Sweden, Thailand, Turkey and the UK.

Speaking at the ceremony, Koïchiro Matsuura told the laureates, 'you are the role models for today's young girls, opening a door to freedom and adventure that has been forbidden them for too long. Women must contribute to scientific research and mark it with their vision of the world and its development.'

Lindsay Owen-Jones added, 'The discoveries that you make push forward the boundaries of science. You are emblems who are a great source of hope; attracting new young women to your fields of research and inspiring a great calling that ensures the future of science.'

Present in 140 countries, L'ORÉAL is the world's number one cosmetics company. Some 55% of the 2,700 scientists responsible for the registration of patents are women, a percentage unmatched elsewhere in the industry.

This year's awards bring to 71 the number of women, from 45 countries, who have been honoured by the L'ORÉAL–UNESCO 'Women in Science' programme since its inception five years ago. L'ORÉAL increased the prize money from US$20,000 to US$100,000 in 2002.

Amy Otchet

For further information, contact: r.clair@unesco.org
or go to: www.forwomeninscience.com


Karimat EL-SAYED


Fang-Hua LI


Ayse ERZAN


Mariana WEISSMANN


Johanna LEVELT SENGERS

Bringing **a little sunshine** to people's lives

Thanks to solar electricity, isolated villages are not only improving their quality of life but also tuning in on the world.


© Ademe

This modest solar-home system provides one household with basic energy services in rural zones


© UNESCO

A solar street lamp enables this woman to continue selling her wares after dusk

Night travellers on the road to Ouallam, a town lying some 100 km north of Niamey, the capital of Niger, are always amazed to see lights shining in the middle of the bush – lights which seem to spring from nowhere, since there is not a power line in sight.

A mystery? Not for the technicians at the Niger Solar Energy Office or the Ministry of Mines who had the idea of electrifying a village of 2,500 inhabitants in the middle of nowhere, the famous 'Solar Village of Koné Beri'.

A villager describes how, when the engineers came, they positioned a lot of equipment around the village. 'Later, they showed us rectangular objects' (solar panels), he said, 'and explained that, if these bits of glass were laid side by side and brought into direct contact with the sun's rays, they would produce energy.

'"This same energy could", they said, "be stored in other devices for use at night". I couldn't believe it', he added, 'until I saw the village medical centre lit up and said to myself, the sun shines even at night!'

A new lease of life

Two years on, the people of Koné Beri swear almost exclusively by the sun god. For the villagers, human ingenuity has judiciously harnessed nature. In fact, there have been several revolutions in this peaceful little town in western Niger. First, the installation of a solar pump serving seven standpipes which now provide drinking water for people and animals; then the electrification and fitting out of the Koné Beri health centre with a refrigeration system to store not only food but also vaccines and other sensitive pharmaceutical products, as well as a solar deep-freeze and solar water-heater and cooker for sterilizing medical equipment.

Since the installation of solar electricity in Koné Beri, the village's economic, social and cultural outlook, not to mention its health, has improved. Jobs have been created and the villagers can gather round the television set to see what's going on in other parts of the country and around the world.

©Ademe

Collecting buckets of water from a solar-powered pumping station. This saves village women and girls from having to walk several kilometres each day to fetch water

A bargain at the price

In the Third World, solar energy offers the least expensive means of providing electricity for basic needs to rural areas. A recent study carried out in Morocco revealed that connecting a standard village of about 1,000 inhabitants to the electricity grid costs an average US$100,000, whereas US$30,000 is sufficient to provide lighting and audiovisual facilities with a solar installation.

This figure could be extrapolated to the two billion people living in rural or remote areas in developing countries. Instead of waiting several generations for a hypothetical connection to the national grid, they can satisfy their basic electricity needs, evaluated at 6 KW per village or equivalent to the average power consumed by one household in an industrialized country, by using renewable energies.

Even if the initial investment may be high, the running costs are remarkably low. To operate an average light bulb, the investment in solar cells, storage batteries, regulators, etc., requires an investment of about US$800. Once the system has been installed, one hour of lighting with the bulb costs about 2 US cents.

The direct costs of installing solar energy panels also need to be compared with the indirect costs of the nuisance created by conventional sources of energy.

Widespread use would bring down costs

Were the use of renewable energy sources to become widespread, the cost would fall through economies of scale and the advances made by the research programmes they would stimulate. Lower costs would make using renewable energies even more attractive to the South, especially in areas where it is already irreplaceable. For the 600 million rural families of the Third World, connection to the national grid would be prohibitively expensive even in the long term and not economically viable because consumption would be too low.

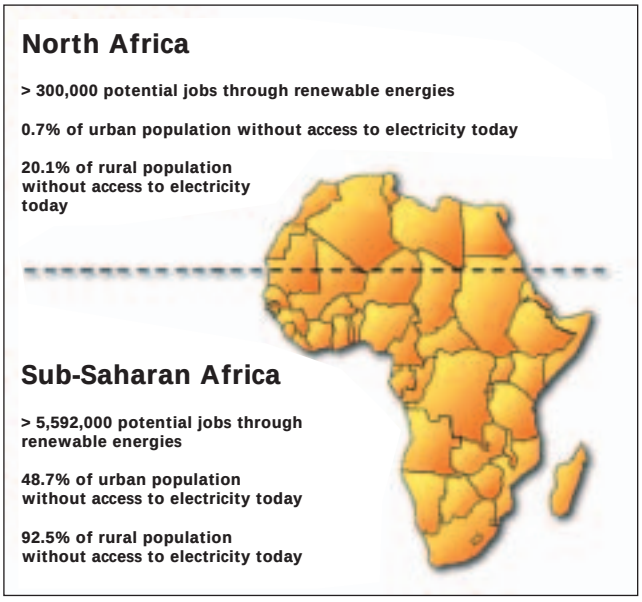
Dedicated researchers are striving to make solar electricity more cost-effective. Hundreds of new types of photoelectric semiconductors remain to be explored, but only one or two of these currently offer better possibilities than the silicon now in use.

The technology already exists to design ‘energy satellites’ whose huge panels could collect the intense radiations of the interstellar void – solar radiation in space – and transform them into electricity which could then be sent back to Earth through the intermediary microwaves. But such a project will not be economically feasible before the cost of launching satellites has been divided by 50.

In the meantime, solar energy has found its market. It is safe to assume that the major world manufacturers, who are mainly American, European and Japanese, would not be producing solar panels if there were no market. In the industrialized countries, the solar panels notably equip isolated homes and communication relays. This utilization, however, will not come close to replacing or even complementing ‘normal’ distribution channels for at least another 20 years, by which time costs will have been divided by three thanks to continuing research efforts.

The light bulb as a means of stemming rural exodus

Solar systems cannot be expected to contribute in a major fashion to the development of the productive apparatus because of their feeble power or, if of sufficient dimensions, their prohibitive cost. But their social fallout is essential: they generate jobs and above all provide those elements of comfort and a window to the rest of the world which curbs the rural



Source: O. Benchikh

Electrification needs in Africa. In addition to providing basic services, electrification is a source of job creation. The figures for the latter are calculated on the basis of generalized rural electrificiation using renewable energies

exodus by reducing the gulf between the 'modernism' of cities and the 'backwardness' of remote and rural areas.

Renewable energy sources are the only possible means of providing poor rural or remote areas with a minimum level of comfort (lighting, pumped water, education and health care), with refrigeration to preserve medicines and food, and with radio, telephone and television to maintain contact with the outside world. Solar villages can have at their disposal a small pump (1–3 KW) for drawing water or irrigating a cultivated area, a microplant serving as a 'fountain of electricity' where users can go to recharge their batteries, a generator to light streets and a school cum community centre which can also double as a medical centre. These installations are all accessible to these rural populations if the public authorities assume the installation costs and users the operating costs.

'Solar' power is therefore an essential means of developing these rural areas, slowing the exodus to the big cities and combating the impoverishment of societies that represent nearly half of humanity. Renewable energies are not only crucial for bridging the widening energy gap and for protecting the environment; they are also one of the keys to tomorrow's development, especially if we want it to be long-lasting.

Facing the facts

If demand continues to focus on fossil fuels – nuclear power will remain marginal in the Third World for both political and technical reasons – an energy bottleneck may strangle development in the non-oil-producing countries of the South and eventually threaten their very survival. To avoid this fate, they will have to devote 10–15% of their investment budgets to the energy sector. If this effort proves to be beyond their means, we can expect that about 35% of the world population will be living in acute energy poverty by 2020 and nearly two billion people in rural areas will still be living on the fringes of society, without electricity and relying on non-marketed energy for 30–45% of their needs.

This challenge leaves the world community with no choice but to face up to its responsibilities and sets a dilemma for the developing world. The only way to meet this challenge, in both the North and the South, is to expand the use of renewable forms of energy as quickly as possible. In the North, these could gradually complement conventional energy, especially for domestic and water heating.

If renewable energies are a necessity for the South, the North also has a stake in them. In addition to using raw materials that nature renews, making them environment-friendly and inexhaustible sources of energy, unlike fossil fuels, renewable energies are also without risk. By diversifying our sources of energy, we shall be giving our children and grandchildren the chance to choose the forms of energy that best suit their way of life.

Despite warnings from experts over the past twenty years that, since reserves of 'black gold' are limited and concentrated, countries under its spell will sooner or later pay their oil dependence, some developed countries are still burying their head in the sand.

The decision by the European Union to meet the 12% share for renewable energies target by 2010 seems a modest step given the enormous potential of these energies and their various applications. And at the global level, we are unfortunately still in a state of denial. The modest target of a 10% market share for renewable energies proposed by the Secretary-General of the United Nations, Kofi Annan, and Brazil, among others, was ultimately rejected by governments at the World Summit on Sustainable Development in September last year.

But the march towards widespread use of renewable energies may be inexorable. According to the Global Environmental Facility, the small photovoltaic solar market is expanding by 15% annually, thanks largely to those countries which have incorporated these technologies into national energy planning schemes. The expanding market and progress in research and development should bring prices down farther. As long as it receives strong incentives from government, the market will do the rest.

Osman Benchikh[22]

22. Responsible for renewable energies at UNESCO: o.benchikh@unesco.org

Irrigating fields with groundwater brought to the surface by a solar-powered pump

Afghanistan on the (rocky) road to recovery

Water rhymes with survival in Afghanistan. In a country prone to prolonged periods of drought, 85% of people remain reliant on agriculture for their livelihood. Competition for the resources of the region's rivers is rife; the negotiation of international agreements between Afghanistan and its downstream neighbours will thus be essential to ensuring the consolidation of peace.

Although water-sector development is one of the highest priorities of Afghanistan's transitional government, two decades of war have deprived the country of the hydrological skills, managerial capacities and infrastructure to attain this objective. Trapped until recently in a time warp, Afghanistan has been side-stepped by foreign investments and by developments in education and technology. If the country can count on a relatively high proportion of national experts for the reconstruction of the water sector, these experts need urgent training in modern techniques.

On the premise that leadership of Afghanistan's recovery and rehabilitation process must rest with the Afghans themselves, UNESCO has been helping Afghanistan since 2002 to develop its human and institutional capacity, design a national water policy and establish regional co-operation for the management of its shared river basins.

Although Afghanistan might be considered as being in a comfortable position for water availability, estimated at 75 billion m^3 annually, the reality is very different, according to Mohammad Yunus Nawandish, Vice-Minister of Water and Power. Afghanistan is an arid and semi-arid country. Hugely dependent on groundwater, the population has continued to extract water despite the almost total lack of rain over the past four years of drought. This has caused the aquifer table to drop by up to 4.6 m in Kabul and 8 m in Kandahar; moreover, several shallow wells have dried up throughout the country. The drought's impact has been exacerbated by inefficient use of water which has often led to wastage.

Less than 20% of urban households have access to piped water. Moreover, owing to lack of maintenance and extensive war damage, piped water and sewerage networks are limited and in poor shape.

Power shortages have prompted a return to traditional biomass fuels for cooking and heating, which will inevitably contribute to respiratory diseases. Electricity is only being supplied to 4% of urban households a few hours per day and the well-field can be immobilized for two consecutive days, according to Mr Yunus Nawandish. To meet the hydropower shortage, Afghanistan is currently planning to import electricity from Iran and Turkmenistan.

Source: 1999 Magellan Geographix, map redrawn by HEXA Graphic

Attempts by NGOs to rehabilitate parts of the piped water supply network have been hampered by the absence of comprehensive feasibility studies prior to rehabilitation, poor planning and insufficient funding, according to the government.

UN agencies have also been rehabilitating the urban water supply system. Yet this emergency 'firefighting' is only a short-term solution; it must be superseded by a complete overhaul of the national water system. And the system will only be self-sustaining if Afghanistan is empowered to undertake the planning and engineering work itself. The challenge is to develop ways of controlling, capturing and delivering reliable water to people, industries and farms. Since agriculture accounts for 85% of water use, increasing the productivity of irrigated water is particularly critical for reducing poverty in the rural areas. As for the cities, they need a reliable water supply and hydropower at a reasonable cost. To ensure long-lasting availability of basic resources such as fuel, fodder and timber, Afghanistan must engage in sustainable water resources development. Detailed field studies and an inventory of natural resources and the population's socio-economic conditions would facilitate the process.

It is of crucial importance that the current dependency on UN and donor agencies with regard to policy-making and project implementation be progressively reduced. One way of putting a stop to the over-exploitation of groundwater resources and of mitigating the effects of drought would be to develop surface waters. Afghanistan is situated upstream of several internationally shared river basins (the Kabul, Helmand and Amu Darya Rivers among others). In order to develop its own water resources, Afghanistan will need to

©UNESCO/M. Demissie

Children pumping water from a Kabul well in August 2002. Note the wastage caused by spillage

establish regional co-operation with the downstream countries of Tajikistan, Turkmenistan, Uzbekistan, Iran and Pakistan.

The development dilemma

There are four dams on Kabul River and its tributaries. The government is planning to add to these to reinforce irrigation, fishing and hydropower generation but, unless an agreement is found, Kabul River's further development could trigger tensions between Afghanistan and Pakistan.

The story is much the same for Helmand River. Draining 31% of Afghanistan's land area, it is (at 1007 km) the longest river and a key player in the development of the southwest desert region. Wetlands in this massive depression, stretching about 200 km from north to south, have supported irrigated agriculture throughout Afghanistan's history. Afghanistan is planning new dams on the river for hydropower, irrigation and flood control. Further studies will be needed to determine whether the Kabul and Helmand River projects can be realized without harming the interests of neighbouring countries.

There are already tensions. In 1974, Afghanistan promised to allocate a flow of 22 m^3/second into Iran from the Sistan branch of Helmand River, located in the south of Zaranj. Under the terms of this agreement, Iran built the Chanimeh reservoirs with a capacity of 0.7 billion m^3 for drinking water storage and is today planning to expand the storage capacity to 1 billion m^3. Yet Afghanistan has never ratified this protocol. In 2001, tensions between the two countries escalated when Iran accused Afghanistan of blocking Helmand River. It later transpired from a UN investigation that drought was the main culprit in the drying-up of the river.

In recent months, Iran has been dialoguing with the Afghan government to develop and share Helmand River. A memorandum of understanding was signed between the two countries in the summer of 2002. Effective regional co-operation, however, requires knowledge. Afghanistan's water experts need to upgrade their knowledge of the latest developments in hydrological research and land engineering and about the use and management of transboundary water resources. They also need training in negotiation and mediation techniques.

In Afghanistan, Amu Darya River and its tributaries are important sources of water for the extensively irrigated northern plains. To date, four projects have been realized in Afghanistan, including the three bridges linking Afghanistan to Turkmenistan, Uzbekistan and Tajikistan. Other projects on the cards include the construction of a pumping station for irrigation purposes and a floodwall along the banks of the Amu Darya.

The Amu Darya feeds extensive irrigation for cotton production and hydropower generation in Tajikistan, Turkmenistan and Uzbekistan. Consequently, the course of the river that used to run for 1,200 km before emptying into the Aral Sea today dries up beforehand. A series of regional agreements for the shared management of the Amu Darya was signed under the Soviet regime in the mid-twentieth century. Under these agreements, an international commission was established to deal with the use and quality of frontier water resources. Since 1991, Tajikistan, Turkmenistan and Uzbekistan have inherited the responsibilities of this commission. Plagued by war, Afghanistan has been unable until now to honour these agreements.

© Mogens Dyhr-Nielsen

Almost dry, Kabul River is incapable of sustaining Kabul City's 3 million inhabitants

Transforming tension into co-operation

It is evident from the foregoing that new regional agreements are required to address the competing demands for water. On the premise that latent conflicts should be transformed into co-operation, UNESCO is encouraging the governments of the region to undertake consultative intergovernmental meetings and in-depth studies involving data collection from the Helmand, Kabul and Amu Darya river basins crossing all five countries. Helping Afghanistan to adopt a co-operative approach at an early stage will not only stave off potential tensions but should serve as an engine for broader regional collaboration and goodwill.

Headwaters of Amu Darya River

Signs of 'neighbourly' goodwill are not lacking. Since April 2003 for example, the Iranian government has been collaborating with UNESCO on a study of Kabul River and related projects which will cost US$1.1 million over the next three years. The initiative is being managed from UNESCO's office in Tehran in co-operation with the Tehran Regional Centre on Urban Water Management established under the auspices of UNESCO, which has also offered its training facilities. UNESCO is seeking additional funds to realize similar work on the Amu Darya and Helmand river basins.

Bridging the knowledge gap

For UNESCO, education is central to solving Afghanistan's water problem. Higher educational institutions lack everything from teachers to up-to-date science textbooks, laboratory equipment and instrumentation. The country is also lacking in data on freshwater resources. There is no assessment process in place yet and hydrological information for the past 25 years is almost non-existent.

The older generation of water experts is highly educated, having benefited from an excellent level of training under the Soviet system when the Kabul Polytechnic Institute was a reputed institution. 'But many of these experts are now approaching retirement and the younger generation lacks experience', says Alhaj Mohammad Akbar Barakzai, Vice-Minister of Irrigation, Water and the Environment. According to him, there are about 5,000 water-related professionals throughout the country, 70% of whom need to upgrade their skills in water sciences and technology.

In response to the UN system-wide appeal for the reconstruction of Afghanistan, UNESCO launched a water-sector capacity-building initiative in August 2002. One of the goals is to bridge the knowledge gap between Afghanistan and its neighbours in using ICTs to access knowledge on water resources management.

As part of the first phase, 15 senior Afghan government water experts and university lecturers attended a training course at the UNESCO–IHE Institute for Water Education (see p. 9) from 29 January to 12 February 2003 on management of transboundary water courses and principles of integrated water resources management. The participants urged UNESCO to pursue its capacity-building initiative and proposed the setting-up of research centres at Kabul University and Kabul Polytechnic Institute.

As a means of creating linkages between Afghan water experts and the regional scientific community, UNESCO invited the Director of Kabul Polytechnic, Dr Pohanwal Mir Fakhradin, to attend the WaterCAN[23] meeting on water and land engineering education in Tashkent (Uzbekistan) in October 2002. A month later, UNESCO brought Ibadullah Hulmi and Mohammad Rahim, respectively Deputy-Director and Advisor to the Minister at the Ministry of Immigration, Water and the Environment, to an international seminar in Dushanbe (Tajikistan) on freshwater resources management, initiated by UNESCO's Director-General. In 2003, the Tajik Ministry of Water Resources placed the training facilities of the Intergovernmental Commission for Water Management of the Aral Sea Basin at the disposal of UNESCO for the training of Afghan experts.

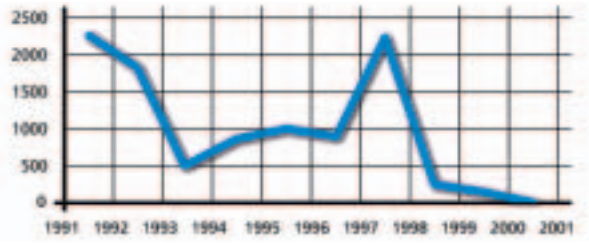
UNESCO is helping the Ministry of Education to rebuild the education system, including through curriculum reform and teaching training. For example, with UNESCO's help, 20,000 students sat the university entrance examination in the spring of 2002. Of these, 16,400 were admitted to various tertiary institutions, including 4,000 to Kabul University.

Where have all the pledges gone?

UNESCO has allocated US$1.4 million to cover implementation of projects in education, culture, human rights, communication and science. Although this amount constitutes a sizeable portion of the Organization's programme budget, it is a drop in the ocean. Afghanistan

Food security remains one of the highest priorities in Afghanistan, especially in the spring and early summer prior to the harvest

Water flow of Helmand River, 1991–2001
(million m³)



Helmand River has experienced dramatic declines in water flow in recent years. In 2001, the river ran at 98% below its annual average. With declining precipitation, the snowfields that supply the headwaters of the Helmand shrank from 41 000 km² to 26 000 km² between 1998 and 2000. With continued withdrawals for irrigated agriculture, Helmand waters failed to reach the Sistan basin altogether in 2001

Source: United Nations Interagency Assessment Report on the Extreme Drought in the Islamic Republic of Iran. Tehran, July 2001.

needs a huge amount of money to train fully a new generation of Afghan water specialists. UNESCO would need US$5.5 million over the next six years to train a critical mass of young scientists. The Organization is keen to see other UN agencies and international organizations join its capacity-building efforts in Afghanistan.

International assistance is critical to maintaining peace and avoiding wastage of recent investments. After the fall of the Taliban regime, a Donors Conference was held in Tokyo (Japan) in January 2002. On this occasion, Kofi Annan told the international community that US$10 billion was needed to rebuild Afghanistan. The world pledged US$4.5 billion for a trust fund to be administered by the World Bank. So far, not even US$1 billion has materialized. In an interview to Kathy Gannon of the Associated Press on 11 November 2002, President Hamid Karzai insisted, 'we are not seeing development money. This is what we need. This is what we are asking for, not emergency assistance, but long-term help'.

The Minister of Higher Education, Mohammed Sharif Faiz, has warned[24] that there will be a revival of fundamentalist ideology unless universities and colleges are established and given the means to operate. Already, he says, Islamic militants are trying to infiltrate Kabul University. Yet international donors do not seem to see higher education as a priority.

Time is of the essence. The Afghan government will only be able to drive national and regional processes of water management reform if it receives adequate financial and technical assistance. Failure to assist Afghanistan will threaten the consolidation of peace and security both in the country and in the region.

Meseret Demissie Yadeta[25]

For further information, contact: m_demissie@unesco.org
or go to: www.developmentgateway.org/afghanistan

23. The WaterCAN (Central Asian Network for Human Capacity Building in Water Resource Management) is a UNESCO initiative
24. International Herald Tribune, *21 December 2002*
25. UNESCO Consultant

Governing **Bodies**

Spring session of the Executive Board

The Executive Board met from 31 March to 16 April to put the penultimate touches to the *Draft Programme and Budget for 2004–2005*, which must be submitted for adoption to the 32nd session of the General Conference beginning on 29 September.

The Board took stock of progress in preparing an *International Declaration on Human Genetic Data*. Elaborated by UNESCO's International Bioethics Committee (IBC), the text seeks to reconcile freedom of research with respect for human dignity and privacy. It is presently the subject of an international consultation. Government experts will be meeting to discuss the project on 25–27 June, paving the way to its adoption by the General Conference in September. The *Declaration* falls within the continuation of the *Universal Declaration on the Human Genome and Human Rights* adopted by the General Conference in 1997.

On the subject of freshwater and ecosystems, the Board proposed the creation of a fund for access to drinking water for countries facing desertification.

The autumn session of the Executive Board will convene from 9 to 24 September.

Exhibition on 'Building knowledge societies'

In May, the Member States were invited by the Director-General to contribute to the exhibition on 'Building knowledge societies' being organized in parallel to the General Conference from 29 September to 18 October.

The exhibition theme reflects UNESCO's main message to the World Summit on the Information Society (see p. 8). The exhibition will strive to demonstrate the potential of ICTs for building on past knowledge and on knowledge diversity, while at the same time keeping track of knowledge, transmitting it, sharing it and preserving it on a world scale.

Under education, UNESCO programmes and centres likely to feature in the exhibit include the: Avicenna Virtual Campus, UNITWIN Chairs, water education, space education, desertification and biodiversity education, the Local and Indigenous Knowledge Systems (LINKS) project, chemistry micro-scale experiments, biotechnology training programmes, solar energy, L'ORÉAL–UNESCO awards for women in science (see p. 12) and the training activities of SESAME (Jordan), of the Abdus Salam International Centre for Theoretical Physics (Italy) and of the Centre for Capacity-building (Ethiopia):www.unesco.org/confgen/exhibition

***Erratum**: In Volume 1, number 2 of* A World of Science, *the photograph on page 5 showed debris flows from the lava dome of Mount Unzen which lasted from 1991 to 1995. Some 43 people were killed in 1991 in one of these pyroclastic flows. The Mayuyama Landslide on the right flank of Mount Unzen did kill 16,000 people but it was triggered by an earthquake following an eruption in 1792 and not in 1992 as erroneously stated.*

Diary

1–4 July
2nd Intl Conference on Wadi Hydrology, organized by UNESCO/EOLSS Chair and UNESCO Cairo. Amman (Jordan): shatanaw@ju.edu.jo

2–4 July
Advisory Committee for Biosphere Reserves, meeting at UNESCO HQ to examine new biosphere reserve nominations: mab@unesco.org

7–8 July
Managing risks associated with recharge of reclaimed water, IAHS/IAH/UNESCO symposium, Sapporo (Japan): a.aureli@unesco.org

10–11 July
SESAME Council, 2nd meeting, organized by UNESCO with Turkish Atomic Energy Authority. Istanbul (Turkey): www.sesame.org.jo

15–18 July
Intergovernmental drafting group meets to refine working documents for *Draft Declaration of Principles* and *Draft Action Plan* of World Summit on the Information Society: www.unesco.org/wsis

17–18 July
Challenges in Water Education: Towards the UN Decade of Education for Sustainable Development', UNESCO–IHE Institute for Water Education, see p. 9.

31 July
Earth Observation Summit for creation of comprehensive Integrated Earth Observation System. US State Dept, Washington, DC, USA. Ministerial-level, with UN participation, including UNESCO and IGOS: r.missotten@unesco.org

1–5 September
Marine Data and Information Management, 3rd ODINAFRICA training course, Brussels (Belgium), see p. 5.

2–3 September
Microscience Experiments Project, consultation of National Co-ordinators from Botswana, Lesotho, Namibia, Swaziland and Seychelles. In Johannesburg (South Africa): an.pokrovsky@unesco.org

8–14 September
7th International Congress on the History of Oceanography co-organized by Russian Academy of Sciences, Ministry of Culture, Admin. of Kalingrad region, UNESCO-IOC, Commission of Oceanography of IUHPS, Kalingrad (Russian Federation): www.vitiaz.ru; a.suzyumov@unesco.org; postmaster@vitiaz.koenig.ru

15–17 September
Ocean Margin Research Conference, Paris (France), co-organized by Ocean Margin Deep-Water Research Consortium, co-sponsored by European Commission and UNESCO: www.ig.uit.no/konferanser/omarc or: a.suzyumov@unesco.org

10–12 September
Network of Science Faculties in Latin America and Caribbean, 1st meeting, Mexico, to examine results of ongoing empirical research on current trends in science training supported by UNESCO: rpfabi@hp.fciencias.unam.mx

15–26 September
Preparatory Committee for World Summit on the Information Society, 3rd meeting, final negotiations on *Draft Declaration of Principles* and *Draft Action Plan*, Geneva (Switzerland): www.unesco.org/wsis

23–24 September
Microscience Experiments Project and DIDAC, UNESCO/GIFCA International Advanced Training Course, Kazan, Tatarstan (Russian Federation): an.pokrovsky@unesco.org

29 September–3 October
54th International Astronautical Congress, Bremen (Germany): y.berenguer@unesco.org

New Releases

Manual on Harmful Marine Microalgae

Monographs on oceanographic methodology 11. English only, 800 pp. Edited by G.M. Hallegraeff, D.M. Anderson and A.D. Cembella; Technical Director: H.O. Enevoldsen. UNESCO Publishing (€49.50), IOC with support from Danish Natural Science Research Council, Danish Ministry of Science, Technology and Innovation and DANIDA.
Some 300 species of microalgae are reported to form 'blooms' or mass occurrences and nearly one-fourth of these microalgae produce toxins. These blooms can cause massive fish kills, contaminate seafood and alter ecosystems. Prepared by 46 leading scientists under the aegis of the UNESCO-IOC for research laboratories, environmental and food safety monitoring authorities, and for teaching and training purposes.

The Virtual University: Models and Messages Lessons from Case Studies

By UNESCO's Paris-based International Institute for Educational Planning, profiles the different types of on-line institutions and the issues policy-makers and education authorities must grapple with when developing virtual education services. Concludes that, while 'both developed and developing countries could benefit from these new methods of education delivery […], countries or specific groups within countries could become even further disadvantaged' by lack of ICT infrastructure. *Download at:* www.unesco.org/iiep/

La Réserve de biosphère de Mananara-Nord : un défi pour la conservation et le développement intégrés

By Charles Hutel, Luc Touber and Miguel Clüsener-Godt, describes 15 years of MAB activities (1987–2002) to promote sustainable development in this part of Madagascar; *French only, request a free copy*: m.clusener-godt@unesco.org

Monitoring beach changes as an integral component of coastal management

CSI Info n°15, English only, 90 pp. By Gillian Chambers. Final report of project on institutional strengthening of beach management capabilities in Organisation of Eastern Caribbean States and Turks and Caicos Islands. Published by UNESCO with Caribbean Development Bank. *For a free copy:* kingston@unesco.org or csi@unesco.org.

Splash!

Free bimonthly newsletter produced by UNESCO during International Year of Freshwater. In English, French and Spanish. *To subscribe:* wateryear2003@unesco.org, or: www.wateryear2003.org

Currents

Free newsletter of UN World Water Assessment Programme. In English, French and Spanish. *To subscribe:* currents@unesco.org, or: www.unesco.org/water/wwap/

To order a sales publication: www.unesco.org/publishing
UNESCO natural sciences portal: www.unesco.org/science

A World of Science is a quarterly newsletter published in English and French by the Natural Sciences Sector of the United Nations Educational, Scientific and Cultural Organization (UNESCO), 1, rue Miollis, 75732 Paris Cedex 15, France.
Director of Publication: Walter Erdelen; Editor: Susan Schneegans; Art Director: Jacques Zahles; Realization: HEXA Graphic (hexa-jac@worldnet.fr).
This issue was printed in 9,000 copies. To subscribe for free/unsubscribe: s.schneegans@unesco.org, fax: (331) 4568 5823