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ON THE
ETHICS OF SCIENTIFIC KNOWLEDGE
AND TECHNOLOGY
(COMEST)

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CONFERENCE REPORT

INTRODUCTION

At the kind invitation of the Government of the Republic of Senegal, the ess Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) was held in Dakar (Senegal) from 6 to 9 December 2006. More than 200 participants from 25 countries participated. Scientists, social and human science researchers, policy-makers, teachers, doctoral students and civil society representatives, mainly from West Africa but also from the remainder of the African continent, Europe and the Americas, thus had the opportunity to come together to analyse the major issues of the ethics of science and technology.

The Fifth Session, the first statutory meeting held on the African continent, enriched COMEST's work on cross-cutting issues, such as the ethics of science, ethics education and environmental ethics, with new ideas and regional experiential data. It also provided the countries of the sub-region with a special forum for exchanges and discussions on the ethical issues of greatest concern to African societies, such as toxic waste management and the interactions between biodiversity, genetically modified organisms (GMOs) and biotechnology.

Furthermore, as part of the sub-regional ministerial meeting convened by the Ministry of Scientific Research of Senegal in parallel with the statutory session of COMEST, the representatives of the Ministries of Research of Benin, Côte d'Ivoire, Guinea, Mali, Niger, Nigeria, Senegal and Togo and an observer representing Kenya discussed the integration of the ethics of science and technology into African official policies and adopted the *Dakar Declaration on the Ethics of Science in Africa*.

A Forum of Young African Researchers on the theme "Social responsibility of researchers in Africa" brought together young engineers and researchers in the social and the natural sciences from Benin, Burkina Faso, Cameroon, Congo, Gambia, Guinea Bissau, Mozambique, Nigeria, Rwanda, Senegal and South Africa. The vulnerability of young researchers, the lack of appropriate science policies and the shortage of training courses in the ethics of science and technology were all discussed at the Forum, at which the *Dakar Declaration on the Social Responsibility of Researchers in Africa* was adopted.

Lastly, a meeting reserved for COMEST members was held on 5 and 6 December 2006 in order to draw up COMEST's work plan for 2007-2008 and elect the new bureau. The members of COMEST decided to focus its work on the fields of science ethics, environmental ethics and nanotechnology ethics. They discussed and reached agreement on three COMEST recommendations, each concerning these fields of action, which will be submitted to the Director-General of UNESCO.

The opening ceremony of the fifth statutory session of COMEST was honoured by the presence of Mr Macky Sall, Prime Minister of the Republic of Senegal, who welcomed the participants and declared the session open.

COMEST would like to express its gratitude to all members of the organizing committee, including the Regional Adviser and Regional Unit for Social and Human Sciences in the UNESCO Dakar Office, for their efforts in making the Fifth Session of COMEST a success.

OPENING CEREMONY

On behalf of the COMEST members, Mrs **Pilar Armanet Armanet**, President of COMEST, commended the efforts of the Government of Senegal in making it possible to bring together specialists and decision-makers from the entire African continent to discuss matters of vital concern to contemporary societies. Their ideas and proposals would provide inputs to the international debate on the ethics of scientific knowledge and technological advances and would guide the action taken by the various stakeholders to promote effective and responsible science and technology. The results of the meeting would, in particular, provide guidance for action by UNESCO and COMEST.

Mrs Pilar Armanet Armanet gave a brief overview of COMEST, established in 1998 by the General Conference of UNESCO at its 29th session in order to ensure that advances in science and technology were underpinned by ethical reflection rooted in the cultural, legal, philosophical and religious heritage of its Member States. After touching on the membership and terms of reference of COMEST, she reviewed the work done by the Commission since its establishment and explained changes made to its methods of work and topics addressed. COMEST had gradually expanded its field of action and achieved tangible results. With its emphasis on practice, awareness-raising and capacity-building, it is currently focusing on the ethics of science and codes of conduct for scientists, environmental ethics, ethics education and future-oriented studies of emerging technologies such as nanotechnology. Mrs Pilar Armanet Armanet said that consultations would be held during the session on those subjects, which were crucial to all nations and all societies. She hoped that a pluralistic, multidisciplinary and enlightened debate would foster the establishment of networks and would give fresh impetus to the scientific and technological development, based on ethics, equality and human rights, of Africa and of the world.

Mr **Souleymane Niang**, President of the Academy of Science and Technology of Senegal, highlighted the consistencies between the themes addressed by COMEST and those covered by the Senegalese Academy of Science and Technology. In regard to education and awareness-raising, the Academy endeavoured to build individual and collective capacities through education adapted to the economic and socio-cultural needs of the African people. In regard to the environment, it organized conferences, carried out field activities and actively promoted dialogue among scientists, decision-makers and civil society. The Academy was also particularly active in the field of bioethics. More specifically, in November 2001 the Academy submitted to the relevant national authorities a project for the establishment of a national advisory committee on ethics in the life sciences. This was evidence of great interest in ethics, which it regarded as a form of inquiry into human action that neither scientists nor decision-makers nor society as a whole could avoid. Mr Souleymane Niang stated emphatically that the Academy was committed to participating in the follow-up and implementation of the resolutions adopted by COMEST at its fifth statutory session, particularly in regard to the promotion of dialogue between the natural sciences and the social and human sciences, and between those sciences and African societies. The Academy, which has four sections, namely agricultural sciences, health sciences, science and technology, and the newly established economic and social sciences section, would benefit from the experience gained from its participation in the Fifth Session of COMEST, and would accordingly be in a better position to act effectively at the local level to ensure that ethical principles were taken into account in technical and scientific development. It would step up efforts to reconcile scientific, social and moral progress further through collective and multidisciplinary reflection, analysis of ethics with due regard for different outlooks, and dissemination through education. Concluding his address, Mr Souleymane Niang touched on the crucial role of awareness-raising in ensuring that all the people of Senegal took part in knowledge development and thus genuinely took control of their future.

Mr **Gilles Forget**, Regional Director of the International Development Research Centre (IDRC),

thanked the organizing committee, UNESCO and the Ministry of Scientific Research of Senegal for inviting the Centre to participate in COMEST's Fifth Session. He recalled the mandate of the Centre, which had been set up in 1970 by the Canadian Parliament to support technical and social innovations which contributed to improving the living conditions and environment of poor and marginalized populations in the South. Even though it was universally acknowledged that the development of scientific knowledge and technology was a mainspring of growth and development, technologies and their potential benefits were being distributed increasingly unevenly. The gap was also growing between rich and poor countries in terms of their ability to meet the ethical challenges raised by emerging technologies. To address those issues, the Centre was endeavouring to support research and the formulation of appropriate policies that would help shape a political, economic and social environment conducive to innovation. To establish such an environment, which was vital if research projects were to have a significant impact locally, there was a need for ongoing dialogue among decision-makers, scientists, philosophers, ethicists, representatives of civil society, businesses and the private sector. To that end, the Centre had launched a new initiative known as "Innovation, Policy and Sciences" (IPS) and had helped, in that context, to organize the Forum of Young African Researchers. It was through the outcome of public debate that a rigorous framework, capable of fostering research which respected ethical values and produced convincing results, could be established and put into effect. In conclusion, Mr Gilles Forget stressed how important it was that COMEST's Fifth statutory Session was being held in Africa because it would remind African researchers of the need to be familiar with the ethical questions being debated across the world, which would encourage them to produce research that was rigorous, reliable and ethically irreproachable and hence competitive internationally.

Mr **Pierre Sané**, Assistant Director-General for Social and Human Sciences at UNESCO, expressed his thanks, on behalf of the Director-General of UNESCO, to the Government of Senegal and the Senegalese Academy of Science and Technology, which had jointly organized the first statutory session of COMEST in Africa. This meeting is important as it would enable COMEST, the mission of which is to foster debate on the ethics of science and technology with due regard for the diversity and creativity of all cultures, to take into account the ideas, experiences, aspirations and proposals of the various stakeholders in African society. Agreeing that the future of societies and their democratic functioning was closely linked to their capacity to develop a scientific and technological culture which met ethical standards, the Member States of UNESCO had made promotion of the ethics of science and technology one of UNESCO's five major priorities and the principal priority of the Social and Human Sciences Sector. For, while advances in scientific and technological knowledge could potentially be used to sustain development, they also gave rise to serious ethical issues which threatened the vital link between science and society and were likely to widen the gap in wealth and opportunity between the rich – countries and individuals – and the poor. Moreover, scientific and technological applications and developments, which had a strong impact on social transformations, were not neutral and depended on value-based choices and decisions. UNESCO and COMEST were therefore endeavouring to foster a public and multidisciplinary international debate, focusing on ethics in particular, to accompany those advances. The aim was to anticipate potential risks and to set out common ethical principles so that well-informed choices could be made and the consequences of the new discoveries and applications better understood. That would ensure that such discoveries and applications gave due regard to cultural diversity and human dignity and contributed effectively to the improvement of living conditions for humanity as a whole. Mr Pierre Sané stressed that the meeting should be used to analyse the ethical issues that were of most concern to the countries of the region and to determine the needs of the local socio-cultural environment more precisely in order to encourage proactive and creative integration into the field of science and technology, making full use of the resources and capacities of the region's countries and also fostering the development of basic research. In conclusion, he welcomed the high quality of the debates held during the Forum of Young African Researchers and underlined the importance that UNESCO attached to their proposals to construct, jointly, a viable and sustainable future for generations to come, which was the ultimate goal of the ethics of science and technology.

On behalf of the Head of State, His Excellency Mr Abdoulaye Wade, Mr **Macky Sall**, Prime Minister of the Republic of Senegal, welcomed the participants. He stated that it was an honour for Senegal to host the Fifth Session of COMEST, which would address the key theme of the promotion of science and technology for sustainable development. The scientific and technological divide, exacerbated by globalisation, was at the heart of many of Africa's economic, political, social and environmental problems. At the same time, sustainable socio-economic development in Africa could only be achieved by the promotion of scientific and technological innovation, which must be founded on ethical considerations and capable of making full use of Africa's distinctive features and assets. In that regard the ethics of science was linked not only to the notion of responsibility and the sense of duty but also to the legitimate aspiration of every individual to just and equitable progress. Ethics in science should therefore be part of the overall, ultimate aim of achieving greater equality through the application of specific principles such as respect for human dignity, cultural diversity and the equitable distribution of research benefits and burdens.

Praising the activities undertaken by UNESCO in its capacity as lead agency of international action relating to the ethics of science and technology, Mr Macky Sall drew attention to the relevance and topicality of the UNESCO Declaration adopted by the 1999 Conference on Science and the Use of Scientific Knowledge, in particular with regard to scientists' responsibility and ethics education. He outlined the major challenges that sub-Saharan African countries were facing in relation to the ethics of science and technology, including the brain drain, the lack of stable funding and the role of women in training and scientific research. Among the courses of action to be followed to meet those challenges he cited the creation of poles of excellence based on the comparative advantage of each country in the region and the establishment of an effective network of research centres. Finally, Mr Macky Sall thanked UNESCO for providing support to Senegal in the crucial areas of development and underlined the importance, to the countries of the South, of the Organization's efforts to raise awareness, build capacities and provide advice, in particular through COMEST, in relation to the ethics of science and technology, a domain that was vital to the future of African societies. He concluded his opening address by wishing the meeting every success.

Keynote Address

Mr **El Hadji Ibrahima Sall**, President of the West African Polytechnic University, gave the keynote address to the Fifth statutory Session of COMEST on the theme "The ethics of science: challenges for Africa". Affirming the need, more pressing than ever before, for an ethics of science and technology, Mr El Hadji Ibrahima Sall went on to ask how such an ethical system could be established and how, while remaining universal, it could take the form of practical action capable of safeguarding the moral ideal and taking due account of Africa's special concerns.

Analysing the development of philosophical thought on the role and place of science in society, Mr El Hadji Ibrahima Sall showed how ethics had been outflanked by science and technology. In less than three centuries, the challenges of physics had moved to the forefront and the subjects and objects of science had become depersonalized and come to be regarded as value-free. With that new approach, which was founded on a new interpretation of nature and of the world, science had become synonymous with power, and science and technology had become the inevitable mediators in the relationship of human beings with objects and with the world in general. The release of science from any ethical constraints and the severing of the ties between science and philosophy had marked the endorsement of humanity's plan to dominate nature through the exercise of power. The worldwide standardization of lifestyles and ways of thinking, the upheaval and neutralization of space and time, the shaping of policy to serve bureaucracy and rationality, were also part of that new scientific approach.

By imposing its principles and criteria, science appeared to have become the philosophy of the contemporary world. There was nevertheless still a need for ethics, since science could no longer be self-regulating. But what should be done to ensure that the ideal of an ethical regulation of science did not remain a mere utopia? The answer lays no doubt in the vital link between ethics and politics, which in a democracy must ensure the general interest and common good. Science ethics therefore concerned not only scientists but also political decision-makers. Indeed, it was incumbent on decision-makers, in cooperation

with the scientific world, to formulate and implement sound research policies in order to define, in the general interest, what was permissible and what was not, and to promote means of orienting research towards the preservation of the prosperity and security of future generations.

Despite the encouraging efforts of UNESCO and COMEST, much remained to be done in order to increase the resources allocated to the ethics of science and technology, develop international coordination, improve the status of researchers and scientists while giving them a greater sense of responsibility, and build capacities in the developing countries. Because traditional and institutional forms of ethical governance could not keep up with the pace of scientific and technological progress, there was a need to redouble the efforts made to anticipate both the risks and the opportunities associated with that progress, in particular for the poorest countries.

Finally, while the need for an ethics of science, and the problems to which it gave rise, were universal and called for concerted action at the international level, Africa was also faced with specific problems of its own, chiefly underdevelopment and the absence of public policy in the field of scientific research and science ethics. To meet those challenges, a sincere political resolve, nationally and regionally, to draw attention to ethical issues and to promote ethics education was vital, as was an increase in public funding for research relating to the ethics of science and technology, the development of bodies to oversee and monitor potential risks and the establishment of ethics committees to help develop appropriate guidelines.

Mrs **Yaye Kène Gassama Dia**, Minister of Scientific Research of Senegal, thanked Mr El Hadji Ibrahima Sall for his outstanding address and chaired the ensuing debate. Several speakers said that particular attention should be paid to the implementation of regulatory mechanisms to ensure that research was effectively guided by the universal values of responsibility, justice and equity and not mainly motivated by economic gain. The question then arose of how to design and develop such mechanisms to ensure that decision-makers, scientists and society as a whole engaged in genuine dialogue and that account was taken of the particularities of local socio-cultural values. One speaker wondered about the influence that the Cartesian scientific vision of science had on the very nature of our thinking about ethics and, in that connection, about the need to develop a new form of ethics which would address the issues raised by the results of the Cartesian scientific vision as it had been presented. Mr El Hadji Ibrahima Sall said that the Cartesian revolution had been so profound that it had changed the way human beings viewed the world and drastically modified the relationship between subject and object, thus giving rise to ethical questions that had to be addressed. Ethics itself was thought to have been changed by Cartesianism. It was necessary, therefore, to exercise the utmost care not to take the *Discourse on Method* as the basis for work on ethics, because ethics would then be merely a simple variation on the Cartesian project which could not claim to guide or underpin the scientific results derived from it. Several speakers expressed concern that science might be exploited for political ends if it was subordinated to politics which, in its turn, was regarded as a legitimate source of morality. History had shown the serious damage wreaked by corrupt scientists and corrupt politicians alike. In the speakers' view, therefore, the answer was not to identify politics with ethics but to establish ethical values that would enable relevant distinctions to be made between corrupt and non-corrupt science and between corrupt and non-corrupt politics. Mr El Hadji Ibrahima Sall said that he was well aware of the serious abuses of science by politicians, in particular under totalitarian regimes. Yet the response to that question was not to do away with political control in order to save science, since the results of science could be beneficial but also dangerous. It was necessary to work upstream to develop public policy based on an ethics of science and technology that promoted the common good. What needed to be done was to establish a blueprint for society under which public regulation of science would mean according priority to putting science and technology at the service of the well-being of the community. The result would be the opposite of the model prevalent in the current context of globalisation where politics, like ethics, was shunted aside by economic power. Mr El Hadji Ibrahima Sall concluded by saying that the extent to which politics should guide and govern science was a delicate issue which merited careful and thorough analysis.

SESSION ON SCIENCE ETHICS, SCIENTIST'S RESPONSIBILITY AND CODE OF CONDUCT

Mrs **Marta Kollárová**, COMEST member and co-chair of the session with Mrs **Margaret Aribiyo Mafe**, Secretary of the National Ethics Committee of Nigeria, opened the debate and introduced the speakers: Mr **El Hadji Issa Sall**, President of the University of Sahel, Dakar, Senegal; Mr **Charles Becker**, researcher at the Centre of African Studies in Paris and lecturer at the Cheikh Anta Diop University, Dakar, Senegal; and Mr **Sang Song-yong**, COMEST member and former professor of history and philosophy of science.

Mr **El Hadji Issa Sall** thanked the organizers for inviting him to take part in the session on the ethics of science and the responsibility of scientists in Africa, a crucial subject that called for debate on how to strike a balance between progress and ethics. Today, the myth that living conditions would continue to improve thanks to science was fiercely disputed and the relationship between ethics and science had become a major issue for all societies, especially in Africa. The West's stranglehold on science and technology, which gave it control over forces of globalisation at the expense of poor countries, the unequal distribution of the benefits of scientific progress, as well as the increasing risk of abuses, were all reasons why drawing up an ethical framework for research should be a priority.

The speaker then turned to the main issues connected with scientists' responsibility and the drafting of codes of conduct for scientists in Africa. The status and situation of researchers raised serious ethical questions. They were subject to severe pressures from their sponsors, which were usually private entities driven mainly by the quest for economic profit. They were isolated because they could not rely on any supervisory ethical bodies or any structures designed to promote open dialogue with society. How, then, was it possible to reconcile freedom of research, its industrial uses, which attracted financial support, the intellectual risks of originality and academic recognition?

Furthermore, the rate of scientific progress was accelerating and its long-term consequences could not be predicted. In that context, scientists not only designed, but also evaluated and participated in projects whose merits they themselves had to assess, while politicians, overwhelmed by the complexity of the modern world, submitted blindly to their opinions. That led the speaker to conclude, in line with Edgar Morin's thinking, that, rather than gagging researchers, it was necessary to monitor those in charge of application, i.e. the decision-makers, who should endeavour to offset science's growing dependence on industry. Science could not be left in its amoral state and politicians needed to act, if ethics was to play a role in science. That was illustrated by three examples particularly relevant to Africa: the ethics of new information and communication technologies, biometrics and toxic waste.

Mr **El Hadji Issa Sall** stressed that the ethics of science and technology should be forward-looking without acting as a brake on science. Moreover, informed public dialogue involving all stakeholders, including the private sector which plays a key role, was needed in order to identify common ethical principles and thus facilitate the drafting of standards or guidelines. He concluded by arguing in favour of a complex philosophy combining science, ethics and politics, in order to break down the barriers which had often separated science and rationalism on the one hand from ethics and subjective humanism on the other. At the present time, only ethics could offer protection from attacks against the individual as a social, autonomous and free actor. Indeed, although some centuries had survived without being ethical, in view of the threats to humanity, the twenty-first century has to be ethical in order to avoid destruction.

During the ensuing debate, one observer commented that one of the main problems with ethics-related work was the ambiguity of the concepts used. He therefore proposed that a distinction be made between two types of science ethics: external ethics, which concerned scientists' social responsibility in terms of the results of their work, and internal ethics, which involved a system of rules designed to organize and coordinate the ethical conduct of scientists. Internal science ethics was particularly vital because scientists, just

like everyone else, were vulnerable to corruption, an ever-increasing danger at a time when science was becoming increasingly commercialised. Furthermore, the complexity and specialized nature of the work done by scientists posed real challenges for those trying to exercise control from outside. By virtue of their expertise, the scientists themselves were therefore in the best position to monitor their work. In order to foster the development of internal scientific ethics, the speaker suggested that a list of principles be drawn up in the form of a code of conduct for scientists and that measures be taken to promote its inclusion in school and university curricula. Another observer wondered about the mutual influence that existed between science and ethics, particularly the effects of feedback. Indeed, ethics evolved in parallel with scientific discoveries. In response, Mr El Hadji Issa Sall confirmed that there was a permanent and dynamic dialectical relationship between science and ethics, characterized by the acceleration of scientific progress on the one hand and a more inclusive system of ethics on the other. It was therefore imperative that scientific ethics should be forward-looking and future-oriented. One participant pointed out that codes of conduct for scientists should take into account researchers' vulnerability, particularly in relation to a social, economic and political environment that, to a large extent, determined their behaviour. In response to another observation concerning the relationship between politics and scientific ethics, Mr El Hadji Issa Sall said that decision-makers should solicit information from a broader range of sources and seek the advice and opinions of experts and the scientific community in general in order to draw up standards for research, including codes of conduct for scientists. Finally, a young researcher highlighted the importance of including the precautionary principle in standard-setting or regulatory instruments in order to avoid extreme positions.

At the invitation of Mrs Marta Kollárová, Mr **Charles Becker** presented a report entitled "Codes of conduct, codes of ethics and the establishment of bodies for the ethics of science and technology in Africa". He particularly emphasized the importance of promoting public debate on the uses of science and technology as a means of building sustainable and transparent relationships among scientists, politicians and society.

He explained from a historical perspective how progress in terms of science ethics and the drafting of codes of conduct was extremely uneven across the world. Africa had barely participated in the international debate on the subject. It found itself in a situation of dependency and inequality, firstly in terms of scientific practice, where little was known about local and traditional expertise, for example; secondly, where the law was concerned, since there were very few legal instruments and regulatory frameworks laying down the responsibilities of researchers and users of the sciences and new technologies; and thirdly, in terms of ethical thinking, which many people still considered to be nothing more than a hindrance to research. Against this background, the first specific regional consultation meeting on codes of conduct for scientists offered a genuine opportunity to stimulate debate on the responsibilities of scientists in Africa and to facilitate the drafting of reference texts governing scientific practice and adapted to Africa's needs and circumstances.

In his view, such reference documents should be the result of the broadest possible debate, covering in particular the scope of the different types of code of conduct, the definition of the role of monitoring bodies responsible for enforcing them, and mechanisms for mobilizing the necessary resources. All stakeholders, including scientists, social science researchers, decision-makers, representatives of civil society and users, should be involved in this process. Moreover, the reference documents for the drafting of codes of conduct should be drawn up at both the international and national level. They could thus take into account the different contexts of scientific development across the world and individual regional situations, which would make it easier for countries and local scientific communities to adapt them to their own needs. The aim would be to promote a framework for exchange that offered a more egalitarian system for developing scientific knowledge in all parts of the world. Mr Charles Becker also mentioned a number of possible places for the creation of bodies to monitor compliance with the standards drawn up, such as already existing ethics committees. He also hoped that, beyond individual invitations, those codes of conduct would give rise to joint discussion initiatives concerning the purposes and principles of scientific research, leading to a more precise definition of the rights, duties and responsibilities of scientists in society.

Finally, Mr Charles Becker said that the lack of training in scientific ethics was a major handicap for Africa and called for firm initiatives such as drawing up an inventory of existing ethics training courses, developing educational programmes and tools and improving university courses. Appropriate training needed to be developed in order to make scientists more aware of their responsibilities and to teach them how to approach ethical issues.

The launching of a public debate on the development of science and technologies with a view to defining priorities collectively and democratically, the adoption of codes of conduct, the creation of mechanisms and bodies to regulate practices and the promotion of ethics training all depended on researchers and politicians agreeing on their priorities and account being taken of society's demands. The ultimate aim was simply to enable Africa to develop laboratories with local research teams, well supplied with resources and capable of setting their own agendas, which would participate fully in the ethical debate and thus contribute to the production and diffusion of knowledge and technologies.

During the discussion following Mr Charles Becker's presentation, the need to make an inventory of science ethics training courses in Africa was emphasized. The shortage or, in many African countries, the complete lack of such courses at school, university and vocational training levels was curbing the development of scientific ethics in Africa. Similarly, the difficulty of disseminating information within the African continent and the linguistic barriers between French- and English-speaking countries were unanimously considered to be major challenges. In that connection, several participants stressed the importance of the meeting for the promotion of exchange between universities, public institutions, professional associations and other African stakeholders. A number of very encouraging initiatives were also mentioned. For example, one participant described the different activities being carried out in Nigeria in relation to science ethics, in particular, the West African Bioethics Training Program, developed in cooperation with the Ministry of Health of the Federal Republic of Nigeria. All the stakeholders were currently involved in developing a code of research ethics reflecting the Nigerian position on the subject. These developments were welcomed by the participants, some of whom stressed the need to ensure that other African countries benefit from these experiences.

It was also noted that codes of conduct for scientists were few in Africa. The need to develop such codes was mentioned and several participants talked about how they should be applied. One speaker noted that the nature of the application mechanisms would depend largely on the actual content of the codes of conduct. Depending on the precise obligations and principles they contained, the codes could be enforced through administrative measures, individual action or joint institutions. A better understanding of the different aspects of ethics, deontology and law was also vital for determining the most appropriate implementation mechanisms. It was also stated that the effective application of the principles enshrined in codes of conduct would mainly depend on states having a genuine political will, particularly in a context where researchers often found themselves in a fragile situation that made them vulnerable to unethical practices such as corruption. Professional bodies and associations would also be required to play a leading role in the implementation of codes of conduct. Several participants agreed that society had a key part to play in disseminating the content of codes of conduct and applying them effectively. Indeed, it was society's responsibility, by designing and creating institutional mechanisms, to ensure respect for the principles contained in codes of conduct in an overall context of collective social responsibility. It was also reiterated that, in order to be effective, application mechanisms should take into account regional and local characteristics, traditions and experience and that frameworks should be set up to ensure that codes of conduct were adopted on the basis of a regional approach. Concerning the content of the codes, one participant pointed out that they should include not only the obligations, but also the rights of researchers, to be respected by politicians, professional associations and society as a whole. Finally, one participant welcomed the distribution, at this session, of the Recommendation on the Status of Scientific Researchers, adopted by the UNESCO General Conference at its 18th session in 1974. Even though it remained extremely relevant, the text, which contained some very interesting provisions on scientific ethics, was hardly known in Africa, particularly by the states, which were ultimately responsible for implementing it.

Mr **Song Sang-yong** explained that since UNESCO's Recommendation on the Status of Scientific Researchers had never been updated since its adoption in 1974,

COMEST had decided to utilize it as a starting point in its reflection on the code of conduct for scientists, particularly with regards to updating the Recommendation to better address contemporary concerns about science. Mr Song Sang-yong then proceeded to elaborate possible areas for further examination and revision, outlined below:

It was observed that the Recommendation is based on the notion of "objectivity" in science. Although a majority of the scientific community still subscribes to this traditional perspective of science, these ideas of scientific neutrality have been severely challenged by the work done in analytic philosophy and sociology of scientific knowledge. Currently, the Recommendation fails to capture this debate about the changing concept of science.

Although the Recommendation's focus on the freedom of science and the rights of scientists is still very important in the current context, it does not capture the expansion of the overall dialogue to include the responsibility and ethics of science.

It was further pointed out that even as the Cartesian distinction between humans and animals is increasingly questioned today, the Recommendation still takes a very anthropocentric approach to environmental problems. Moreover, the Recommendation does not presently incorporate the concept of sustainable development.

The Recommendation should also be examined in light of recent developments such as the rise of bioethics as a priority considering the rapid advancements of bioscience and biotechnology; ongoing concerns about the relationship between scientific research and military applications, especially with regard to bacteriological warfare and bioterrorism; the need for new ethics appropriate in an era of global interconnectedness due to the digital revolution; the application of the Precautionary Principle as part of the ethics of emerging technologies; and the recent problems of scientific misconduct and fraud. Furthermore, the Recommendation is silent on the gender imbalance within the practice of science, and the exclusion of ethnic minorities and disadvantaged groups.

Finally, Mr Song Sang-yong observed that cooperation with the humanities and social science is indispensable when attempting to solve the complex problems faced by science today. In order to promote a well-balanced view of science, ethics of science needs to be included in all levels of science education. As such, ethics education is one of the priority areas for COMEST.

During the debate chaired by Mrs Margaret Aribiyo Mafe, the participants discussed the dissemination, distribution and application of the recommendations and declarations adopted at international level in relation to ethics of science and technology, as well as existing codes of conduct. One participant considered it vital to set up institutionalised monitoring and discussion bodies as part of any standard-setting process in the area of ethics of science and technology. Several participants regretted that the Recommendation on the Status of Scientific Researchers, adopted in 1974, and the Declaration on Science and the Use of Scientific Knowledge, adopted in 1999, which were considered fundamental texts in ethics of science and technology, were largely unknown, especially in Africa. Some participants thought that the dissemination of those texts, not only to experts and professionals but also to society as a whole, remained a huge challenge that needed to be addressed even before any steps are taken to draw up new codes of conduct. Otherwise, those new instruments, although necessary, might also be insufficiently known and applied rarely or not at all. Mr Song Sang-yong described UNESCO's efforts to disseminate those texts through, inter alia, the "Ethics around the World" programme of rotating conferences and regional consultations on scientific ethics. He admitted that these efforts would need to be stepped up and stressed the usefulness of regional consultations as an effective means of disseminating that type of information to the scientific community and professional associations linked to research. Mrs Margaret Aribiyo Mafe pointed out in her closing speech that the purpose of science ethics and codes of conduct was to help rebuild society's confidence in the integrity of science, to prevent abuses and to reduce the risk of practices harmful to the environment and humankind. To be effective, codes of conduct would need to be developed on a participatory basis and their content should be easy for everyone to understand. Special effort would be required to raise awareness and disseminate the content of the codes, and specific monitoring mechanisms would need to be devised and implemented. Reiterating the importance of awareness-raising, Mrs Margaret Aribiyo Mafe asked the

participants at the Fifth Session of COMEST to act as agents of change in their respective countries. Finally, she hoped that this session would generate proposals for action and practical initiatives that could be implemented as part of follow-up to the session.

SESSION ON TEACHING OF ETHICS OF SCIENCE AND TECHNOLOGY

Mrs **Aminata Cissé Diaw**, Professor of Philosophy at Cheikh Anta Diop University in Dakar, Senegal, and Mr **Sang Song-yong**, COMEST member and former Professor of History and Philosophy of Science, co-chaired the session and presented the speakers: Mr Ruben Apressyan, Professor of Philosophy at Moscow University and Director of the Ethics Sector of the Institute of Philosophy, Russian Academy of Sciences, Federation of Russia; Mr Clifford Tagoe, Professor and Vice-Chancellor of Lagon University in Accra, Ghana; and Mr Kwami Christophe Dikenou, Professor of Philosophy at Lomé University, Togo.

Mrs **Aminata Cissé Diaw** started her preliminary allocution by citing Edgar Morin: "Science increases the power of technologies which bear fabulous promises but also threats of annihilation and subjection [...]". She continued citing Edgar Morin: "science remains blind on itself, it understands neither the causes nor the consequences of its action, it lacks the principle that rendered it able to reflect on itself, to find itself at the anthropological, sociological, historical, logical and moral levels". The key issue raised today is therefore the following: How to consciously watch over science and technology? In the eyes of Mrs Aminata Cissé Diaw, teaching of ethics of science and technology would be one of the main means of bringing the required elements and competences not only to the experts, but also to citizens, in order to establish a real "ethics of discussion". According to her, it is on this basis that the collective responsibility of the entire society could be exercised.

Mr **Ruben Apressyan** emphasized that a fundamental course in ethics education should include basic understandings and skills in morality, expanding to address the students' ethical development towards their future profession at the higher education level. As such, the content of ethics education should encompass elements of moral or character development, social sciences and the humanities, philosophy, and professional education. It was pointed out that due to unique ethical aspects of professional activities that are often not evident for the common moral consciousness, ethics teaching in professional education contributes significantly towards social sustainability.

Through the Ethics Education Programme (EEP), UNESCO is working towards strengthening and expanding ethics teaching for science and technology professional education. In COMEST's report *The Teaching of Ethics*, it was asserted that ethics education should aim to develop a student's ability in recognizing and analysing ethical issues so as to reach decisions on how to act ethically. It was pointed out that in various complex professional activities involving diverse stakeholders, use of natural resources and environmental impacts, moral intuition is deemed insufficient, and a broader ethical awareness and responsibility is necessary. This can only be achieved through special reflection based on knowledge, understanding and critical thinking, especially in science and technology.

In this context, UNESCO has convened an advisory committee comprising ethics teaching experts from different parts of the world for the purpose of developing a core curriculum in bioethics. The core curriculum utilizes a novel approach to the teaching of bioethics by structuring its content around the principles of UNESCO's Universal Declaration on Bioethics and Human Rights. Through the bioethics core curriculum, students should be able to apply the principles of the Declaration; to recognize an ethical issue; to reason about ethical issues; to justify ethical decisions; and to implement ethical principles in medical practice. Traditional bioethics principles and problems are incorporated into the curriculum, and explained according to the principles of the Declaration. This approach allows for the core curriculum to be developed in the form of guidelines for professional behaviour instead of a sum of knowledge applicable in practice. In this way, students are trained on ethically competent professional behaviour rather than to a double (separate) competence of professional and ethical behaviours, as has been criticized of the traditional approach to bioethics teaching specifically, and applied ethics teaching in general.

Mr Ruben Apressyan asserted that this approach is an appropriate way for both professional and moral education, especially in the teaching of ethics of science and technology.

During the discussion that followed the presentation of Mr Ruben Apressyan, it was asserted that the development of ethics teaching was a priority for Africa, which suffers from a serious deficiency of qualified professionals and of training and research programmes in this field. The work developed by UNESCO was appreciated, in particular the 2003 COMEST report on *The Teaching of Ethics,* and the efforts to elaborate, with a consultative committee of experts, a core curriculum for bioethics teaching on the basis of the 2005 Universal Declaration on Bioethics and Human Rights. A call was made to expand this exercise to other fields such as environmental ethics and science ethics. Moreover, it was pointed out that UNESCO should develop a core curriculum with a universal scope on these subjects and then collaborate with local partners to adapt it to the regional level, taking into account the cultural and traditional particularities. However, it was also recalled that the principles set forth in the Universal Declaration on Bioethics and Human Rights have a universal scope and at this stage, focus should be put on the forms of application of these principles at the local level, as well as of the bioethics core curriculum that was built around the Declaration.

Concerning the teaching methods of ethics of science and technology, several participants underlined the need to encourage not only formal education but also new forms of informal education. This is supported by the fact that ethical values are integrated mainly within the framework of social education. It was noted that in a large number of regions of the world, ethics teaching received by students at schools or at universities is in contradiction with the practice that they observe in society, thus making the work of teachers particularly difficult. In such cases, it was asserted that priority should be given to eliminating these harmful practices and to ensuring the effective application of fundamental ethical principles. It was also observed that due to the nature of ethics, whilst professors could be hopeful with regard to the beneficial effects of their lectures, they could not be certain of this. Therefore, contributing to the development of a social education promoting ethics fell within their competence as citizens, not as professors. Furthermore, in the COMEST report on *The Teaching of Ethics*, it was affirmed that the work of UNESCO would be oriented, at least at the first stage, on university education. It was therefore preferable to limit the discussion to this subject.

The need to privilege discussion, teamwork and the analysis of case studies within the framework of ethics teaching was also underlined. Mr Ruben Apressyan explained that UNESCO chose this approach in developing the core curriculum on bioethics. The final objective of ethics is to guide an individual in responsible behaviour. Therefore, its teaching could not merely be the transmission of a truth. It requires discussion, exchange and rational reflection. In this regard, the importance of not confining oneself only or mainly to tradition or moral intuition within the framework of ethics teaching was noted, and reflection and rational analysis which are essential when facing the many professional and personal ethical challenges should be promoted. Finally, some participants indicated that special attention should be given to the media, especially its crucial role in the field of awareness-raising.

Mr **Clifford Tagoe** emphasized that since less than 2% of global research output comes from Africa, and in light of the persistence of poverty, strife and disease throughout the continent, Africa is particularly vulnerable to scientific abuse, making the issue of ethics of science a very important consideration. Mr Clifford Tagoe pointed to the insufficiently developed bioethical aspects of HIV/AIDS research carried out in Africa, especially with regard to ethically deficient research procedures and conduct, and research objectives that do not address the needs of the local population, as examples of the pressing need for better ethical reflection in scientific research and development on the continent. Furthermore, with ongoing efforts by the international community to strengthen Africa's scientific research and teaching capacities in its institutions of higher learning, there is an urgent and parallel need to train young African scientists in the ethics of scientific research, with particular emphasis on their social and environmental responsibilities.

It was also pointed out that although professional ethics is included in the curricula for health professions, it is highly doubtful that this is the case for other science professions in Africa. In addition, bioethics

teaching has not been integrated into Africa's education programme for health professionals to the extent within developed countries, and is often manifested as occasional lectures and symposia.

In order to stimulate the growth of ethics education in Africa, firm political commitment at the highest levels is needed to legislate on ethical issues as required; to establish or strengthen existing ethical review processes and ethics committees; and to provide the necessary information and communication technology infrastructure for the teaching of ethics of science and technology. Furthermore, a critical mass of trainers must be trained, including the re-tooling of existing faculty members with expertise in science ethics and bioethics. It was also suggested that a multidisciplinary core curriculum covering the history and philosophy of science, as well as various principles pertinent to the practice of science should be introduced. The teaching of professional ethics in the health professions should be strengthened and expanded to cover the principles outlined in UNESCO's Universal Declaration on Bioethics and Human Rights. The teaching of professional ethics should also be extended to other science professions in Africa.

It was further emphasized that the teaching of ethics of science and technology should commence at the secondary education level through to the post-doctoral level. Ethics education in Africa must recognize and incorporate the diverse cultural values of the continent. Sub-regional, South-South and North-South collaborations are critical for the development of science ethics and bioethics in Africa. Finally, it was asserted that UNESCO and WHO have critical roles to play in the development of ethics teaching within the African context.

The discussion that followed Mr Clifford Tagoe's presentation was opened with concerns about the state of Africa's traditional knowledge. Much of this knowledge, which includes fundamental incidences in the field of ethics, will disappear if scientific research is not developed in areas such as the traditional pharmacopoeia. It was also observed that teaching programmes should be translated into local languages in order to facilitate their dissemination, and to encourage the teaching of ethics of science and technology to the holders of traditional knowledge and isolated or illiterate populations. It was also proposed that teaching programmes should be promoted among members of national ethics committees as they are appropriately positioned to raise awareness amongst the various local agents. Mrs Nouzha Guessous-Idrissi, ex-officio member of COMEST and Chairperson of the International Bioethics Committee (IBC), recalled that the bioethics teaching programme developed by UNESCO will be addressed specifically to students in medicine. Whilst indicating that the target audience could be progressively expanded, she asked the participants if it is necessary to develop a specific African curriculum in the field of bioethics or if a general framework of training illustrated and supplemented by local specificities would be sufficient. Participants affirmed that it was important to coordinate efforts and to build on what had been elaborated in the field of ethics of science and technology. They were in favour of the elaboration of a general framework which could be adapted to African factors and finalized by African universities at the application stage. It was pointed out that it would be desirable to promote the teaching of ethical and civic values starting from primary school in cooperation with Ministries of Education. The difficulty of reconciling the theory with daily practice in order to strike an appropriate balance that governs individual behaviour in different cultures was also underlined. It was indicated that the levelling of cultures should be avoided and that cultural diversity and identity should be protected. To this end, respect for traditional knowledge and for traditional approaches to knowledge should constitute a basic element of education. It was also emphasized that the perception of right and wrong was not naturally evident but should be built. It was concluded that this challenge needed to be addressed in order to find solutions to the major issues at stake.

Mr **Kwami Christophe Dikenou** presented on the theme "Promotion of diversity in teaching the ethics of science and technology". On the basis of the 2003 COMEST report on *The Teaching of Ethics*, he proposed several ideas on how teaching content and methods, as well as research in the field of ethics of science and technology, could reflect the cultural diversity and traditional differences within the African university context.

Noting that existing problems related to the management and protection of the environment are crucial for the sustainable development of Africa, Mr Kwami Christophe Dikenou emphasized that environmental ethics should be a priority when elaborating the content of ethics of science and technology. He then examined in a more detailed manner ethics issues raised by the management and protection of the environment in seven main fields: biodiversity, forests, fresh water, land, coastal and sea environment, urban environment and the atmosphere. He suggested that UNESCO should look into the elaboration of a universal declaration on environmental ethics.

Concerning the methods of ethics teaching, Mr Kwami Christophe Dikenou reiterated the virtues of deliberation to create a reflective morality as opposed to an imposed morality. He specified that the development of a critical and creative mind was particularly important within the African context in order to allow students to acquire a critical perspective free from the moral benchmarks dictated by their culture and to be open to universal values. In instances when Africa transmitted its moral principles, it was often based on indoctrination, respect for tradition and a wide spectrum of emotions. Therefore, Mr Kwami Christophe Dikenou noted that ethics teaching should avoid paternalistic indoctrination which would not cultivate a critical spirit when confronted with cultural and traditional diversities, and cultural relativism which would corrupt interculturality and prevent the acceptance of universal humanity.

Mr Kwami Christophe Dikenou explained that it is precisely thanks to this exercise of critical and creative thinking that local environmental ethics could be developed with objectivity within the framework of cultural diversity. He also suggested that interdependence be included among the possible founding principles of this ethics, which calls for a holistic vision of things and the aesthetical value of nature.

Finally, Mr Kwami Christophe Dikenou hoped that UNESCO's action in the field of capacity-building in Africa will contribute to filling in the lack of qualified teachers and educative resources in the field of ethics of science and technology. In this regard, he suggested that UNESCO reinforce its collaboration with international, regional and national organizations such as the Association of African Universities, the United Nations University Institute for Natural Resources in Africa (UNU-INRA), and the Francophone University Agency. Mr Kwami Christophe Dikenou concluded his intervention with an African proverb that states: *"Knowledge is similar to a baobab trunk. Both arms of an individual cannot surround it. Several are needed"*. He expressed the wish that, within the framework of constructive discussions, this meeting might allow for the identification of the best ways to teach ethics of science and technology which respect the diversity and pluralism, taking into account the real concerns of societies and Member States of UNESCO.

In the ensuing discussion, many participants expressed their agreement that environmental ethics, in particular the ethical issues linked to fresh water management, should be a priority for Africa. In this regard, an interest was expressed concerning the possibility for UNESCO to develop a teaching programme framework in this field. However, some participants questioned the relevance of elaborating a curriculum on the basis of a specific African approach. It was also suggested that this work be developed in consultation with the United Nations Environment Programme (UNEP).

It was pointed out that the value of scientific societies and associations' role in the teaching of and awareness-raising in ethics of science and technology should be increased and developed in Africa. It was suggested to describe the state of the art of these structures as privileged frameworks of exchange and discussion. Moreover, the difficulty of decision-makers to make ethical decisions when they are not popular was pointed out, raising reservations about the capacity of decision-makers to act ethically. In response to this intervention, Mr Kwami Christophe Dikenou said that he believed that each decision-maker could make ethical and responsible decisions if she/he was trained in ethics. In order for a decision to be considered fair, prior reflection and comprehension of the situation and values at stake are required. He recalled that there is no catalogue of rights and obligations in ethics which could be applied systematically.

According to a professor of philosophy attending the discussion, it was possible to teach and learn a "moral language". Although it is a very complex task

due to the absence of tools such as grammar, some combination of words would be acceptable in ethics and others would not. It is therefore very important to understand and learn the meaning of the words of this "moral language" in order to be able to communicate and use ethical values and principles in a rational manner. The professor explained that it is mainly through the exchange of views, discussion and the analysis of practical examples that this training can be realized. Many participants recognized that discussion and debate were essential to the construction of ethics. Finally, the professor recalled that science and technology nowadays have a global impact, and therefore, it is indispensable to think in a global manner when making a rational moral decision related to a local problem.

Concerns about the definition of more appropriate pedagogical methods in the teaching of ethics of science and technology were also raised. Several participants from very different regions of the world noted that the lack of a deliberation culture, which was evoked by Mr Kwami Christophe Dikenou in his presentation, is a widespread and generalized phenomenon across the world. Teachers in ethics should foster the development of the critical mind and promote a non-submissive attitude to the dominant thought.

Several participants reaffirmed the importance of traditional knowledge and welcomed the progressive awareness of the scientific community in this field. It was emphasized that some issues should be raised concerning traditional knowledge, in particular with regard to the most appropriate type of ethics teaching for the holders of this knowledge, so as to foster an awareness of their rights, obligations and responsibilities. It was underlined that within the framework of agricultural policy, the label of origin and geographical denominations are efficient means to protect traditional knowledge, to ensure the responsibility of holders of this knowledge, and to monitor the quality of the product delivered. Furthermore, the question of finding a balance between tradition and universalism was raised, and the assertion that assessing tradition in the light of universal values does not question cultural diversity was affirmed. It was argued that tradition should not be considered sacred and unquestionable, particularly since questioning was needed to assess the beneficial effects of traditional knowledge. Mr Kwami Christophe Dikenou supported this position and affirmed that traditional knowledge should be protected using a critical and creative approach. However, disagreement was voiced concerning the idea that African traditions would constitute an obstacle to critical evaluation of the dominant thought, and the possibility of using the African palaver as a means of fostering the confrontation of different points of view in order to reach consensus was proposed. Mr Kwami Christophe Dikenou pointed out that it was generally recognized that some African societies currently do not allow for expression of ideas that are against the opinions of relevant authorities and wondered whether it was really possible to compare the African palaver with the principle of democratic equality. Finally he affirmed that a better dissemination of the work developed on ethics teaching within the African academic circle was needed.

SESSION ON ENVIRONMENTAL ETHICS AND THE QUESTION OF TOXIC WASTE IN AFRICA

Mr **Pierre Sané**, Assistant Director-General for Social and Human Sciences of UNESCO, and Mrs **Nadja Tollemache**, COMEST member and former Chair of the Health Research Council of New Zealand Ethics Committee, co-chaired the session and introduced the speakers: Mr **Johan Hattingh**, COMEST member, Professor of Philosophy specializing in applied ethics and Head of the Environmental Ethics Unit at Stellenbosch University, South Africa; and Mrs **Yveline Houenou-Agbo**, Doctor in the Department of Medical Sciences, Cocody University, Abidjan, Ivory Coast.

Mr **Johan Hattingh** explained that environmental ethics emerged as an academic field primarily during the 1970s, in response to concerns about the depletion and destruction of resources experienced in industrialized countries. First-generation environmental problems defined during this period were single-point problems such as a source of pollution or the exhaustion of resources. This concept eventually evolved into second-generation environmental problems that are systemic, interconnected and regional, stemming from multiple causes and resulting in multiple impacts on the ecosystem. Finally, third-generation environmental problems are defined as small decisions made by people in the present that will generate disastrous effects in the future, impacting large numbers of people spread over vast geographical areas. These are global problems that affect the biosphere, and typically suffered by people who may not have lived during the period of causation.

Mr Johan Hattingh also elaborated three theoretical debates underlying the evolution of environmental ethics. The first debate revolves around the tension between anthropocentrism and biocentrism, particularly whether it is appropriate to extend human ethics to non-human entities such as plants and animals, and whether the alternative of a nature-centred ethics would undervalue and neglect the needs of humans. The second theoretical debate questions whether the instrumental value theory, in which the environment is assessed in terms of its use-value to humans, should be replaced with an intrinsic value theory, in which non-human entities are valued for their own sake regardless of use-value to humans. The third line of inquiry highlights the tension between environmental ethics as theory and as practice, raising doubts about the accessibility of unsettled and continually changing theoretical concepts in practical environmental management, while questioning the appropriateness of environmental protection without informed value positions. It was recognized that there are no final conclusions to these debates, and there is a need for continuous critical reflection on the values guiding our interaction with our environment, and on the nature, meaning, scope and effects of adopting and applying a certain set of values.

It was further pointed out that environmental problems are embedded within a specific place and time in history. Place and time can be conceptualised according to the following scales: consumer scale (from zero to five years), socio-cultural scale (from zero to 200 years), and geological scale (from zero to infinity). As such, our actions occur simultaneously in these scales, and we should strive to only do that which makes sense in a multiplicity of place and time scales.

The African circumstance is shaped by the devastating effects of colonialism, the exploitative practices of the post-colonial era, internal differences and strife, the HIV/AIDS pandemic, and the vast deposits of renewable and non-renewable natural and human resources. Within this context, it is evident that the continent is still facing the challenges of unsustainable development and environmental injustice. At this point, Mr Johan Hattingh noted that sustainable development has been defined with the qualifications that the needs of the poor should receive priority in the satisfaction of needs, and that the state of science and technology, and social organization, are the primary limitations on levels of needs satisfaction (instead of the carrying capacity of nature).

When considering Africa's environmental problems against the continent's backdrop and the concept of sustainable living, it is evident that environmental ethics must address both the conservation of nature and the agenda of development for poverty alleviation

as both these issues are intertwined. When examining environmental ethics from the African perspective, it was asserted that there is a need to find intellectual resources on the basis of which current patterns of unfair distribution, environmental injustices and unsustainable development can be identified, questioned and challenged. Finally, Mr Johan Hattingh outlined ongoing efforts by COMEST to formulate an advice on environmental ethics to the Director General of UNESCO, based on the following six points of departure: respect for all life, human and non-human; respect for biodiversity; safeguarding the sustainability of the biosphere; environmental justice; precautionary principle; and the principle of the earth as global commons. Participants were encouraged to provide input on the concerns, aspirations, and suggested actions for Africa in this respect.

Mrs **Yveline Houenou-Agbo** presented on the question of toxic waste in Africa. She briefly introduced the dramatic events that occurred in the Ivory Coast on 20 August 2006 when a Dutch company dumped toxic waste at various sites around Abidjan with the agreement of Ivory Coast authorities, which resulted in serious environmental, social and political consequences. On the basis of this example, Mrs Yveline Houenou-Agbo highlighted the problem of dangerous waste management and the shipment of such waste to poor countries. She underlined that in the present context, the reflection on environmental ethics was directly linked to the determination of the role of international organizations, the application of conventions and declarations related to the preservation of the environment, as well as to the definition of the responsibilities of local and national authorities.

In order to address the scale and complexity of toxic waste trafficking between rich countries and poor countries, environmental deterioration in Africa due to poverty, lack of access to safe water, as well as global problems faced by the continent such as greenhouse gases, climate change and deforestation, the international community has proposed numerous development programmes, conventions, protocols and recommendations. In this regard, Mrs Yveline Houenou-Agbo mentioned actions such as the New Partnership for Africa (NEPAD), the 1989 Convention of Basel on Toxic Waste, the 1991 Convention of Bamako and the 1969 African Convention on the Conservation of Nature and Natural Resources. However, in her opinion, these normative instruments remain largely ineffective because of the low number of ratifying parties, the absence of implementation monitoring and insufficient dissemination. Moreover, the intrinsic moral values of right and obligation, justice and dignity, solidarity and sharing, and search for peace and prosperity for all have not been sufficiently taken into account within the framework of those normative texts.

Mrs Yveline Houenou-Agbo pointed out that new approaches to the solution are being developed on the African continent at the same time, particularly in the field of research and education. Thus, the new global initiative to reinforce the links between health and environment (HELI) enabled the elaboration of a new decision-making mechanism connecting decision-makers and researchers. Another example is the ecosystem and human health approach (AES) which is based on the principles of transdisciplinarity, participation and equity, and explores existing relationships between the different components of a given ecosystem for the purpose of defining and evaluating the priority determinants of human health and the sustainability of the ecosystems, whilst privileging local knowledge and the role of the community. This approach, which is illustrated by the Buyo case in the Ivory Coast, promotes the values of governance, respect, equity, solidarity, dedication and humility. It fosters the self-promotion of health care within the local population and reinforces social cohesion. Concerning education for sustainable development, Mrs Yveline Houenou-Agbo highlighted the Mainstreaming Environment and Sustainability into African Universities (MESA) programme, which aims to raise awareness of African universities on their leadership role in this field. She also pointed to the IDRC training project on research and community intervention in the management of household waste within urban and suburban areas in Western and Central Africa. Mrs Yveline Houenou-Agbo concluded her intervention by emphasizing the need to promote individual and collective awareness-raising of the key role of environmental ethics in the sustainable development of Africa.

The ensuing discussion focused firstly on the Abidjan toxic waste dumping case. More details were requested from Mrs Yveline Houenou-Agbo concerning the immediate response and follow-up provided by local authorities, the tests carried out on

the various population groups affected, the level of compensation given, and the procedures employed in the treatment of the contaminated areas. With regard to the total direct and indirect costs of treating the waste dumped in Abidjan, a participant indicated that estimates were about 30 billion euros. In spite of contributions from the international community, the people of Ivory Coast are still bearing the bulk of the clean-up costs. Moreover, several participants expressed their indignation at the impunity of the persons in the Ivory Coast who authorized the dumping of the toxic waste.

It was suggested that an exhaustive state-of-the-art for Africa on the management of both internal and external waste be established. It was also highly recommended that the application of existing national and international normative instruments be reinforced, that sufficiently dissuasive sanctions for companies and countries that send their waste overseas illegally be enacted, and that watchdogs and observatories at national, regional and international levels be created.

It was observed that a series of ecological disasters around the world have fostered the development of a real global consciousness that calls for the deepening of responsibilities in this area, better regulations and more efficient monitoring at all levels in order to ensure that these terrible situations will never happen again. It was emphasized that UNESCO should heed this movement within public opinion and place environmental ethics firmly on the international political agenda. Mr Johan Hattingh proposed that an anticipatory approach be taken by reviewing all the elements that have led to the situations to be avoided in the future so that an ethics of prevention can be created. The tendency is to function on the basis of reactive ethics that tries to repair the impacts on the environment without really dealing with the underlying causes.

Good governance and the development of collective and individual responsibility of politicians, researchers and the entire population in the field of environmental ethics were identified as major challenges. Based on the experiences of the participants, recurring questions in Africa include the absence of ecological impact studies; the lack of dialogue between politicians, researchers and society; the insufficient participation of affected local populations in decision-making; and the lack of consideration given to local scientists who are often better versed with the environmental challenges in their regions than their foreign counterparts. In this regard, the case of the foreign constructed bridge in Saint-Louis (Senegal) that seriously affected local agriculture was discussed.

The teaching of and capacity building in environmental ethics were identified as areas of priority action. Concerning pedagogical methods and methods of ethical reflection, it was recommended that preference be given to case studies, identification of good practices and reflection on local projects that have produced beneficial results. Raising public awareness, particularly of the most isolated or marginalized populations, was also considered essential for the development of collective and individual responsibility. In this regard, it was recommended that raising awareness about environmental ethics should start from an early age, and the dissemination of such messages and information in the media should be promoted.

Moreover, the effective application of local and international norms concerning the protection of the environment remains a major problem. Participants were particularly concerned about the low ratification level of international conventions and declarations, the absence of transposition into national law, and the absence of environmental norms issued at national level. It was proposed that an international declaration on environmental ethics in the form of a code of conduct for States as well as an international watchdog to monitor its application be formed. Better dissemination and comprehension of existing normative instruments is also needed to promote their implementation. Mr Johan Hattingh recalled that in the context of major crises such as desertification, access to fresh water and pollution, ethics as a form of reflection and analysis of the problematic can contribute to the identification of criteria for distinguishing appropriate behaviours from the environmental point of view.

With regard to the principles, values and examples on which ethics should be based in responding to Africa's environmental problems, several participants evoked the "polluter pays" principle, as well as the principles of collective and individual responsibility and of good governance. Likewise, it was

underlined that a better articulation of the principles of environmental ethics and further reflection on its application is highly desirable.

Mr Johan Hattingh thanked the participants for their rich contributions and specified that COMEST will duly take into account their recommendations for international action in environmental ethics.

SESSION ON INTERACTIONS BETWEEN BIODIVERSITY, GENETICALLY MODIFIED ORGANISMS (GMOs) AND BIOTECHNOLOGY: AFRICAN PERSPECTIVES

The session was co-chaired by Mr **Amadou Tidiane Ba,** Director of the Institute for Environmental Sciences and Professor at Cheikh Anta Diop University, Dakar, Senegal, and Mr **Khalid Abdulla Al-Ali**, COMEST member, Professor of Human Genetics and Director of the Foundation Unit at Qatar University, Qatar.

Mr **Jeremy Ouedraogo**, Geneticist at the Institute of Environmental and Agricultural Research, Ouagadougou, Burkina Faso, made a presentation on the African perspectives with regard to the interactions between biodiversity, genetically modified organisms (GMOs) and biotechnology, in which he argued that biotechnology and biodiversity are not necessarily in opposition. In his opinion, biotechnology can contribute to limiting the deterioration of natural habitats, and to foster a more sustainable use of biodiversity while addressing the challenges related to agriculture production on the African continent. These technologies should be carefully employed and each application must be subjected to rigorous and scientific biosafety assessment beforehand. Mr Jeremy Ouedraogo said that Africa will be able to generate such research which is essential to informed decision-making, if existing capacities are recognized, developed, reinforced and focused around research projects and risk assessment projects at a regional level.

Mr Jeremy Ouedraogo then highlighted the main challenges that the use of GMOs, and more generally of biotechnology, raises for African countries and proposed elements of reflection for meeting these challenges. In order to ensure that the use of GMOs does not deepen the dependence of farmers on external interests, the setting up of competent biosafety structures and strengthening of capacities linked to the control of the African genetic heritage and protection of intellectual property were considered essential. As such, the weakness of current African capacities to prevent unwanted effects due to uncontrolled dissemination of GMOs was raised. In this regard, Mr Jeremy Ouedraogo lamented the lack of an African strategy in the field of biotechnology and biosafety, the insufficient allocation of financial and human resources, as well as the absence of appropriate regulations and normative harmonization at a regional level. He also deplored Africa's disadvantage in international trade and related negotiations, as well as the poverty of information provided to the general public about biotechnology. Mr Jeremy Ouedraogo emphasized that Africa should urgently focus on filling in these serious gaps so that the potential of new technologies can be exploited while ensuring environmental protection.

Mrs **Ourèye Sy**, Doctor at the Department of Vegetal Biology, Cheikh Anta Diop University, Dakar, Senegal, asserted that the advent of biotechnology could contribute to solving some of Africa's main problems such as increasing food demand, malnutrition and under-nourishment. She also specified that the use of GMOs raised a number of questions of scientific, economic, social and ethical nature that should be dealt with urgently.

Mrs Ourèye Sy outlined the various possible applications of biotechnology for agricultural development, pointing out both positive and negative aspects. In terms of the possible dangers related to the use of GMOs in Africa, she referred to environmental and agricultural risks such as the uncontrolled dissemination of genetically modified plants and abandonment of local food crops. She also looked into socio-economic risks, particularly on the patenting of living beings, food autonomy, the erosion of the social fabric, vanishing local know-how, and changing food habits. With regard to the increasing power of some agro-chemical multinationals deemed to be a threat to the independence of farmers and local decision-makers, Mrs Ourèye Sy contested the contracts of exclusivity brought by multinationals on plants or animals belonging to the world's heritage and condemned the growing risk of economic neo-colonialism. However, these difficult and important

issues should not eclipse the potential benefits of biotechnology for the African continent if deployed using the precautionary principle. Biotechnology should be approached from a new perspective and research aimed at solving problems relevant to developing countries should be encouraged. Moreover, Africa should be equipped with the means to preserve and exploit its biological reservoirs, and to ensure the traceability of genetically modified organisms.

The elaboration of norms at the international, regional and national levels within the present context was underlined as essential. The 1992 Convention on Biological Diversity and the 2000 Cartagena Protocol on Biosafety constitute important steps forward. However, the debate on GMOs and biosafety has only recently appeared within regional organizations such as the Economic Community of West African States (ECOWAS) and the Western African Economic and Monetary Union (UEMOA), and the majority of African countries still do not have the required infrastructures, equipment and qualified professionals to evaluate and manage the risks related to the use of biotechnology. Likewise, despite the elaboration of regulation models within regional organizations and the launch of international programmes supporting the development of national frameworks in biosafety, none of the countries within the sub-region, except Burkina Faso, have adopted operational legislation. Mrs Ourèye Sy concluded her intervention by indicating that it is essential to define regulations in the field of biosafety that will promote ethical practices. Furthermore, it is also crucial to assess the risks associated with biotechnological products and to introduce mechanisms to control their use.

Mr Amadou Tidiane Ba, who is also the President of the National Committee on Biosafety of Senegal, opened the subsequent discussion by underlining the excellent quality of the presentations, but stated that in his opinion they have not dealt sufficiently with the disadvantages and possible dangers that biotechnology might cause. As a member of the Biosafety Expert Committee set up by the African Union, he outlined the work carried out by this body in promoting the harmonization of regulations and the elaboration of a regional framework that will allow biotechnology to be used safely. Finally, Mr Amadou Tidiane Ba informed the participants that the government of Senegal is presently studying a preliminary draft law on the production and use of GMOs in Senegal.

During the discussion, participants underscored the need to promote public awareness raising and information on the challenges and applications of GMOs. In this regard, it was pointed out that special efforts should be deployed to inform farmers and producers in an appropriate way in order to avoid past mistakes caused by insufficient consideration of their needs and experiences, for example within the context of the "green revolution".

It was asserted that the lack of information about actions of big companies who control the GMO market should be solved. It was also unanimously recognized that information and awareness-raising are essential elements for a real discussion involving the whole society and for enabling informed choices. In this regard, Mr Jeremy Ouedraogo recalled that Africa suffered from a flagrant lack of GMO information structures that should be solved urgently. He highlighted the case of Burkina Faso, where the first experimentations on Bt cotton in 2003 had been preceded by four years of work within an inter-ministerial commission and a series of meetings with associations of producers. Nevertheless, a lot remains to be done to inform the entire society so that it is able to participate effectively in decision-making concerning GMOs. In order to remedy this situation, a national agency was recently established in Burkina Faso.

Furthermore, it was pointed out that the issues concerning the traceability and labelling of products containing GMOs were not yet resolved in spite of their importance in enabling consumers to make fully informed choices.

Participants further agreed on the urgency of developing training for and strengthening the capacities of African specialists in biotechnology, as well as better utilization of existing local competencies, especially in internatinal negotiations. In this regard, an appeal for support was made to the relevant international organizations. It was also pointed out that the value of African biodiversity could be improved using biotechnology, for example in the identification of species.

Several participants shared the view that biotechnology, which encompasses a vast set of applications, constitutes a good tool for the development of Africa. This is the reason why it is important to differentiate between GMOs and biotechnology in order to prevent the fear associated with GMOs from creating a slowdown in biotechnology research. Following this line of thought, Mrs Ourèye Sy indicated that priority should be given to the conception, consultation and implementation of appropriate regulatory frameworks at the Pan-African level, which will regulate biotechnology research, particularly the production and development of GMOs.

The risk of Africa becoming increasingly dependent on foreign entities with the adoption of GMOs was also highlighted. In this regard, Mr Jeremy Ouedraogo recalled the importance of developing capacities in the technical aspects of biotechnology, and explained that in the Bt cotton case of Burkina Faso, the government would decide on possible commercialisation once the current experimentations are completed, and such commercialisation would be carried out through a national production system. A prior negotiation, which will duly take into account the interests of national producers, would define the prices and advantages.

Finally, several interventions emphasized the importance of holding this kind of meetings on the issue of GMOs, a subject that has caused concern for African countries, requiring caution when addressing the challenges created.

FORUM OF YOUNG AFRICAN RESEARCHERS ON THE SOCIAL RESPONSIBILITY OF RESEARCHERS IN AFRICA

Mr Pierre Sané, Assistant Director-General for Social and Human Sciences of UNESCO, chaired the morning session of the Forum of Young African Researchers which gathered young researchers in basic sciences and social sciences from Benin, Burkina Faso, Cameroon, Congo, Gambia, Guinea Bissau, Mozambique, Nigeria, Rwanda, Senegal and South Africa. Mr Pierre Sané emphasized the importance given by UNESCO to this Forum which has been held on a regular basis since 2003 within the framework of the ordinary sessions of COMEST. The Forum aims at allowing young researchers of the region to meet and exchange views and experiences on ethical challenges that they face in the development of their work with COMEST members and eminent experts. The results of this meeting will facilitate better approaches to the issue of social responsibility of young researchers in Africa, and enrich the work carried out by UNESCO and COMEST to promote a more efficient and responsible use of science.

Mrs **Mariama Diallo**, Representative of the Young African Researchers, welcomed all participants and thanked the organizers for providing the opportunity to young researchers from twelve African countries to reflect together on the crucial role that they have to play in order to contribute to the development of African societies.

Mr **Innocent Butaré**, Programme Specialist of the Regional Bureau of the International Development Research Centre (IDRC) in Senegal, underlined the relevance of the Forum's theme in ensuring that research works are on the same wavelength with the needs and expectations of the society. He evoked some main challenges that young researchers have to face in Africa, including contradictory and difficult to articulate social needs and demands, the paternalistic management of research bodies, over-dependence on external solicitations, and the compartmentalisation of the scientific community. These challenges create difficulties in rooting science in the social urgency of African communities. Finally, in order to enrich the discussion on the issue of social responsibility of young researchers in Africa, Mr Innocent Butaré proposed that young researchers look into issues such as the reinforcement of their capacities to communicate with other social stakeholders, the implementation of systematic assessments of socio-economic costs and benefits of research activities, the production of reliable results in reasonable time-frames, and mechanisms to promote professional careers.

Mr **Oumar Dia**, PhD in Philosophy at the Faculty of Literature and Human Sciences, Cheikh Anta Diop University, Senegal, made a presentation on the theme "Globalization, Sciences and New Technologies: Which Utopia or Dystopia for our Era?". He dealt with the potential perverse effects that the development of new technologies such as information and communication technology (ICT) and biotechnology could generate, in particular with regard to the creation of conditions favourable to the emergence of totalitarian political regimes. In order to prevent the subjugation of humanity using technology and to safeguard its diversity, Mr Oumar Dia proposed elements of reflection and strategies to be adopted at a global level and at the African level. Thus, he emphasized the importance of setting up a normative framework at the international level to manage the use of new technologies. In order to avoid the exclusive control of new technologies by any scientific, political or economic group, such a framework should be based on the principle of transparency and should give special attention to the issue of mitigating social exclusion and to the questioning of the market logic. At the regional level, Mr Oumar Dia highlighted the importance of a strong political will in ensuring that real comprehension and mastery of science and technology exists, and is directed towards guaranteeing the political independence of the African continent.

Mr **Samba Ka**, Representative of the PhD and Young Researchers Association of the Cheikh Anta Diop University, Senegal, presented on the theme "Stakes and Challenges for Young African Researchers". On the basis of a brief overview of the state of the art of research in Africa, he highlighted the deficiency of public funding and support for scientific

and social research. Some of the challenges that young African researchers have to face in their daily work are the following: brain drain, the lack of policies to integrate researchers in their countries, the absence of institutionalized follow-up mechanisms of expatriate researchers, the deterioration of infrastructures and equipments, and the diminished quality of education at the university level. Mr Samba Ka pointed out that Africa, nevertheless, possesses the advantages, capacities and endogenous competencies to advance beyond this situation, such as the still under-exploited traditional knowledge of the continent.

Young African researchers are called upon to play a key role in the definition of a new social contract involving the convergence of all their energy on a common action: the eradication of poverty. Mr Samba Ka noted that it is up to young researchers to show that it is feasible to reverse the research trend in Africa, by working on the subjects and applications that are of priority interest for local populations and that address the welfare of human beings and societies. They should also consult with the other social stakeholders on a permanent basis, in particular the political apparatus, private sector, education institutions and civil society, and they should contribute to the de-compartmentalisation of disciplines and research institutions at national and regional levels. Mr Samba Ka insisted on the necessity for a strengthened ethical culture in Africa in order to successfully carry out these tasks. Finally, he pleaded in favour of the creation of centres of excellence at the supranational level in order to respond in a global and integrated manner to the economic, social and ecological challenges that the continent is facing.

Mr **Knowledge Rajohane Matshedisho**, a sociologist at the University of Witwatersrand, South Africa, made a presentation on "What Is, What Should Be: a Difficult Choice for Researchers in Africa". He outlined the main ethical questions that African researchers are faced with in order to attain an ideal in the research process, presented in hypothetical forms, based on objectivity, rigour, reliability and inter-subjectivity. In this regard, he proposed some themes of reflection aimed at increasing the individual and collective responsibility process of researchers, as well as taking into better account their often-critical situation. In order to address the sometimes contradictory pressure and controls exerted by the research team, partners, ethics committees, employers, supervisors, backers, as well as peers, the setting up and strengthening of networks of trust is urgently needed. The "watertight contract" concept proposed by Professor Grinyer could also contribute towards guaranteeing a better balance of forces at stake and equally distributing the researcher's responsibility towards each of the other stakeholders. Moreover, the issue of the ideological or religious affiliations of researchers poses problems in this quest for an ideal research process. Mr Knowledge Rajohane Matshedisho pointed out that biased research could not be effectively regulated by scientific protocols alone, and institutional, normative and statutory protection remained crucial. In this regard, intergovernmental institutions should formulate directives to guide the actions of public authorities and local professional associations. The establishment of research agendas and formulation of research assessment criteria determine, at least partly, African researchers' chances of accessing funding and possibility of obtaining recognition at the regional and international levels. As such, important reflection is needed to adapt these crucial elements to the specificities, realities and needs of Africa. Mr Knowledge Rajohane Matshedisho argued in favour of a retrospective research agenda rooted in a given context, as well as a prospective one, which will explore solutions in the long term. Such an agenda could only be established through close coordination between researchers, decision-makers and the other relevant civil society stakeholders. He pointed out that a lot remains to be done to dispel existing obstacles and develop an essential dialogue towards the creation of positive synergy for an adequate handling of the results of African research.

Mrs **Astou Diop Diagne**, an economist and expert in gender and development, made a presentation on "Gender and Research in Senegal". She provided an overview of the issue of gender equality in Senegal, pointing out some of the most serious inequalities limiting women's education possibilities, as well as their capacity to make decisions, to participate in political life, and to contribute to and enjoy the benefits of development. For example, in the field of technical and professional training, gender significantly influences the choice of studies; women in Senegal constitute only about 14% of the students in the Faculty of Sciences. Mrs Astou Diop Diagne further described the main

actions undertaken by the Government to promote gender equality, including the elaboration of a national strategy for gender equity and equality, the realization of a methodological guide of gender integration in development, and the creation of a gender and scientific research laboratory. She then noted some of the priority issues related to the social construct of gender that young African researchers should explore. Within this context, from the point of view of Mrs Astou Diop Diagne, the issues of low participation by girls in science education, the consequential impacts on the research capacity of women and the studies carried out on women, and the diminished capacity to incorporate the gender approach as a tool in research methodologies deserve further studies by young researchers from a specifically African perspective.

Mr **Cheikh Diouf**, an historian and General Secretary of the Gathering of Post-Graduate Students (Retcycl) of the Cheikh Anta Diop University of Dakar, Senegal, presented on the topic "De-compartmentalized Research: for a Dialogue of Sciences in Africa". He first described the major obstacles to the development of Africa as a consequence of the intellectual isolation of researchers. This compartmentalization is present not only between the researchers in social sciences and basic sciences, the various disciplines, the centres of research and the universities, and countries, but also between the researcher and his/her social environment. In order to promote a "process of dialogue of sciences", which is a prerequisite to quality research that will be able to contribute efficiently to the development of Africa, Mr Cheikh Diouf put forth several concrete proposals. He evoked the urgency of developing a common research policy to foster the emergence of a true space for African research, as well as to support the establishment of networks aimed at facilitating the circulation of information and experts in efforts to harmonize and better coordinate research works. Moreover, he underlined the importance of breaking the disciplinary and linguistic fences at the national, regional and continental levels. For example, the regular organization of forums would gather experts from various disciplines and countries, and facilitate the creation of centres of competence. Finally, Mr Cheikh Diouf insisted on the necessity of developing exchanges amongst African researchers as well as between them and researchers from other developing and developed countries. In the field of cooperation, special attention should be given to the African scientific diaspora, which could play a catalyst role in the creation of research spaces of quality within Africa.

Mrs Esther Olembe, PhD in Sciences of Information and Communication at the University of Yaoundé, Cameroon, presented on the theme "Science and Society", dealing with the reality of the practice of research and its aptitude to produce useful knowledge and applications for African societies. Mrs Esther Olembe's interest in the social dimension and ethical challenges of the production of knowledge in Africa is based on an economic perspective and an ethical concept and utility of knowledge. She underlined that the responsibility of researchers cannot be limited to the production of good science and should take into account "the various interests and ethical challenges linked to the threefold dimension of acquisition, distribution and application of scientific knowledge" within both local and global contexts. She added that the distance between the choice and orientation of research topics on the one hand and African social interests on the other can be explained by the excessive dependence of local research on external funding, the shortage of mechanisms to disseminate the research results, the lack of strategies fostering constructive interaction between science and society, and the absence of a technologically developed society. In her opinion, the inappropriate contextualisation of research results is also due to social perceptions of research and of local researchers in Africa. Local research in basic sciences is generally considered as mediocre even when stricter international standards are met. With regard to research in social and human sciences, it is viewed with suspicion due to the perception that it is too dependent on social and political influences. In order for local research to contribute towards the production of useful knowledge in Africa, further theoretical studies should be conducted on African society as well as on the way that issues are presented, dealt with and applied within the African context. Mrs Esther Olembe concluded her presentation by sharing her conviction as a young researcher that, as stated by Professor Gilbert Hottois, from an ethical posture the thematic choice and orientation of research should unite pure rationality and experimental rationality.

Mr B.M. Tchibozo, Researcher Trainer at the Ministry of Health in Benin, and Mr Djego Julien Gaudence, Teacher-Researcher at the Faculty of

Agronomic Sciences, University of Abomey Calavi in Cotonu, Benin, presented on the "Collaboration between Researchers, Decision-makers, Backers, Communities: Keystone of the Social Utility of Research in Africa". They argued that in order for research to bring forth solutions to the problems within African societies, it is essential that decisions be made based on a sensible exploitation of scientific observations and research results, and that appropriate development policies be formulated and implemented. In their opinion, this will occur through better collaboration amongst all partners concerned, i.e. researchers, decision-makers, backers and communities, at all steps of the process, from the choice of research subjects that meet the needs and development priorities of the relevant populations, to the collaborative implementation of results and identification of the most appropriate channels for disseminating the results. Mr B.M. Tchibozo and Mr Djego Julien Gaudence encouraged young African researchers to go forward in this manner while reinforcing their capacities and defending the independence and freedom of research. They then reflected on the need to develop multidisciplinary collaboration and to appropriate new planning and results implementation tools in order to contribute towards finding more effective solutions to the problems of African societies. They demonstrated an impact mapping approach that plans and measures work in international development, and which was finalized by a group of international experts with the support of the International Development Research Centre (IDRC). To this end, they presented the methodology employed and the conclusions obtained within the framework of a study carried out by a team of young Benin researchers aiming to enhance decision-making in the health sector. Mr B.M. Tchibozo and Mr Djego Julien Gaudence concluded their intervention by presenting a set of concrete recommendations based on their experience in maximizing the utility of research and in contributing to the sustainable development of Africa.

Mr Pierre Sané introduced the afternoon session of the Forum, which was co-chaired by Mrs Pilar Armanet Armanet, President of COMEST and Ambassador of Chile to France and to UNESCO, and Mr Innocent Butaré. He also introduced the members of COMEST attending the fifth ordinary session of COMEST, as well as Mr Ben Sikina Toguebaye, Member of the Academy of Science and Technology of Senegal, with whom he invited young researchers to dialogue on the theme of social responsibility of researchers.

Mrs **Pilar Armanet Armanet** introduced **Mr Claude Abé**, who teaches sociology at the Catholic University of Central Africa in Yaoundé, Cameroon. He made a presentation on "The Paths of Acknowledgement and Visibility of the Researcher in Social Sciences in Africa: Choices of Situation and Production of Development vis-à-vis the Ethics of the Scholar". Mr Claude Abé noted with regret that in spite of the acknowledgement that scientific production is a factor of development and social transformation, the African researcher in social sciences is still isolated at both local and international levels, weakening the social utility of this field. In order to explore the frameworks that could be utilized to inspire a revaluation of the African researcher, Mr Claude Abé looked into the multiple spaces in which the researcher commits her/his efforts. At the local level, he observed that many African scientists serve the state apparatus, support particularistic ideologies, and engage in intellectual interventions in the media in order to build their legitimacy. At the international level, the researcher seeks acknowledgement from his peers by publishing externally, participating in international research networks, acquiring work experience abroad, and consulting for international organizations. Mr Claude Abé then examined the nature and forms of the researcher's mobilization in the quest for acknowledgment and visibility, as well as their relevance to the characteristic requirements of an ethical scholar. It was asserted that corporatism and vassalage to various political and financial interests do not contribute to development and political liberalization in Africa, and reveal an increasing disconnection between the militant population and the African intelligentsia. Furthermore, publications of African researchers oscillate between the disconnection and exchange of paradigms and theoretical approaches produced outside the continent, particularly in the West. Mr Claude Abé views the claim of specifically African sociology or anthropology as an evasion of the difficulties faced in contemporary scientific issues and of peer criticisms in the field of social sciences. In his opinion, the territorialization of knowledge does not create a measure of validity/truth or a criterion for assessing the relevance of the

research contribution to the transformation of social stakeholders' life conditions from which the aforementioned knowledge is produced. On the contrary, Mr Claude Abé called for the development of analytical methods that are able to create footbridges that could serve as platforms to a relevant, reflective and productive practice of sociology and anthropology in Africa. According to him, globalized sociology is only relevant if it functions as a sociology of footbridges which evolves around the thematic, methodology, theory and problematic, as opposed to the thesis of disconnection. It is through this approach that some African authors have once again successfully appropriated methodological and theoretical positions developed elsewhere, while others have produced new orientations that have inspired and influenced works carried out in the West. Mr Claude Abé concluded that the African researcher is in search of her/himself. Some ways will weaken her/him and others will be meaningful and hopeful.

Mrs Tafeeda Jarbawi, COMEST member and Director of the Ramallah Women's College of Palestine, made a presentation on the social responsibility of young researchers in Africa. Assuming that the principle of responsibility of scientists is the same irrespective of the country where the profession is practiced, Mrs Tafeeda Jarbawi asserted that the special responsibility of young African scientists depends on the role they are called upon to play in the application of their knowledge in response to the needs of socio-economic development and quality of life enhancement of African societies. In this regard, the ethical commitment of scientists is crucial.

Mrs Tafeeda Jarbawi presented and analysed the Hippocratic Oath for scientists and engineers elaborated by the Institute of Scientific Innovations. She recommended that it should be broadly disseminated to encourage reflection on the potential consequences of every research project. Mrs Tafeeda Jarbawi also underlined the role of codes of conduct in reducing misuse of research results and helping scientists evaluate the pressures and influences to which they are subjected in the social and institutional context in which they operate. It is of utmost importance because scientists are those who can best predict the consequences of their work, minimize the risks, and maximize the benefits for human beings. They are also responsible for informing the public and for transmitting their knowledge in a clear, concise and comprehensible manner. In order to promote the elaboration and the adoption of codes of conduct for scientists, Mrs Tafeeda Jarbawi asserted that the establishment of close cooperation amongst the various relevant actors is essential, including at the level of the international community. UNESCO, through COMEST, is called upon to play a leading role in this arena as well as in the promotion of the most appropriate implementation measures. It was further pointed out that the integration of science ethics at all levels of formal education would greatly contribute towards raising awareness in the scientific community. Mrs Tafeeda Jarbawi also recommended that awareness-raising campaigns and debates on ethics and scientists' responsibility in the context of their research projects be organized.

Finally, Mrs Tafeeda Jarbawi outlined a set of development indicators for Africa to illustrate some of the main challenges that young researchers have to address in the fields of education, health and environment. She indicated that reflection on these challenges and the setting up of a common strategy based on a permanent and open social dialogue require proactive political will and active commitment. Mrs Tafeeda Jarbawi encouraged young Africans, who represent a great part of the population, to explore their potential in order to help Africa.

Mr Ben Sikina Toguebaye congratulated Mrs Tafeeda Jarbawi and Mr Claude Abé for the quality of their interventions. He made a brief commentary on the presentations of both speakers and extracted a set of conclusions that he presented as questions on social responsibility and science ethics, thus opening the door to the discussion with young researchers.

The issue of the condition and visibility of young researchers in Africa played a central role in the subsequent dialogue. The precariousness of the socio-professional and economic situation of young African researchers was extensively discussed.

The young researchers were concerned by intergenerational tension and career development problems. They highlighted the material, social and ethical challenges that they face in order to scrape a living in their profession and to put their competences in the

service of Africa's development. The vassal relationship with professors, centres of research, backers and editors prevents the expression of new ideas judged as too radical. In this regard, several young researchers pointed out that the African tradition, which advocates respect towards the word of elders, does not always facilitate the free expression and the establishment of spaces of dialogue with their elders. They welcomed the opportunity that this Forum provided for them to freely exchange opinions and points of view with experienced specialists.

It was also pointed out that structural problems are preventing the development of an autonomous scientific thought. Concrete examples were provided to illustrate the inappropriateness of research management, including insufficient allocation of resources for research, lack of competent persons to mobilize resources within local research institutes, over-dependence on external funding, and the definition of research agendas based on criteria distant from African realities. In addition, the lack of acknowledgement of researchers' contributions to the comprehension and transformation of African societies was raised. In this regard, the systematic appeal to external competences when they are available at local level was unanimously condemned. Furthermore, the shortage of prestigious African scientific publications was considered a major problem. On the one hand, the majority of applied research developed in Africa is of little interest to prestigious publications outside of the continent. On the other, the quest to publish in non-African journals shapes the content of research and moves it away from the real needs of African societies. Finally, the few existing African scientific journals are disseminated only at national levels and rarely at regional or international levels, and are usually not referenced in library databases. An observer noted that in order to render visible and develop the performance of research in Africa, these should be referenced through a good index system.

The issue of the priority given to applied research compared to fundamental research was discussed at length. Recalling Africa's delayed participation in the field of fundamental research, several speakers asserted that it is necessary to privilege this kind of research in order to ensure the independence of Africa in science for the long term and to respond in a specific way to the needs of the continent. Taking into account the lack of available resources, other speakers argued that applied research should be privileged in order to offer concrete solutions to actual development problems in the short term. They pointed out that applied research is also a creative research that requires the mobilization of endogenous capacities. Participants also agreed that it is necessary to establish a logical footbridge between fundamental research and applied research.

It was further noted that the problem of integration of young researchers in Africa is worsening for women. Proactive public policy is essential not only to support the access of women to scientific education, but also to allow them to integrate and access positions of responsibility, particularly in the field of basic sciences.

Several speakers coming from non-African countries pointed out that many of the issues raised were shared by other countries and affirmed the importance of developing international cooperation and the dissemination of good practices.

Based on the challenges faced by young researchers, participants questioned their current position in society, and the steps that need to be taken to empower them to be real actors of change and development, instead of mere observers. It was pointed out that the reputation and capacity of a researcher are developed through intense daily efforts, and the commitment of young researchers when facing this task should be strong. It was also observed that science is a personal realization from which an intellectual and creative pleasure is derived, and responsible conduct should be part of this endeavour. The social and professional integration of young researchers was unanimously considered as a prerequisite for their contribution to the development of Africa. In this regard, it was asserted that since the researcher is conditioned by the social context in which s/he operates, it is also the duty of society to create appropriate spaces for the researcher to develop her/his work in an efficient and responsible manner. In this regard, it was suggested that a critical analysis of social and political conditions requiring collective and institutional effort be carried out.

Recognizing that research in Africa is a fundamental and strategic element in the struggle for

development, the ethical considerations of science and technology were judged to be essential in the development of the continent. In this regard, it was observed that ethical reflection remained insufficient in Africa. A speaker questioned the ethical dispositions that African researchers could take to maximize the benefits offered by scientific advances. Moreover, a young researcher wondered whether Africa had the same comprehension of ethics as the West and whether it is useful to elaborate a unique ethics for Africa. In response to this intervention, several speakers defended the universal value and scope of ethical principles, arguing that these could be adapted according to local realities.

Furthermore, the necessity to promote scientific ethics and social responsibility not only at the individual level but also at the collective level was affirmed. Awareness-raising activities should be addressed to researchers and other relevant actors such as decision-makers, donors, editors, and managers of research centres. It was pointed out that one of the main responsibilities of the researcher was her/his commitment to maintain open spaces of scientific dialogue and discussion.

The necessity for developing training in ethics of science and technology in order to promote social responsibility amongst researchers was reiterated. In most African countries, this type of training is still at a very early stage or do not exist. The setting up of spaces of dialogue between scientists and philosophers, ethicists and researchers in social sciences, and the development of interdisciplinarity were also considered as essential. Moreover, it was suggested that control mechanisms by peers be created through the establishment of scientific committees in charge of assessing the scientific merit of research, and of ethics committees in charge of reviewing the ethical aspects.

It was observed that the promotion of social responsibility amongst young researchers requires not only reflection but also action, starting with the inculcation of society's expectations into the researcher's set of responsible and obligatory results. The researcher should be a factor of change and should be socially engaged, in particular with regard to marginalized populations. Participants expressed the idea that the researcher has a social responsability to communicate and to establish links with society in order to fully comprehend the context, and to be able to offer responses to the real needs expressed. It was pointed out that there is still a lack of mechanisms and space of exchange with civil society, and that the association of the media with awareness-raising efforts and dialogue is very important. The difficulty of appropriation of research results by broad sectors of the population due to the lack of scientific training was also raised. As such, it was asserted that efforts to train and raise awareness at all levels should be undertaken.

Furthermore, it was observed that better understanding between researchers and decision-makers is crucial to ensure that science advances in an efficient and responsible manner. Several speakers recalled that, without support and real political involvement, the willingness, conviction and courage of young researchers to develop their work based on ethical principles would probably not yield concrete results. The creation of meeting and dialogue spaces should be privileged, building trust and facilitating the definition of national and regional priorities in the field of research by all stakeholders, based on ethical criteria. It was pointed out that there is a need to develop long-term programmes to overcome the existing gap between the lengthy process of research and the search for immediate solutions of politics. It was further recommended that better disclosure of research results to decision-makers and society should be encouraged so that these results are visible and exploited in a productive manner. In conclusion, the de-compartmentalization of research in Africa was deemed essential. This requires collective action, strong political will, commitment of researchers and other actors involved in research, and active participation of the whole society. It was further concluded that the social legitimacy of the researcher should go hand in hand with dialogue and cooperation with the various stakeholders.

CLOSING SESSION

Mr **Johan Hattingh**, Rapporteur of COMEST, took the floor to give a summary of the presentations and debates that took place during the fifth ordinary session of COMEST. The importance of ethics in addressing the divides created by scientific and technological disruptions in Africa was noted during the opening session. The ability of science and technology to self-regulate was severely questioned due to the reduction of science to a narrow Cartesian rationality, and the danger of scientists becoming complicit in merely reproducing the domination of nature, societies and individuals. The importance of stimulating the conscience of science using public debate was asserted, and echoed throughout subsequent sessions.

During the session on science ethics, it was concluded that ethical science is a collective responsibility. Emphasis was placed on utilizing a regional approach to ethical codes for scientists and engineers, and participants called for mechanisms to implement and monitor such codes in Africa. It was also observed that the UNESCO Recommendation on the Status of Scientific Researchers (1974) and the UNESCO-ICSU Budapest Declaration on Science and the Use of Scientific Knowledge (1999) are insufficiently known in Africa, and steps should be taken to better publicize these instruments. Such actions will contribute towards building trust in science within the wider African community.

From the session on ethics education, it was asserted that ethics teaching in Africa needed to be expanded to include professions in environment, science and engineering. A universal core curriculum that can be tailored to incorporate regional specifications and promote the diverse moral and ethical frameworks of the continent is of particular interest to Africa. The teaching of ethics of science and technology should also extensively utilize case studies and interactive experiential learning, focusing on showcasing best practices in the region. Ethics teaching should also be introduced into Africa's informal learning tradition. It was further observed that UNESCO's previous work in the area of ethics education should be better disseminated on the continent. Efforts should be made to iteratively make existing documents available on the continent.

The session on environmental ethics highlighted the importance of case studies in this field. In addition, there is also a strong need to articulate the fundamental principles of environmental ethics. From the African perspective, these should include the principles of polluter pays, accountability and governance, and personal responsibility, as well as an ethics of prevention. It was also suggested that existing international normative instruments should be better utilized.

From the overview of the benefits and risks of GMOs and biotechnology presented during the fourth session, it was concluded that the use of biotechnology is compatible with the protection of Africa's biodiversity, and that this scientific progress should not be compromised. However, it was also emphasized that the ethical principles of sustainable use of the technology, equitable sharing of benefits, and informed choice (via circulation of information) should be applied in this area. It was also highlighted that a continental governance system that includes regulations and a framework for public consultation and debate is required.

Mr **Joao Ribeiro Butiam**, Representative of the Instituto Nacional de Estudos y Pesquisa of Guinea Bissau, took the floor on behalf of the participants in the Young African Researchers Forum to thank the organizers of the Fifth Session of COMEST and to present the Dakar Declaration on the Social Responsibility of Researchers in Africa, which was adopted in the framework of the Forum.

Mr **Souleymane Niang**, President of the Academy of Science and Technology of Senegal, thanked all participants for their rich and diverse contributions, which have facilitated the success of the Fifth Session of COMEST. He welcomed the convening of the Young Researchers Forum, the discussion of which raised the main ethical issues regarding the place and responsibility of researchers within the African context. Mr

Souleymane Niang recalled that ethics of science and technology is permanently part of the foundation of the Academy's programmes and reaffirmed its willingness to actively encourage the reflection on science ethics, codes of conduct for scientists, as well as environmental ethics from an African perspective. Furthermore, he confirmed the commitment of the Academy to promote the dissemination of ethics teaching and to initiate the necessary collaborations, in order to instil into young scientists a positive attitude of reflection, alertness and awareness of the ethical dilemmas that they could face in their professional life.

On behalf of Mrs Yaye Kene Gassama Dia, Minister of Scientific Research of Senegal, Mr **Cheikh Christophe Guèye**, Director of the Cabinet of the Minister, presented the Dakar Declaration on Ethics of Science in Africa.

On behalf of the COMEST members, Mrs **Pilar Armanet Armanet** thanked the Senegalese Government and people for the opportunity offered to COMEST to hold one of its statutory sessions on the African continent for the first time. She particularly welcomed the work enthusiastically carried out within the framework of the Young Researchers Forum, which brought an original point of view on ethics of science and technology. She congratulated the ministers responsible for science and scientific research in ECOWAS on having taken the initiative to elaborate the Dakar Declaration on Ethics of Science in Africa. Mrs Pilar Armanet Armanet informed the audience that the mandate of the existing COMEST Bureau had been renewed by members of the Commission during the Fifth Session and thanked them for their trust. She also reaffirmed the strong willingness of the Bureau to work towards fulfilling the important mandate that UNESCO had entrusted to COMEST. Finally, Mrs Pilar Armanet Armanet expressed her thanks to the COMEST Secretariat, the interpreters and all those who had contributed to the success of the meeting.

Mr **Pierre Sané** pointed out that the Fifth Session of COMEST in Dakar, which will be followed within six months by the fourteenth session of the International Bioethics Committee of UNESCO (IBC) in Nairobi, reflects the priority given by UNESCO to Africa in the field of ethics. In this regard, Mr Pierre Sané regretted that the contributions of the African participants during this session were more focused on science and technology than on moral values, ethical principles and African sensibilities that could have enriched the global discussion in the field of ethics of science and technology. African societies and cultures produce different values that are permanently evolving. He explained that several crucial issues concerning their definition, compatibility and forms of articulation require a large public debate. Moreover, within a context marked by globalization, "bad development" and North-South inequalities, the discussion on ethics rather than science is the most urgent, such as society's choices and principles of governance that should inform law, policy – including scientific policy – and governmental and social practices. Mr Pierre Sané appealed to all participants to pursue and enlarge the effort facilitated through the framework of this meeting for the purpose of responding to the need for a wide democratic and inter-disciplinary debate on ethical issues, and for consolidating a social cohesion that is threatened everywhere in Africa today. He reiterated the willingness of UNESCO to pursue and support the process of encouraging pluralistic dialogues on ethics of science and technology, bioethics, ethics of information, ethics of the management of social transformations, and ethics of education, with the objective of promoting the consolidation of informed, plural and responsible societies, and the construction of social and international relations based on the values of peace and solidarity. Finally, Mr Pierre Sané thanked all those who had enabled COMEST to initiate a fruitful discussion with the African scientific community, particularly the Government of Senegal, the Ministry of Scientific Research of Senegal, the Academy of Science and Technology of Senegal and the International Development Research Centre (IDRC).

Mrs **Celestin Monteiro**, Secretary General of the Ministry of Higher Education and Professional Training of Benin, took the floor to deliver the thanks of the participants in the Fifth Session of COMEST addressed to the President of Senegal, Mr Abdoulaye Wade, the Senegalese Government and People, UNESCO and all the organizations and experts who contributed to the success of the first statutory session of COMEST in Africa.

After having expressed his thanks to all participants, Mr **Mustapha Sourang**, Minister of Education of Senegal, emphasized the relevance of holding a

session of COMEST in Dakar to stimulate the integration of ethics into all knowledge creation processes and the use of research results, which form a fundamental base for the whole society. He welcomed the convening of the Young African Researchers Forum, which threw a retrospective glance at the role of science and technology in the configuration of African societies, but also a prospective glance on the responsibilities of researchers in the construction of future societies based on the principles of dignity, equity and justice. Mr Mustapha Sourang pointed out that, as Minister of Education, he will attach special importance to the conclusions delivered by youth, the banner of tomorrow. Furthermore, he indicated that the pertinent conclusions of the discussion on science ethics and responsibility, environmental ethics and ethics teaching will be very useful to highlight political choices and strategic options of African decision-makers. In this sense, he praised the sincere and open dialogue that had governed the meeting of Ministers responsible for science and technology of ECOWAS, held as a side-event of the Fifth Session of COMEST. Through the Dakar Declaration, which notes without reservations that African countries have given little attention to ethical implications of science and technology and that the socio-cultural dimension of scientific and technological advances should be better taken into account, the Ministers committed themselves to integrate ethics of science into the African policy for economic and social development. Mr Mustapha Sourang announced that the Senegalese Government would bring the Dakar Declaration to the attention of the Heads of State and Government meeting within the framework of the African Union Summit in January 2007. He appealed to UNESCO to develop, in collaboration with ECOWAS, a regional programme aimed at the implementation of the commitment stated in this instrument. Finally, on behalf of His Excellency Mr Abdoulaye Wade, President of the Senegal Republic, and on behalf of the Senegalese Government and People, Mr Mustapha Sourang expressed his thanks to UNESCO, the Academy of Science and Technology of Senegal, the International Development Research Centre (IDRC) and to all partners who contributed to the success of this COMEST session in addressing topics of crucial importance for Africa and the world. He bid farewell to participants returning to their various countries, and closed the Fifth Session of COMEST.

ANNEXES

PILAR ARMANET ARMANET: OPENING ADDRESS

Chairperson of COMEST

Mr Prime Minister of the Republic of Senegal,
Madam Minister of Scientific Research of the Republic of Senegal,
Mr Assistant Director-General of the Social and Human Sciences Sector of UNESCO,
Distinguished Members of COMEST,
Excellencies,
Ladies and Gentlemen,

It gives me great pleasure to be with you today at the opening of the Fifth Session of the UNESCO World Commission on the Ethics of Scientific Knowledge and Technology, which is being held on the continent of Africa for the first time. On behalf of the members of COMEST, I should first like to thank our Senegalese hosts, in particular His Excellency the Prime Minister of the Republic and Madam Minister of Scientific Research, for their generous invitation and their efforts to ensure the success of this important meeting.

We are today opening a major forum that will focus on two basic aspects of scientific knowledge and technological progress: ethics and responsibility. Eminent scholars, policy-makers, young researchers, representatives of civil society, delegates from many countries and independent experts who are members of COMEST will be taking part in a constructive debate that will be both analytical and future-oriented. Such cooperation among the various stakeholders is a vital link to future action, since the results of this meeting will point the way for all those who, at the local, regional or international levels, are endeavouring to ensure that science is used not only efficiently but also responsibly. In particular, it will guide the activities of UNESCO and COMEST in this field.

All nations are faced with crucial questions arising out of the ever quickening pace of progress in science and technology, such as how to stimulate growth in an information society, how to prevent environmental damage, how to limit risk and derive the full potential benefit of the new technologies and how effectively to prevent epidemics from spreading. Ethical reflection on the development and application of science and technology is central to these questions which are of growing concern in our societies. UNESCO and COMEST are therefore playing an active role in trying to ensure that ethics are fully integrated into any measures or policies for national scientific capacity-building and international scientific cooperation. In the next three days, we shall discuss in depth cross-cutting ethical topics of global relevance and the main challenges facing Africa in terms of the ethics of science and technology, such as the problem of toxic waste and the links between biodiversity, GMOs and biotechnology. Africa will thus be making a valuable contribution to the global debate on the ethics of science and technology. We shall thus be able, together, to translate Africa's position and needs into appropriate and effective recommendations for action.

Ladies and Gentlemen,

COMEST was established in 1998 by the UNESCO General Conference at its 29th session for the purpose of placing scientific and technological progress in a context of ethical reflection rooted in the cultural, legal, philosophical and religious heritage of all its Member States. A genuine platform for reflection and exchange of ideas and experience, COMEST consists of 18 distinguished independent figures from different regions of the world. Its terms of reference are wide-ranging for it is required to serve as an intellectual forum for the ethics of science and technology, to detect the early signs of risk situations and to promote dialogue between scientific communities, politicians and the public at large. COMEST has also been given the task of advising public policy-makers who, in view of the rapid progress of scientific research, face problems of growing complexity and technicality and thus need to draw on readily available enlightened opinions so that they may make informed decisions.

To meet these challenges, COMEST initially concentrated on very specific areas, namely the ethics

of freshwater resources, the ethics of energy, the ethics of the information society and the ethics of outer space. On the basis of experience gained and results achieved, COMEST has gradually extended its field of action. It has therefore now turned its attention to science ethics and codes of conduct for scientists, environmental ethics, the teaching of ethics and the exploration of emergent technologies such as nanotechnology. Allow me to outline very briefly some of these fields of action, which will be examined at greater length in the individual meetings to which they have been assigned.

As regards the ethics of science, UNESCO's Division of Ethics of Science and Technology has collected and analysed on a preliminary basis existing codes of conduct in various scientific and professional fields and in various countries and regions in order to provide interested Member States and professional associations with tools to facilitate the updating or adoption of codes of conduct for scientists. It is also studying the ethical aspects of the Recommendation on the Status of Scientific Researchers adopted by UNESCO's General Conference in 1974 and the Declaration on Science and the Use of Scientific Knowledge with a view to possible follow-up mechanisms that could be used to publicize these texts and encourage States to apply them. Lastly, Member States, intergovernmental and non-governmental organizations and the relevant national and regional bodies are being consulted on science ethics and scientists' responsibilities. In this connection, I should like to emphasize the major importance of the consultations that will be held during this session.

Participatory, plural and informed debate and decision-making encouraged and supported by the very foundations of society all require a prior deep-rooted understanding of the ethical issues at stake in the development of science and technology. Education, awareness and dialogue have thus been key elements in COMEST's work from the very beginning. As early as 1999, moreover, the World Conference on Science expressly requested COMEST to take the lead in this field.

At present, UNESCO's Ethics Education Programme, established on the basis of the recommendations in COMEST's report *The Teaching of Ethics*, aims specifically to build Member States' capacities in the field of ethics education. In this connection, the mapping of experts in ethics teaching and the sampling of teaching programmes in ethics are under way in order to facilitate development and subsequent implementation of curricula in this area, especially in developing countries. I am convinced that the consultations to be held during this session will yield valuable information about the content, methods and tools used to teach various fields of applied ethics in Africa, and this will provide additional material for our mapping, which is meant to be global. The information will also enable the region's needs in the field of ethics teaching to be determined more effectively and will serve as input to joint reflection on the most appropriate cooperation strategies for meeting those needs. Lastly, an Advisory Expert Committee for the Teaching of Ethics is working on a draft core curriculum in bioethics and on the development of standards and criteria for the evaluation and certification of curricula. This is the central theme of one of the scheduled meetings.

In regard to the raising of awareness, rotating conferences on ethics have been held in some 20 countries with the active cooperation of COMEST members. The Ethics around the World Programme contributes to the dissemination of knowledge and information about the ethics of science and technology, to the encouragement of interaction with local experts and professionals and to the establishment of networks. In addition, UNESCO's Global Ethics Observatory (GEObs), launched in December 2005, provides a number of databases covering ethics experts, institutions and curricula worldwide for use by the general public. A fourth database on legislation and principles relating to ethics is being finalized. Through such practice-oriented working methods, COMEST and UNESCO aim to provide and disseminate efficient tools for the formulation of informed policies, the development of curricula and the strengthening of infrastructure in the field of ethics.

As regards environmental ethics, COMEST is working, in the follow-up to the World Summit on Sustainable Development held in Johannesburg in 2002, to promote exchanges between scientific knowledge and expertise on the one hand and social analysis of the ethical aspects of sustainability and the environment on the other. The work done to

date has shown that environmental ethics, although undoubtedly a pressing global issue, is also a particularly complex and sensitive matter, especially with regard to the statement of common principles. To ensure that specifically moral dimensions are properly addressed, a group of ethicists has taken stock of the present situation in environmental ethics and has identified possible international action by UNESCO in this area. Articles by members of this group have been collected in a book entitled *Environmental Ethics and International Policy*, which has just been published by UNESCO. The work, which gives an overview of the main issues of environmental ethics, will inform both specialists and the public at large. In addition, a draft COMEST policy paper on environmental ethics, to be submitted to the Director-General of UNESCO, is under consideration. This working document will be studied and discussed by African experts, decision-makers and representatives of civil society present here in order to determine the relevance and feasibility of the international action proposed.

Ladies and Gentlemen,

Thanks to the exemplary dedication of its members, the enthusiasm of its former presidents, Mrs Vigdis Finnbogadottir and Mr Jens Erik Fenstad, and the unwavering support of the Secretariat, COMEST has made great strides forward since its inception and has achieved solid and tangible results. There is still much to be done, however, to build an African, and indeed a global, network for scientific and technological development based on ethics, equality and human rights. To succeed, genuine commitment and closer coordination of the work of all stakeholders are required at the international level. I am sure that this meeting will produce creative and innovative ideas and proposals that will give fresh impetus to this collective effort and drive future action to develop science and technology guided by clearly stated common ethical values and principles.

Thank you.

SOULEYMANE NIANG: OPENING ADDRESS

President,
Academy of Science and Technology of Senegal

Madam Minister of Scientific Research,
Distinguished Teachers and Researchers,
Distinguished Participants,

The programme of the Fifth Session of COMEST, which our country is honoured to host, has been very well received by the National Academy of Science and Technology of Senegal. The topics selected for this meeting reveal similarity between the concerns of COMEST and the concerns of the Academy. COMEST has been conducting a programme on the ethics of science while the Academy, ever since its establishment in November 1989, has set itself specific tasks and goals in the field of science and technology.

Thus, in the field of science education, it has, in particular, been engaged in the tasks of: ensuring rigorous and targeted promotion of scientific and technological innovation and research in the creative arenas of science in order to be more closely involved in scientific production; encouraging young people to take up science as a career and motivating them to learn and use science; and contributing to the development of scientific literacy and to bringing science and society closer together in forms of logical coexistence. In concrete terms, as early as 2002, the Academy adopted a National Indicative Programme (NIP) to revitalize science education. In its capacity as leader of the Science and Education Programme, it has held an international symposium on the development of a regional programme for primary-school science and technology education in Africa. A special part of this programme ought perhaps to be devoted to the very young. It is also necessary, in this context, to develop individual and collective capacities through teaching geared to the economic and socio-cultural needs of African communities.

Similarity between the two programmes is also apparent in the environmental field, in which the Academy has carried out a number of activities. It has conducted a fact-finding mission and held a special meeting on "Flooding and Town-Planning: A Case Study of the Town of Saint Louis", at which it adopted a strategic document on flood control and a strategic document on urban management. In addition, the Academy, together with the Ministry of Agriculture, has taken part in an international conference on host countries. It has thus been involved in the establishment of the Sahara Development Authority and in the Great Green Wall project under the auspices of the Ministry of the Environment.

These two objectives relating to science education and to the environment and biodiversity obviously aim to achieve sustainable development in Africa in general and in Senegal in particular. Such studies and activities are supported, where appropriate, by ethical analysis that respects individual beliefs. Aware that knowledge cannot be left to scientists alone, the Academy endeavours, through these conferences and its field work, to bring science and society closer together.

The Academy's structure has also enabled it to become involved in training in best practice and clinical trials. During the science meetings and public lectures that it regularly organizes in order to provide scientific leadership nationally, the speakers are always mindful that ethics constitute a means of questioning human activity and, especially in the field of bioethics, they are aware that the research subject's weakness and personal freedom must not be left to the mercy of the investigator's power. On the contrary, they understand that it is necessary to foster a positive, protective and beneficial human relationship. At the very least, they must follow ethical rules, treating the mighty in the same way as the weak, pondering certain issues and asking what they would do if they were the patients and the patients their doctors.

In the field of ethics, in November 2001, members of the Academy submitted to the Senegalese authori-

ties a proposal for a National Advisory Committee for Ethics in the Life Sciences. Its second article provides that the Committee shall have the task of issuing opinions on moral and ethical matters raised by research in all branches of biology, medicine, pharmacy, traditional pharmacopoeia, agriculture, animal and plant science and technology and all issues that have an impact on human and animal health, the environment and social groups.

Mr Assistant Director-General of the Social and Human Sciences Sector of UNESCO, the Academy hereby pledges to follow up and implement the resolutions adopted at this session of COMEST. On the basis of this commitment, the Academy, which has three sections – agricultural sciences, health sciences, and science and technology – has added a fourth: social and economic sciences. The Academy, reinvigorated by the proceedings of the Fifth Session of COMEST, will thus be in a better position to honour its commitments and meet the need to establish linkages between the pure sciences and the social sciences that will enable them both to do more to meet societies' needs and their ethical, or even cultural, needs, especially in a context of economic and scientific competition in which researchers inevitably cannot afford to neglect the industrial interest of their research.

In its activities, the Academy has therefore attempted to reconcile moral, social and scientific progress within three approaches that are constantly being refined: collective, multidisciplinary expertise for the purposes of reflection and study; ethical analysis that ensures respect for individual beliefs; and educational outreach. Expertise is essential to policy-makers who, on the basis of sometimes incomplete scientific findings, take decisions whose consequences are often serious and sometimes not immediate. Ethical reflection is invaluable to scientists, who, in some sensitive areas, may not be aware of their responsibilities. It is also valuable to the legislature, whose decisions are often based on discoveries that are in need of a clearly defined framework. Lastly, outreach must involve all the citizens of Senegal in the development of knowledge so that they may determine their future and progress in step with science, while measuring not only the progress achieved but also, on occasion, the attendant risks.

Thank you for your kind attention.

GILLES FORGET: OPENING ADDRESS

Regional Director,
International Development Research Centre (IDRC)

Your Excellency, Mr Prime Minister,
Madam Minister of Scientific Research,
Madam President of COMEST,
Mr Assistant Director-General for Social and Human Sciences of UNESCO,
Mr President of the Academy of Science and Technology of Senegal,
Ladies and gentlemen,

Allow me first of all to thank the COMEST organizing committee, UNESCO and the Minister of Scientific Research for inviting the International Development Research Centre to participate in this fifth ordinary session of COMEST and say these few words.

The global inequalities in wealth and welfare are matched by equally large, or even larger, inequalities in knowledge, technology, research and the capacity to harness them for development.

Established by the Parliament of Canada in 1970, the International Development Research Centre's (IDRC) mission is to "[...] initiate, encourage, support and conduct research into the problems of the developing regions of the world and into the means for applying and adapting scientific, technical and other knowledge to the economic and social advancement of those regions".

Therefore, in accordance with its programmatic framework, the IDRC supports technological and social innovations that help to improve the social, economic and environmental situation of poor, oppressed and marginalized population groups of the South.

Ladies and gentlemen,

The high-income industrialized countries spend 1.5% to 3.8% of their national income on research and development. African countries spend, on average, only 0.3% of their national income on research and development compared to an average of 0.5% for developing countries as a whole. This of course has repercussions on other research and development indicators such as the number of researchers, research centres, libraries and laboratories, and the number of research inputs such as articles published in specialized journals and patents issued. Africa, for example, has 13% of the world's population, but only 1.2% of its researchers.

The current fast pace of economic and social change throughout the world is associated with an even more fundamental and rapid change in technologies, especially information and communication technology, biotechnology and nanotechnology. These new technologies and their benefits are unevenly spread throughout the world. In spite of the opportunities afforded by technologies, there are also drawbacks. There is a wide gap in research capacity between rich and poor countries. It is, however, probably narrower than the gap in their capacity to respond to the issues raised by new technologies, in particular in the areas of biotechnology and nanotechnology.

All countries face hard policy choices with respect to, for example, GMOs, intellectual property rights, trade in new technologies and their products, food safety, environmental protection and many other areas. The developing countries very often have only meagre resources at their disposal to analyse these problems in order to tackle them on the bases of conclusive data. At the same time, all countries alike are increasingly aware of the opportunities for poverty reduction, employment and sustainable and equitable development opened up by the new technologies.

Ladies and gentlemen,

In the countries of the South, the IDRC has long been seen as a leader in providing aid for research. Whenever possible, it supports stakeholders in charge of formulating national research policy and has often had the opportunity of working with ministries respon-

sible for research in the sub-region and in particular with the Ministry of Scientific Research of Senegal.

The IDRC has understood from its experience that research projects only have a significant impact in environments that are politically, socially and economically stimulating for innovation processes. It is therefore important to help African societies to acquire the capacity to initiate such processes and sustain them in the long term. Innovation policies must also be consistent with other development policies. The IDRC therefore supports the establishment of frameworks for dialogue and exchange among researchers, political decision-makers, economic actors, producers and consumers on the major issues linked to the enhanced use of research results and technological innovations.

The Centre operates in a changing environment, in which research methodologies are changing. To keep pace with these developments, building on experience gained in two fields of exploratory activity, namely new technologies and research on knowledge systems, the IDRC has decided to introduce a new programme area entitled "Innovation, Policy and Science" (IPS).

This programme should give actors involved in innovation systems, and in particular researchers, a better understanding of the processes entailed in innovation systems, in improving related practices, in strengthening the inclusion of research in policy-making and in formulating advocacy statements. This is possible, however, if research is conducted within a rigorous framework and is founded on conclusive results.

It is, then, as a general principle, very important to the IDRC that all areas of scientific research that it supports respect ethical standards. Indeed, it provided support for the First Bioethics Days for West and Central Africa, held in Dakar in July 2005 on the theme "Ethics for Research in Africa", and, more recently, for the Second Bioethics Days, held in Yaoundé from 5 to 7 June 2006, which coincided with the Fourth Pan-African Bioethics Initiative (PABIN) Conference.

In this connection, the IDRC regional office for West and Central Africa, acting under the "Innovation, Policy and Science" programme, was associated with UNESCO in organizing the Forum of Young African Researchers on the question of the social responsibility of researchers in Africa, which was held here yesterday.

We therefore consider COMEST's decision to hold its Fifth Session on the African continent for the first time to be an important event. It should focus the attention of the world of research in Africa on the need to be familiar with the ethical issues under discussion worldwide so that African research would be internationally competitive and therefore rigorous, reliable and ethically irreproachable.

Scientific research in Africa has already been marked, and will in the near future be marked by profound changes, not to mention new departures, in order to meet the needs of societies, contribute effectively to the continent's development and play a full role in the scientific world. We therefore think it indispensable that these changes be accompanied by a reflection to define the codes of conduct necessary for the development of research and for ensuring that it is taken into account by policy-makers.

Thank you.

PIERRE SANÉ: OPENING ADDRESS

Assistant Director-General of the Social and Human Sciences Sector of the United Nations Educational, Scientific and Cultural Organization (UNESCO)

Mr Prime Minister of Senegal,
Madam Minister of Scientific Research of Senegal,
Distinguished Members of the Government of Senegal,
Madam President of COMEST,
Distinguished Members of COMEST,
Mr President of the Academy of Science and Technology of Senegal,
Excellencies,
Ladies and Gentlemen,

On behalf of the Director-General of UNESCO, I should like to pay tribute to the Senegalese Government and the President of the Republic, who have generously offered to host the Fifth Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST).

It is the first time that a formal session of COMEST is being held on the continent of Africa. COMEST, whose task is to promote reflection on the ethics of science and technology that is open to the diversity and creativity of all cultures, is honoured by this opportunity to meet in Dakar after its sessions in Oslo, Berlin, Rio de Janeiro and Bangkok. Thanks to the Government of Senegal and the Senegalese Academy of Science and Technology, we have been able to bring together under the same roof scientists, ethicists, philosophers, legal experts, young researchers, and ministers of scientific research from the Economic Community of West African States (ECOWAS), whose participation will greatly increase the visibility and political impact of our message.

All of these stakeholders will have an opportunity to compare their points of view and engage in dialogue in order to arrive at mutually agreed positions that take account of both the scientific dimension and the ethical dimension, which cannot be dissociated. In 2006, declared "Senghor Year" by President Abdoulaye Wade to mark the centenary of the birth of this bard to the culture of the universal, we can hardly imagine a more highly symbolic place for a fruitful discussion guided by the values that he espoused, namely universality, participatory democracy and the promotion of cultural diversity.

Allow me also to say how pleased I am to be with you today and to thank the organizers for their warm hospitality. It is a true privilege to be at home surrounded by conscientious men and women of science eager to play a part in informing the progress of science with due respect for basic ethical values.

Mr Prime Minister,
Ladies and gentlemen,

Promoting the ethics of science and technology is one of UNESCO's five main priorities and the leading priority of the Social and Human Sciences Sector of which I am in charge. This is so because the Member States of UNESCO have agreed that the future of our societies and the practice of democracy are intimately linked to their ability to develop a genuine scientific and technological culture that takes ethical requirements into account.

The present and future of such vital areas as agriculture, capital goods, medicine, the environment and communications depend on the way in which scientific and technological developments take place. Such developments have transformed our societies and greatly contributed to the improvement of living conditions and the quality of life for many people.

However, serious ethical problems are raised by some uses and applications of scientific discoveries and technological progress. Desertification, pollution, the technological divide, the use of toxic substances, and accidents and ailments linked to scientific and

technological developments are but a few of the issues that are cause for growing concern and must be resolved in order to preserve the vital link between science and the public. Moreover, amidst globalization and an exponential increase in new discoveries, many of the benefits provided by science and technology are being reaped by the privileged, thus worsening inequalities in wealth and opportunity between industrialized countries and developing countries and within each society. Thus, for example, the growing economic pressure on scientists and the increasing share of research driven by profit are not in the least conducive to scientific developments that genuinely meet the priorities of developing countries or of more vulnerable individuals.

Scientific knowledge and the many technological applications are not neutral factors whose future development has somehow been mapped out in advance. On the contrary, science policy goals, research topics, methods of investigation and the results and products obtained, depend on human choices and decisions that are based on values. In short, they are consistent with our aims and purposes. Acknowledgement of this fact requires us to shoulder our responsibilities and together explore methods of developing and applying science that both respect cultural diversity and human dignity and are capable of improving living conditions for the whole of humanity.

Assisted by COMEST, UNESCO is working positively to achieve this and is supporting the consolidation of informed, inclusive and responsible societies capable of addressing the hopes, fears and challenges raised by the development of science and technology with an informed and critical mind. To this end, UNESCO is taking the lead in promoting a broad public debate and multidisciplinary reflection on the ethics of science and technology, convinced that it is on the basis of meetings such as this, gathering the various partners concerned – including eminent persons and young scientists, politicians and ethicists and representatives of international bodies and civil society – round the same table that we shall be able to anticipate potential risks effectively in order to forestall their consequences and lay down common ethical principles to inform the choices and repercussions of the new discoveries.

Allow me therefore, Mr Prime Minister, to introduce to you briefly the members of COMEST who have travelled to Dakar: Mrs Pilar Armanet Armanet, President of COMEST, currently Ambassador of Chile to France and to UNESCO; Professor Khalid Abdulla Al-Ali, Director of the Foundation Program at the University of Qatar; Professor Ruben Apressyan, Head of the Ethics Department at the Institute of Philosophy of the Russian Academy of Sciences and Professor at Lomonosov Moscow State University; Doctor Somsak Chunharas, Secretary-General of the Thai National Health Foundation and Director of the Thai programme on Bioethics and Advanced Biomedical Research; Mr Cheick Modibo Diarra, Mali, Chairman of Microsoft Africa and former Director of NASA's Jet Propulsion Laboratory; Professor Johan Hattingh, Vice Dean of Social Sciences in the Faculty of Arts and Social Sciences at the University of Stellenbosch in South Africa; Professor Alain Pompidou, Professor at the Cochin Faculty of Medicine and Member of the European Academy of Sciences and Arts; Professor Tafeeda Jarbawi, Principal of the Ramallah Women's Training Centre and Dean of the Educational Sciences Faculty; Professor Marta Kollárová, Vice-Rector for Science and Research at the Comenius University in Bratislava and Chairperson of the UNESCO National Bioethics Committee in Slovakia; Professor Sangyong Song, former President of the Korean Bioethics Association, Vice-President of the Asian Bioethics Association and Distinguished Professor of Philosophy at Hanyang University; Professor Nadja Tollemache, former Council Member of the Auckland University of Technology and former member of the Health Research Council of New Zealand Ethics Committee; and Professor Jun Fudano, Director of the Applied Ethics Center for Engineering and Science at the Kanazawa Institute of Technology (KIT) in Japan and Professor of the History of Science and Technology. Last but not least, Mrs Nouzha Guessous-Idrissi, Morocco, is the Chairperson of UNESCO's International Bioethics Committee and ex officio a member of COMEST.

The first session of COMEST in Africa will offer the opportunity to analyse the ethical challenges of greatest concern to the countries in the region. The issues of toxic waste, the links between biodiversity, GMOs and biotechnology and the issue of combating poverty will thus be addressed from a specifically African angle.

This work is all the more important in that, to provide effective support for infrastructure development and the science and technology policies of African countries so that they may effectively reflect needs expressed at the local level, the social, cultural and environmental context must be duly taken into account. We may here recall an oft-repeated saying of President Leopold Senghor: "Assimilate, don't be assimilated." To bridge the technological divide, which is the real ethical challenge facing the international community, the answer cannot be to impose blind imitation of the models of the most developed countries in the scientific and technological fields. Stakeholders working at local, regional and international level to foster receptive and responsible science must on the contrary promote and support the study, selection, integration and adaptation of the more relevant scientific and technological discoveries to ensure that they are relevant to the local socio-cultural environment. In a word, creative and proactive assimilation that makes full use of a country's own resources and capacities and fosters the development of basic research at the local level must be encouraged.

Mr Prime Minister,
Ladies and gentlemen,

We have gathered here in order to formulate generally accepted ethical principles as guidance for a more responsible, equitable and sustainable form of management of technological and scientific developments primarily because we are concerned about our young people's future. For this reason, UNESCO attaches special importance to the Forum of Young African Researchers. These young scientists, whose contribution has proved particularly valuable and stimulating, will perhaps be the first people to apply in their everyday work the principles that we are endeavouring to establish today on the basis of multidisciplinary, multicultural and intergenerational dialogue. They are also future stakeholders, who will be living in a world shaped by the results and repercussions of what we shall achieve – or fail to achieve – here. We have a major challenge before us: building a viable and sustainable future together for future generations.

Thank you.

MACKY SALL: WELCOMING ADDRESS

Prime Minister of the Republic of Senegal

Madam Chairperson of COMEST,
Madam Minister of Scientific Research of Senegal,
Honourable Ministers,
Your Excellencies, Ambassadors,
Mr Representative of the Director-General of UNESCO,
Ladies and Gentlemen, Members of COMEST,
Mr President of the Academy of Science and Technology of Senegal,
Eminent Professors and Scientists,
Honourable Guests,
Ladies and Gentlemen,

It is with great pleasure that, on behalf of the Head of State, His Excellency Abdoulaye Wade, President of Senegal, I chair the opening ceremony of the Fifth Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), established by UNESCO in 1998.

You will understand that it is a great honour for our country to host this important session, the first of its kind in Africa, which has chosen to promote science and technology for sustainable development.

Africa is affected by many divides (digital, agricultural, social and so on). There is probably, however, one other major divide, the scientific and technological divide, between those who possess scientific knowledge and turn it into technological opportunities and the others. The scientific divide, still an unavoidable reality, is the source of many economic, political, social and even environmental problems facing African population groups. Africa, formerly "scandalously rich in natural resources", "is not poor but has been impoverished" and, today, has fallen behind in a globalizing world and the divide has widened by a hundredfold, if not more.

All the same, profoundly pan-Africanist, I remain convinced that Africa, always able to unite on the most important issues, will make up the ground that it has lost. We are strongly convinced that there will be no rapid progress towards sustainable development on our continent unless science and technological innovation are promoted.

Ladies and Gentlemen,

Fully aware of our responsibility with regard to the inexorable progress of science and technology, this occasion compels us to take account, in an even more practical way, of the need for the production of scientific knowledge and technological innovation to be founded on ethical considerations.

Science ethics is not only linked to the notion of responsibility and a sense of duty, but is also based on each person's more than legitimate aspirations to just and fair progress.

Ethics in respect of scientific knowledge and technology must be integrated into the overall finalization of a process geared to greater equality through the application of specific principles such as the need to respect the dignity of individuals, the need to remain aware of cultural differences, the need to alleviate suffering and the need for an equitable distribution of both the profits and the burdens of research.

The situation of exclusion experienced by some population groups in Africa, particularly with regard to the treatment of HIV/AIDS, raises questions for us as citizens and compels us to act to give people all over the world access to the best treatment available.

UNESCO was quick to respond to the urgent need to establish a specialized commission that would have the status of an independent advisory body. The commission, to which the Organization has assigned an advisory mission in regard to ethics in the field of science and technology, is as strategic as it is important, particularly to the countries in the South.

Ladies and Gentlemen,

It is in this context that we welcome the UNESCO Declaration on Science and the Use of Scientific Knowledge adopted at the World Conference on Science for the Twenty-first Century: A New Commitment, held in 1999: "The social responsibility of scientists requires that they maintain high standards of scientific integrity and quality control, share their knowledge, communicate with the public and educate the younger generation."

The culture of ethics obviously requires that it be integrated into the education system, from preschool through to university, and even into teacher training. It is only under these conditions that the values and virtues on which Africa prides itself will gain acceptance and provide young people with benchmarks so that they may take up the many challenges raised.

Ladies and Gentlemen,

If it is agreed that an approach based on technological innovation is the only sustainable and effective alternative capable of positively enhancing our specific characteristics and promoting the socio-economic development of peoples, then it must be recognized that sub-Saharan African countries face some problems in taking such an approach. In the main, it needs:

• to have qualified personnel at its disposal and to organize technical expertise in such a way as to have a critical mass of scientists capable of addressing the people's concerns efficiently and in real time;
• to combat the brain drain by creating laboratories that meet world standards and by improving the living conditions of research teams;
• to create the conditions for relevant knowledge and technology transfer to boost sustainable endogenous development and the provision of suitable products;
• to build capacity to ensure synergistic action by the various stakeholders;
• to create the conditions to arouse the interest of pupils and students and, above all, encourage girls to join science and technology streams, thus increasing in the near future the critical mass of our human resources, which is crucial to our policy of promoting science and technology;
• to ensure sustainable funding for research priorities in all sectors of activity;
• to rely on a system for the protection of intellectual property rights recognizing the inventions of scientists, the prerogative of farmers to store and exchange seeds, and access to and the fair sharing of profits made from the use of scientific knowledge.

Ladies and Gentlemen,

I am convinced that it will only be possible to take up these many challenges when we agree to establish centres of excellence based on our comparative advantages in a dynamic and effective system of networking research centres.

I may not conclude without congratulating UNESCO on this wonderful initiative taken to enable scientists generally to establish greater morality in research. UNESCO holds a great responsibility for science and education at the heart of the United Nations system. I should like to reiterate, on behalf of the President of Senegal, His Excellency Abdoulaye Wade, the Government and people of Senegal, our profound gratitude for UNESCO's constant support in vital sectors of development. Nor may I conclude without acknowledging the honour conferred on our country by UNESCO in awarding the 2005 Félix Houphouët-Boigny Peace Prize to His Excellency Abdoulaye Wade.

I welcome you all to Senegal and wish that your work will be crowned with success. I now declare the Fifth Session of the World Commission on the Ethics of Scientific Knowledge and Technology open.

Thank you for your attention.

EL HADJI IBRAHIMA SALL:
THE ETHICS OF SCIENCE: CHALLENGES FOR AFRICA

President, West African Polytechnic University
Centre for Research on Ethics and Development, Senegal

Mr Prime Minister of Senegal,
Mr Minister for Higher Education of Guinea,
Madam Minister for Scientific Research of Senegal,
Madam Chairperson of COMEST,
Mr Assistant Director-General of UNESCO for the Social and Human Sciences,
Mr Regional Director of IDRC,
Excellencies, ladies and gentlemen,

I should like to begin by thanking UNESCO for choosing me to introduce the world conference that brings us together here in Dakar and which is devoted to the ethics of science in general and, more particularly, to the problems this issue raises for Africa's future.

Of course, at a time of dramatic scientific and technological advances, this call to reflection on ethics awakens in me another age-old question: "What are poets for in a destitute time?" In turn humanity may now be wondering, "What is ethics for in an era of unfettered scientific and technical progress?"

Why do we need an ethics of science and technology? On what are we to base this ethics of science? How are we to integrate this ethics of science – universal by its very essence – into a concrete policy capable of preserving a moral ideal and encompassing the distinctive concerns of the African continent?

By providing human beings with the means to act, science gives them mastery of, and responsibility for, a specific situation. It creates the conceptual tools that shape people's behaviour towards things, their fellow beings and the universe. It offers human activity a range of prospects and, above all, initiatives. Thus, the tool structures the relationships between things, the relationships between people and, finally, our perceptions, projects and desires, and the scope and boundaries of what is possible. In short, technology structures the lives of people, who become one with the instruments that mediate their relationships with things and the world.

Along this path science is guided by universal criteria of validity: neutral criteria free from all moral considerations. Pascal had warned us: reason may be able to declare itself universal, but it cannot establish the value of things. In terms of value the subjects and objects of science are depersonalised and totally neutral. Whence our concern: can the individual researcher do as he likes? Must he preserve an ideal? If so, which one? And how will he be able to make these moral considerations non-utopian while allowing conscience to maintain its watch over science?

If we are to answer the questions raised by the ethics of science, we need both an analysis commensurate with the means that the past has bequeathed us and a determination commensurate with our responsibilities. We need ethics because science, as the history of its emancipation from philosophy demonstrates, is no longer capable of self-regulation. This will be my main contention here.

Science became autonomous and, from the outside, forced its own standards on things. Once it became free – like most of the researchers driving it forward – it imposed its norms, criteria and principles on all spheres of human activity. The global standardization of ways of living and thinking (think of biodiversity), the deracination and neutralization of space and time (think of the environment), political life dictated by bureaucrats and instrumental rationality (think of the encroachments on our freedoms) – all of these reflect the new scientific spirit. Always and everywhere we find the same metaphysical approach, by which science seeks to reduce nature to mathematics and man seeks to dominate the planet.

This approach, ladies and gentlemen, extends beyond the narrow world of scientists. Since it is the

approach which decides in advance how reality is to be treated, it excludes everything other than what is calculable and profitable. This same approach has been perceived in a number of different ways: by Husserl as the "crisis of European science", by Freud as "civilization and its discontents", and underlies Maurice Merleau-Ponty's campaign wanting to restore, in a concept-free world, the meaning of rivers and landscapes that we all had even before we knew what geography was. One senses here the activation of something essential concerning humanity's view of the universe as a whole.

In this rebellion by man against nature lies the very nature of technology, the essence of scientific progress: to the extent that Martin Heidegger in his essays and lectures was led to say that there was no point whatsoever in blaming the scientific researchers, who were no more than mere instruments. The ethics of science and technology would seem quite naturally, then, to transcend the limited – and innocent? – world of scientists. How is such absolution from blame possible?

For me to prove my point, ladies and gentlemen, please allow me a brief historical aside. In the course of a very short period – let us say roughly two or three centuries – remarkable events occurred on our planet that literally changed the fate of the world. In pursuing lines of enquiry that denied the random nature of the world, a handful of individuals – Pascal, the Chevalier de Méré, Laplace, Gauss, Leibniz, Newton and Galileo – established mathematical laws for a natural world that was henceforth to be measured, quantified and known. Flying in the face of a tradition insistent on the separation of science from power, Francis Bacon decided to bring the two together for the first time: *Sciencia et potentia in unum coincidat*. Gone were the days when Archimedes politely but firmly rejected King Heron's request that his mathematical discoveries be used for the making of war machines. Gone were the days when Alcibiades, at the head of the Athenian army, was concerned with "restraint" for fear that by advancing too quickly he would "lose the initiative".

These modern thinkers had new concerns stripped of all ethical considerations. Everything must contribute to this mathematical approach to nature and the domination of the Earth. Let us re-examine the most modern of them all, Descartes.

The world is there to be possessed, and science can help – a science that must primarily serve mankind against nature's exigencies. The aims of this approach would remain very close to people's concrete concerns: extending their lifespan, rejuvenating them to some extent, slowing the ageing process and reducing human suffering. This practical agenda for science and philosophy is the focus of all the thinking in the fifth part of the *Discourse*. In meditations on the heavens, space, the natural world, fauna, flora and the human body, the philosopher reveals a passion for a vast range of physical questions. This practical concern was dictated by a new programme: after so many centuries of pointless speculation, it was now time to understand the how of things, in order the better to act on them. The questions of the purpose of the world and the goal of existence were no longer the prime concern, centre stage now being occupied by questions of the physical world: the challenge was how to bring order into multiplicity in space and then time and then to use this knowledge for practical ends. By presenting himself as the ultimate purpose of things and the centre of the world, man reduced his relationship with the world to a right to dominate nature. No other purpose was conceivable beyond the one conferred on man by God's grace and which gave him a virtually absolute right to impose his thinking and his will on things. Nature and the world would have to get used to the idea of being malleable and readily manipulable.

This is – dare we say it – the ancient dream of the alchemists: a magical dream, which has been taken up again with and by the resources of science. To realize the dream the new science has to be based on a new interpretation of nature and the world. The world is not something already made; it still remains to be made and to be produced. To achieve this we must begin by penetrating the intimate secret of its composition and its changes, so as to be able to predict and act effectively on it. It was on this basis that the first scientific experiments began, the purpose being to analyse natural phenomena and encompass them within a conception that empowers us to act on them. The dream of contemplating a world at peace was succeeded by that of taking it over, of using it and profiting from it.

Thus the machine compelled recognition not only as a tool – an external element of the approach – but above all as a heuristic model for the way nature functions. The machine is the visible example of what man is. It is a way of functioning that has been intellectually conceived to render the structure of the world comprehensible. Everything visible is capable of being interpreted technologically, since everything – or almost everything – will reproduce the machine model. The invariability of divine laws makes that multiplicity not only intelligible, but also and above all open to invention, creation and production. The level of ambition was raised by the imperative of producing and of fashioning nature. The new style of thinking was beguiled by the automaton – epitome of the mechanical – to the extent of forcing the human body to be equated with a mobile machine. Ends are excluded from this new interpretation of nature: all that counts – as in a mechanics laboratory – is the "how" of things, the functioning of the internal principles that drive them. The natural is subordinated to artifice and technology asserts its rights.

Everything – up to and including the Supreme Being – is grist to the mill of the new philosophy. God has his place, since, among other things, he created the natural world, itself postulated as an artificial creation. Technology is seen as the dominant archetype: rather than imitate, it will invent, fashion and produce new things. *Genetic manipulation goes back a long way!*

But how is this new task to be carried out? How is this new kind of dream to be realized? How are we to achieve an interpretation of nature that will provide the keys to its mysteries? How are we to act in practice so as to dominate and rule over the world? Descartes suggested the solution. To achieve this relocation of the world, he would resort to the same stratagem as Archimedes: "Archimedes sought just one fixed and immovable point in order to move the entire earth from one place to another." The fixed point – the lever, to put it more precisely – was to be Descartes' stratagem, as it would be the sleight of hand needed for human intervention.

The first levers were real tools, instruments serving as intermediaries between our senses, our thoughts and things. Descartes speaks at length about this in a famous letter to Huygens of October 1637. The lever, the pulley, the screw, the inclined plane and the wedge are all, he says, devices by means of which "one may, using a small force, lift a very heavy burden", and the ideas he develops in the letter are sufficient, in his opinion, for "those involved in inventing new machines" intended to enhance human strength. In the first part of his *Optics* he expresses regret at the slowness of science, which has only discovered these instruments, vital to human action on nature, fortuitously and by chance.

The revolution went much deeper than this, however. Philosophers are aware of how the idea of method – conceived as a line of thought (*odos*) or, for Plato, a patient dialogue among several people – became, after publication of the *Discourse* in 1637, a breviary for going straight to the objective of "being the master and possessor of nature". They are not unaware either that by the 1880s the time was ripe for Nietzsche to demolish the age-old balance that philosophy had maintained between understanding and the will in favour of the latter; but above all, for him (still Nietzsche!) to assert, in the name of the will to power, man's imperative need to conquer the Earth – even though, he added, "humanity were to perish in the attempt".

Here we are at the very heart of the drama. A product of the world of philosophy, science, which Plato had said always needed enlightenment by a higher truth, found itself, with the coming of the modern age, not only out of the reach of any desire for wisdom, but above all, through the imposition of its principles and criteria, it became the philosophy of the modern world. Moralists would unanimously recognize that ethics had been outflanked by science and technology. Having emerged from philosophy, science cut free of it and took its place, to such an extent that any attempt to ground science in philosophy or regulate it in philosophical terms became illusory. Heidegger sums up this liberation of science from all ethical or philosophical regulation, the divorce between science and philosophy which marks the recognition of the project to dominate nature against the backdrop of the will to power. The expansion of science simultaneously signals its liberation from philosophy and the establishment of its self-sufficiency.

In such a context the ethics of science poses serious questions for humanity. Any attempt to reply respon-

sibly to such questions demands great lucidity and courage, beginning with a refusal to take refuge behind a catalogue of obsolete taboos – the way, in 2007, people still use Louis XV drawing-room furniture to cultivate the illusion of living in the past.

But if we conclude that the ethics of science raises more questions than science itself – which is incapable of regulating itself – is that to pronounce the end of ethics and so abandon all moral claims? What must be done to ensure that the ideal of the ethical regulation of science is not mere utopianism?

The answer lies in the indispensable coming together of ethics and politics. Without politics the ideal would be utopian. Political action is not without hope, because the ideal – and morality – are always there. There is always a moment when vice pays tribute to virtue, and lies to sincerity. The hypocrite, through whom such tribute is paid, is never cynical enough, for he still has a nostalgia for sincerity. Consequently, the task of politics is to watch over the general interest and the common good. The environment, biodiversity and energy resources hinge on questions of the common good – as does the preservation of the ethical principles that must guide all official regulation of science, whether in time or space.

The ethics of science is thus no less the business of scientists and researchers than of politicians, for it is their responsibility, in the context of protecting the general interest, to lay down the boundaries of what is permissible and what is to be proscribed and to promote ways and means of pointing research in directions that maintain the prosperity and safety of present and future generations. It is up to the politicians, working in conjunction with the scientific world and confronted by all kinds of inventions, to find ways of preserving the *principles of equality* (violated by genetic manipulations that give rise to a society of the "wanting" and the "wanted"), of *spatial and temporal solidarity* (violated by onslaughts on the environment and biodiversity) and lastly of *human safety*.

The world needs such rules in the main areas in which the major innovations of our century will take place: the computer revolution, the quantum revolution and the biomolecular revolution. Regional ethics regarding the environment, genetics, nanotechnology, energy and toxic waste are moving in this direction, even if there is a regrettable delay in developing the ethics of the information society, which is the area par excellence where all the dangers weighing on human freedom and safety are concentrated.

The agenda of the United Nations and UNESCO as applied via the currently existing instrument for ethical regulation – COMEST – is encouraging. But much remains to be done. More funds are needed. Better global coordination is needed. The capacity of poor countries to face global challenges needs to be enhanced. And we must act fast – faster than we are at present – if we are not to be overtaken by research whose "collateral effects", to use the currently fashionable term, we still have difficulty in assessing. Scientific and technological advances are pre-empting official and traditional forms of ethical regulation. This situation demands urgent thinking about the need to pursue scientific research while at the same time forestalling the dangers it presents for people, things and the universe.

It is also up to politicians to devise good research policies capable of anticipating the risks scientific and technological innovations can entail, and to ensure appropriate scientific recognition for researchers so that, in order to earn a living, they are not in the pay of private-sector decision-makers little concerned with the general interest. There is no ethics without the common good and no morality without an awareness of others. Finally, it is up to politicians to ensure that researchers' freedom is shaped and channelled by a rational sense of freedom. The ethics of science is an imperative because scientists are free human beings and science has freed itself from all outside influence.

Ladies and gentlemen,
Distinguished guests,

It is clear that an ethics of science, like the problems it raises, has a universal dimension. The challenges are common to the world as a whole and the dangers are mutual and global. This situation calls for global policies and ethics. In this issue of universal scope, Africa stands out mainly by reason of its underdevelopment and the lack of public policies regarding scientific research and the ethics of science. If Africa no longer

wishes to continue to be a dumping ground for toxic waste and a focal point for scientific activities incompatible with human freedom and dignity, it must come up with a sincere political viewpoint. This requires:

• the promotion of ethical issues and of all services relevant to the common good in the region (African Union);
• the promotion of ethics education in universities. In our own recently established university we have set up a Centre for Research on Ethics and Development, and I call on all those interested in these matters to support us in this venture;
• substantial public funding for programmes of research on the ethics of science, the environment, biodiversity, biotechnology, nanotechnology and the information society, which are directed towards anticipating the impact of certain discoveries on Africa;
• the formulation and implementation of effective policies for nuisance control and the monitoring of major hazards;
• the establishment of national ethics committees to contribute to standardization and legislation in this sphere.

Excellencies, ladies and gentlemen,

In the kind of meeting that brings us together today, it is customary to restrict discussion to the ethical responsibilities of researchers. Bowing to this practice, I should like to mention, in addition the notion of social responsibility of scientists, certain qualities required of scientists and researchers, e.g. emotional and psychological maturity, a capacity not just to reason but to make judgements; self-restraint, resistance to certain affective behaviour, a vision of the world broad enough to embrace not only science but all human activity and a spirit of open-mindedness that ensures pluralism and multidisciplinarity.

One may hope, of course, that scientists will face up to their responsibilities: because the will to do good is a matter of passionate commitment; because good must be done as a matter of urgency; because if something needs to be done it is up to me and to all of us to do it; and because what counts most of all in ethics is my personal status as a representative of morality.

It is not in order to set aside the social responsibility of researchers that I have chosen to break with tradition and emphasize the ethical responsibility of politicians. In a democratic society it is the politician who, in the final analysis, decides everything. Indeed, it is this that makes his calling the noblest of all. If I have insisted on the role of politicians, it is because I have a conviction fuelled by an intuition. The conviction is that science has become too crucial a matter to be left solely to scientists. The intuition is that our destiny is calling us, through politics, to take action to maintain reason as part of the public life – because outside society any progress by reason is impossible.

EL HADJI ISSA SALL:
ETHICS FOR SCIENCE: A CHALLENGE FOR AFRICA

Chairman, University of the Sahel, Dakar, Senegal

"Science without conscience is but the ruin of the soul"
François Rabelais

Pantagruel, sixteenth century

Introduction

To speak about science and ethics, as we are invited to do at this meeting, is to reflect on the establishment of a balance and to encourage dialogue, a dialectic, between progress and morals. In other words, this debate raises the issue of the proper use of science. It is important to remember at this point that for the thinkers and scientists who left their mark on the Age of Enlightenment, science was consciousness exercising its observational and experimental capacities on nature with a view to the discovery of divine manifestations. Accordingly, scientific activity became an act of meditation, an attitude of contemplation through which man was to transcend the material in a constant movement towards the spiritual.

Consequently science and religion became one, coming together in some great harmony reserved by God for humanity in its entirety. It was in that sense that the essence of science contributed to the common good, laying the foundations of progress that guaranteed the happiness of human beings on earth. Thus, primarily by vocation, science has defined a conscience for itself. It is already ethically rooted in the grandiose qualities of humanism. Is this not what Rabelais sought to call to mind in his celebrated maxim "Science without conscience is but the ruin of the soul"? Against the yardstick of that set of values that constitutes human excellence, science still connotes beauty, peace, progress, well-being, development and happiness. What an optimistic vision, you may well retort!

Why, then, wonder about the already sacred relationship between science and ethics? Why ask questions about the future that science holds in store for humanity? In other words, what justification is there for our existential Angst in the face of the lightning progress of science and technology at the beginning of this third millennium? What code of conduct should we Africans adopt in response to science that, while enriching us, seems to make us the victims of globalization and the digital divide?

The truth is that everyday experience forces us to accept the obvious. The West's monopoly on science and technology is a power that gives it a stranglehold on the world and which guarantees it the right rigorously to control the stakes of globalization. Through science, the West exerts a dictatorship over the rest of the world, which may at any moment be affected by its excesses and blunders. In this, the most informed thinkers have long sounded the alarm. They have warned insistently of the errors of science, and history has to a large extent confirmed their wisdom, for it has been marked by perilous adventures and suicidal experiments on which science has taken humanity.

In many respects, science and technology are still subject to the demonic tyranny, the insane passions, the lust for conquest or simply the moribund childishness of man. Indeed, in these times of geopolitical restructuring and reconfiguration of civilizations, it is the constant risk of error that invites us to rethink the ethical framework of invention and discovery. This situation can be explained in part by fear of the moral impasse that is created by illusionism, disenchantment, the fragmentation of knowledge and cultures, individualism and the transformation of social ties.

We must accept the obvious. The myth of progress loses credibility, as the catastrophic consequences of economic development increase, above all among the poor who live in the LDCs. The pretext for self-promoting research has always been that it would heal and feed as many people as possible and improve living conditions. However, instead of these advances, modernization has caused such an ecological disaster that the most basic necessities, such as clean water and air, healthy food and vegetation, have become luxuries. Moreover, the idea of continuous improvement

of living conditions owing to technological advances obscures the subjection of individuals to phenomena that make them daily dependent on new technology and the compensatory gratification that it accords.

Ethics in question

Traditionally associated with the natural sciences, and the living sciences in particular, ethics today has made inroads into the social sciences, the "hard" sciences and communications and information technology. While it now forms part of our everyday vocabularies, gives rise to reports, conferences and congresses and is currently a key societal issue, it is still necessary to discuss its true significance.

What, then, is ethics? as Jean Bernard asked Hélène Ahrweiler. She replied that the word "ethics" had two etymological roots. The term *itos*, which means the conduct of the soul and the term *etos*, complementary to the above term, which refers to all rules relating to respect for moderation. Ethics is the discipline that takes both *itos* and *etos* into account. It ensures harmony, which stems from proper conduct in all acts, in a word, from understanding between the soul and the environment. It presupposes rational action. It is the preserve of human beings. Comte-Sponville (2001) has written: "Ethics is a task, a process, a journey: it is a thoughtful approach to life in that it leads to a life of goodness, in the Greek tradition, or the least bad life possible, and it is the only true form of wisdom." For the ancients, ethics, morality and deontology were three ways of saying the same thing. Since Spinoza and Kant, however, it has been important to draw a distinction between the terms.

The Robert dictionary of the French language defines ethics as the part of philosophy that studies the foundation of morals: that is to say the moral principles that underlie human conduct. It is a way of life, aimed at happiness and culminating in wisdom. It includes morality and an answer to the question "What should I do?". Morality, for its part, is a body of rules of behaviour regarded as absolutely good and consists of the duties that we impose on ourselves independently of any expected reward or punishment. It is therefore free of ulterior motives. Morality therefore commands and ethics recommends. Deontology concerns good professional conduct and consists of essentially moral principles targeted at a group of people. The emergence of a professional code of ethics is generally a sign that a profession has reached maturity and is seeking recognition.

Responsibilities and codes of conduct for scientists

The advances of science and new opportunities for its application raise the question of standards and values. Knowledge for the sake of knowledge is no longer a goal of modern science. It is market potential that determines whether or not a research team engages in the development of a product. As pure research no longer provides guarantees of a return on investment, it is applied research, more profitable and less risky, that is now predominant. The myth of pure science was dispelled when science and industry became definitively interlinked. "Modern" science has, since its beginnings, sought primarily to produce durables through the use of machines and is thus technoscience.

The researcher's everyday life is often one of solitude in the face of concrete problems, in the absence of any professional framework within which to discuss with others, ask questions and make decisions with regard to ethics. Questions arise as to what motivates researchers, the constraints that they face and their relations with industry and with society. Difficult issues abound and concern the means of reconciling the freedom of research with its relevance to industry and thus its capacity to attract funding, the intellectual stakes of originality, recognition by academics and the monetary rewards of success.

Scientific research is riven with contradictory lines of reasoning. The call for African scientists to become responsible is not a call for them to take the place of politicians, but rather for them to be answerable for the enormous impact of their endeavours on the future of their continent.

These questions have now become extremely pressing issues and new approaches are thus required. Whether the issue in hand concerns humanity's predatory behaviour which is destroying the world's biodiversity

and climatic balance, nuclear proliferation, advances in genetic engineering, or the risk of losing control over the products of human ingenuity owing to error or fear, it is our survival as a species that is at stake today. It is not a question of muzzling science under the pretext that it has the potential to cause damage, but rather of inviting scientists to reflect on their responsibilities and on the potential impact of their practices, as discovery per se is not bad but the use made of a discovery can be harmful and it is the misuse of scientific practices that must be combated.

The role of politicians

From nuclear physics in the 1940s, we have moved to biological research. This science now manipulates living organisms but cannot predict the long-term consequences of its activities.

GMOs are spreading in the wild, attempts at cloning in laboratories worldwide are being revealed, the first step having been taken with Dolly. For many people, including the most uneasy and unresponsive, it is only a matter of time since the technical means to do so exist.

Experts very often design, assess and take part in projects on which they are required to make decisions. Moreover, specialization in science is today such that very few experts are truly able to validate a line or, more precisely, specific use of research. According to Edgar Morin (1982), politicians are overwhelmed by the complexity of the world in which they live. Although they hold enormous responsibilities, they are totally out of step with the concerns of citizens because they lack information and rely on the opinions of experts. Instead of supervising scientists, we should be supervising those who put science into practice.

Although the science of the seventeenth century perforce severed all ties with ethics, theology and politics in order to be independent, an amoral, rather than an immoral, stance that fostered development, the situation today is altogether different owing to the great capabilities that have developed, in particular, since technology and science joined forces. Technology is a means of putting science to the test and technology, itself linked to industry and therefore profit, means that science is no longer independent. It has become the motor of a process in which powers of destruction, such as atomic energy, or of manipulation, such as genetics, are jumbled together. Science can no longer be left in its amoral state.

For ethics to play a role in science, political intervention is necessary. There is no natural connection between science and ethics. They must be brought together. Ethics and politics are only vaguely linked and politics and science only interact on a purely practical level because governments use scientific discoveries. We are currently facing energy problems and the question is whether we should continue to use fossil fuels or try atomic fission. Ecological or environmental problems and issues relating to genetic manipulation are no less pressing and concern the life of every citizen. Yet politicians are locked into their routine views of the world and do not realize that existential questions have become political ones.

Without attempting to cover all of the scientific fields which range from nanotechnology to space, and include the life sciences, structural and physical science, in which ethical considerations must be included, we shall refer to three cases that are of particular concern to us in Africa: information and communication technology (ICT), biometrics in Senegal and toxic waste in Côte d'Ivoire.

The ethics of ICT

Although information technology does not help to eliminate or redress inequalities in our society, this is not due to the nature of the technology but rather to the context in which it is developing. The language of information technology may, however, lead to a mentality that raises both uncertainty and ambiguity. In other words, by reducing reality to binary language or numbering, artificial machines allow neither disorder nor vagueness, thus dispelling subjectivity and intuition, important – even determining – elements of our culture, and placing emphasis on objectivity only. Whether such a turn of events is unavoidable or not, information technology is likely to lead to the predominance of "system" imperatives. It is therefore necessary to place emphasis on solving the problem rather than on debating the significance of the problem.

In other words, information technology forces us to

advance at high speed and we are very often tempted to ask "how" rather than "why". That however is the basic question which marks the inception of any ethical approach.

The ethics of biometrics – the case of Senegal

In many African countries, the registration of births, marriages and deaths is not compulsory. In the absence of any legal identity, no political, civil or social right can be recognized or exercised. Migrations on the one hand and electronic and media flows on the other have overturned the established order. Biometrics is the answer to the problem of verification of identity. However, if biometrics becomes standard as seems likely, the very concept of identification is destined to change. Linking individuals to a date of birth, a city, a country or a gender will no longer have any importance. It will suffice merely to link them to one of their physical characteristics. In other words, we are on the verge of a new concept of citizenship: biological citizenship.

Biometrics may well play a structural role in the constitution of societies. Every day billions of information items concerning us and our bodies travel the length of electronic circuits. Our virtual bodies are dismembered and identified innumerable times in the streams of thousands of data banks to which we belong. What, however, is the status of a computerized body? What value does information collected by a biometric system and stored in a data bank have? This is much more of a political question than is apparent at first sight.

The ethical debate today is between biometrics as a civilisational endeavour, as Plato wanted, or biometrics as a tool for ascertaining and plundering identities, and this debate concerns scientists and politicians as well as ordinary citizens.

The problem of toxic waste – the case of Côte d'Ivoire

In Côte d'Ivoire there was recently a case of toxic waste disposal in rubbish bins. This resulted in several deaths and thousands of people are still suffering the consequences. Procedural breakdowns, negligence and inaction by the authorities are listed as the major causes in the 100-page document submitted to the Prime Minister of Côte d'Ivoire after two months' work. The document based on accounts given by 78 people charts a long chain of responsibilities at both the public and private levels. "Problems linked to insufficient managerial rigour, failure to observe personal ethics and the failure to apply regulations resulted in toxic waste entering and being dumped in the district of Abidjan," as Mrs Diakité states while regretting that "private interests had been placed above the public interest". On resignation the Prime Minister said that "the government of Côte d'Ivoire wanted to show the way by returning to the notion of good governance and ensuring that all citizens understood that, if the Republic is to function sustainably, it must be grounded in ethics".

Conclusion

Such ethics must be resolutely geared to the future. Ethics must assist human beings in making choices, yet, all too often, discourse on ethics is reactive to new technology and causes disquiet because it is viewed as condemnation after the event or as a brake on scientific efforts.

With a view to protecting humanity from the threat of manipulation, it is important that ethics be, if possible, forward- rather than backward-looking. Ethicists must thus pay great attention to research trends in cutting-edge fields. This means that the scientist must gradually draw on the store of knowledge to engage in dialogue from which standards and guidelines should emerge. This condition is all the more achievable because scholars often take the initiative in terms of such reflection. The involvement of the economic world, which benefits substantially from the application of new technology, does, however, seem more problematic. Yet its attitude is likely to be decisive.

Confronted with the conscious or unconscious manipulation to which we may fall victim, is there a conceivable response that would allow us to preserve and even promote such crucial values as liberty, social justice and participation?

In a work that is likely to be of great interest to all those who are keen to find a humanist solution to relations between humanity and science and humanity and technology, Edgar Morin (1982) emphasizes that only

ethics currently protects us from attacks against man as a social, autonomous and free being. He advocates a complex process that links science to ethics, and ethics to politics in order to break down the hermetical barriers that have often marked relations between science and its rationalism on the one hand and ethics and its subjective humanism on the other.

CHARLES BECKER: CODES OF CONDUCT, CODES OF ETHICS AND THE ESTABLISHMENT OF BODIES FOR THE ETHICS OF SCIENCE AND TECHNOLOGY IN AFRICA

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Introduction

Reflection on ethical issues raised by scientific and technological "progress" and on scientists' responsibilities to society is obviously nothing new. However, it has now led to the suggestion that action be taken to formulate codes of conduct and codes of ethics for scientists. UNESCO has thus called for the ethical aspects of the Declaration on Science and the Use of Scientific Knowledge, adopted by the World Conference on Science organized jointly by UNESCO and the International Council for Science at the University of Budapest in June 1999, to be studied, with emphasis on codes and regulations governing scientific professions.

It is about this process that I have been invited to speak before this gathering. The point of view that I shall be developing in this paper derives from my dual experience as:

- an historian and anthropologist specializing in law before turning to philosophy to teach bioethics and the history of health codes, which explains the presence of certain references;
- a member of a health research ethics committee in a country of the South for four years, arguing on the basis of clearly established imbalances between scientific practice and the attendant ethical reflection.

Allow me to open my remarks with an anecdote indicative, moreover, of considerable ambiguities in relations between the sciences: a few years ago I was approached by a colleague, a microbiologist, who was looking for a social anthropologist to help him to apply some of his important research findings and to impose the technological innovation "by stealth" without having to persuade the peasant societies concerned. This circumstance is doubly revealing, firstly of scientists' belief, or even faith, in the non-negotiable nature of scientific "progress" – which is to be imposed without any discussion of the priorities to be set in the search for knowledge or of the options open to societies – and secondly of the tacit ranking of the sciences, which seems to relegate the social and human sciences to an ancillary role.

I consequently wish to offer here a few thoughts based on research experience in the South, given UNESCO's current drive to achieve progress in Africa, among other places, regarding the elaboration of the standard reference texts which are needed for scientific practice and which must, in a word, compel debate on such practices in all fields of knowledge. I should stress at once that reference texts will be useful only if they are drawn up at *both* the international and national levels, being appropriated (rather than adapted) by local scientific communities and countries in the context of exchanges forming part of a basic trend towards a more egalitarian development of scientific knowledge in societies throughout the world. I should subsequently like to outline a few options for establishing bodies responsible for ensuring compliance with the standards drawn up by scientific communities and also by society. Lastly, I shall emphasize that there is a pressing need to develop appropriate training in order to create a clearer awareness among scientists of their responsibilities and actually to teach a spirit of ethical inquiry and thus promote the urgently needed social debate on the uses of science and technology.

The role and social responsibilities of scientists in Africa

The *Report by the Director-General on the advisability of elaborating an international declaration on*

science ethics to serve as a basis for an ethical code of conduct for scientists (August 2006) endeavoured to take stock of reflection on ethical questions raised by scientific and technological progress through two main types of activity being promoted by UNESCO: (1) *surveying the wider field of science ethics* and particularly topics that are relevant from an international perspective by carrying out consultations with individual scientists, philosophers, policy-makers and relevant international and regional organizations and stakeholders in all regions, in order to identify and discuss ethical issues that merit further reflection; (2) *collecting and analysing* existing codes of conduct in various scientific and professional areas, and in different countries and regions.

The history of such reflection on ethical issues raised by scientific and technological "progress" and scientists' responsibilities to society is marked by numerous gaps in many countries of the South. Its latest advance has led to the suggestion that codes of conduct should be drawn up for scientists, since the lack or inadequacy of such codes constitute obvious drawbacks. From the thoughts of the sociologist Max Weber, just after the First World War, on the respective occupations and vocations of the scholar and the politician, to the creation of the concepts of "bioethics" and "biopolitics" and the philosophical work of Hans Jonas on the *responsibility principle*, the question of responsibility has been a constant, requiring continuous dialogue between scientists and society.

However, scientific communities throughout the world are not all at the same point, and progress in the field of ethics and the drafting of codes of conduct is very uneven. It must be emphasized at once that there is little African participation in these debates, as is apparent, for example, from the May 2006 Bangkok Consultation Workshop on Codes of Ethics in Engineering, Science and Technology and from meetings on bioethics. Although Africa is genuinely represented among the members of COMEST, there have not yet been any specific meetings on codes of ethics for Africa, and we must hope that this meeting in Dakar will constitute a first major step, finally marking a point of departure and leading to African meetings on codes of conduct and codes of practice and, beyond that, the responsibilities of scientists in Africa.

Some imbalances

Historical reflection is needed if we are to understand these gaps, which are obviously linked to the history of how science took root in Africa and to the underdevelopment of ethics training, which, although such training is not so long-established in Northern countries either, is particularly apparent in sub-Saharan Africa. Suffice it to recall that scientific communities in Africa are still very fragile and to point out the extent to which facilities on the continent are highly unsuitable for conducting advanced research, thus perpetuating a situation of dependency and inequality. Simon Ellis's presentation at the recent Dakar workshop on science statistics highlighted these drawbacks:

> "It is necessary to have scientific and technological experts who can identify the possibilities arising out of scientific innovation and discovery and work out effective policies in fields such as science, business and resource management. Such specific expertise is essential for innovation and performance.
>
> Africa lacks skilled personnel in all these fields, and one of the main reasons for this shortage is the exodus of a large proportion of skilled African personnel to the developed world. Some 70% of Ghanaian medical staff trained during the 1990s have left, and, according to the estimates, there are more African scientists and engineers working in the United States than there are in the whole of Africa.
>
> This shortage begins in higher education, which ought to be generating the talents which the continent needs. Higher-education and research establishments can also improve government accountability and increase participation and citizenship. In addition to training skilled personnel, they carry out independent research and analysis which fuels lively discussion and which can substantially improve the effectiveness of government policy and other services." (Ellis, 2006, p.2).

Any discussion of the ethics of science and technology must start with these established facts, while

also considering how the present imbalances can be diminished, without regarding them as inevitable.

There is no need to discuss at length the situation of universities in sub-Saharan Africa or the small number of recently established scientific academies for specific scientific disciplines. Nor shall we expound on the minimal level of scientific publishing by African researchers in Africa (through traditional channels or using the new information and communication technologies (NICT)), on the disparities between scientific communities in different disciplines, or on the enormous inequalities between men and women in access to scientific training and knowledge. We need only note that the efforts already made have not reduced a "digital divide" (Mvé-Ondo, 2005) whose very existence ought to elicit more discussion and more measures to change a damaging situation because it represents a major handicap in meeting the current challenges of persistent poverty and attaining at least some of the ambitious Millennium Development Goals.

Thoughts on research and technology practices in Africa

The example of health research in Senegal gives an idea of the important role of history in understanding the historical roots of medical practice and the oppressive legacy of a past marked by delay in forming an African research community and gaining access to biomedical knowledge as well as by actual denial of local knowledge. Health is a field of science in which research practices are already quite well established and the formation of scientific communities is more advanced. However, there is still little discussion of these practices, and the weaknesses regarding existing codes have been emphasized. In particular, there are no codes of conduct, and reference is still frequently made to international provisions that have not been adequately assimilated. This observation can be extended to the other scientific disciplines, and there is an urgent need for consultation in all disciplines – including the social sciences – in order to draw up codes of conduct, especially where they do not exist at present.

In the light of my experience as a member of an ethics committee in Senegal, a number of well-established facts stand out regarding the projects submitted in the last four years: the research agenda is still very largely set elsewhere; research initiated locally receives infinitely less funding than research proposed by institutions of the North; laboratory facilities often "necessitate" the undebated transfer of samples and the formation of whole "biobanks" abroad, the de facto existence of which has not been the subject of ethical discussion. Consideration of ethical aspects is still very inadequate, and even when protocols have been approved by the relevant committees in the North, they often raise fundamental problems in the South, including the responsibilities of researchers and promoters in situations where the law does not provide sufficient protection for those involved in research and where researchers themselves are also fallible.

What can be said about other scientific practices and the dissemination of technological innovation in Africa except that statutory frameworks are still very weak when it comes to defining the responsibilities of researchers and users of new technology? The adoption and ratification of international agreements and declarations of international organizations are undoubtedly useful but insufficient to guarantee environmental protection, respect for life and recognition of intellectual property rights or to give voice to the demands of society and lay down priorities.

The delay in adopting laws is also mirrored by delays in formulating ethical thought: the establishment of statutory and regulatory frameworks is therefore a matter of extreme urgency here and can occur only on a realistic basis where the precautionary principle, representing ethical accountability and the rule of law, will undoubtedly require "a number of changes in scientific culture and in the way in which risk assessment is performed" and should no longer be regarded as a barrier to research and the use of new knowledge.

Which kind of codes of conduct, practice or ethics does Africa require? Which kind of monitoring bodies is needed to apply codes of conduct or ethics in Africa?

We cannot use these various terms, often employed indiscriminately or interchangeably, without first clarifying them. Codes of practice and codes of conduct must be distinguished from codes of ethics, for each

type of code is associated with a specific set of questions and gives rise to specific regulations. However, we can agree that ethics provides the basis for codes of practice. Further efforts and reflection are thus required finally to standardize definitions and above all to set out more clearly the basic distinctions between different types of register, reflection and responsibility – the ethical, the moral and the statutory – which are today defined with varying degrees of adequacy in relation to existing laws and regulations in society.

Discussion of the terminology is necessary, but debate is needed in particular to determine the scope of the various types of code that may be adopted after the consultation process, to plan the establishment and define the role of the bodies responsible for applying them and to demand appropriate resources. These codes will therefore emerge from discussion within the scientific community, admittedly, but must also take into account the contribution of science and technology users and the debates among scientists, society and legal specialists.

There is an urgent need to finalize codes of conduct for scientists. To this end, account must be taken of the variety of practices in the various scientific disciplines, the history and development of practices in different parts of the world and consequently the range of contexts in which science has developed in the countries of the South. In Africa, in particular, human and technical potential is uneven and there is often a considerable degree of dependency. Account must also be taken of specific regional situations in which there are often no ethical bodies in fields of basic and applied research and technology (for example, ethics committees) and in which ethical questions are rarely raised by society.

However, codes of conduct should not simply be an individual invitation to persons involved in developing science and technology to abide by ethical rules. They should also constitute a point of reference for collective initiatives – by professional associations and political authorities – to discuss the principles and purposes of scientific research and technological innovation and for a clearer definition of the rights, duties and responsibilities of scientists in society.

It seems obvious that associations of scientists and teachers, and the research institutes and universities that constitute Africa's research centres, should give priority to the adoption of rules on the status of researchers, enshrining moral and ethical principles, and, better still, concomitantly to the formulation of appropriate codes with universal content for all scientists as well as specific content for branches of research and the possible uses of knowledge.

In this process, the production of new codes and updating of existing ones will make it possible to emphasize researchers' responsibilities in producing, disseminating, subsequently using and then sharing research findings with society. There is a fine book on the ethics of research and the ethics of care in developing countries, which shows just how vital the connection between scientists and users is to the promotion of ethics.

It must also be pointed out just how much the absence of ethical training remains a major handicap, calling for strong measures. A review of ethical training is urgently needed in the scientific and teaching communities, in professional associations and among students. There is growing awareness of the pressing need for education and training programmes on ethics, bioethics and the law relating to scientific practice and institutions to provide such training. Appropriation of bioethical questions by a wide-ranging audience is particularly crucial, as is, therefore, the preparation of teaching materials to provide a range of training courses taking account of the existing knowledge of the various sectors of the public. It is desirable to strengthen university teaching, not only in the science and medical faculties but also in the human sciences, law and politics, economics, veterinary sciences, communication sciences, educational sciences and management sciences. Similarly, joint programmes should be prepared by trainers in various countries in order to promote exchange, while taking account of linguistic diversity (speakers of English, French, Arabic and Portuguese, not to mention the African languages). This could be done with the support of the partners attending this session of COMEST and in consultation with stakeholders so that society may be properly informed about the issues of scientific research and biotechnological progress and will thus be in a position to understand what is at stake in research and express an opinion about the choices and risks.

I shall conclude here by setting out a few questions on codes and authorities which consultations in Africa would make easier to raise and to which they should help to provide answers.

- What kind of commitment to the codes of conduct is (or will be) required from scientists?
- What kind of forum should be created in society and within professional associations to encourage the dissemination of information and promote dialogue between researchers and the stakeholders in society?
- How and where should bodies responsible for evaluating and encouraging ethical debate be established? Various types of bodies are possible, such as subject-specific associations of scientists, learned societies, universities, basic and applied research bodies and, last but not least, national science and technology ethics committees, and international or even global committees.
- What tasks should be assigned to these bodies? Should they regulate the practices of researchers and research teams, deliver opinions on questions raised or make recommendations on research priorities and best practices?
- What should the membership of these bodies be and, more specifically, what sort of expertise in science ethics should their members possess?
- How can these bodies interface with the societies in which scientists are working and to which they are answerable?

There is also the basic question of whether the code of conduct should be binding, which should lead to reflection on the connection between existing codes of practice in some professions and the law and regulations on scientific and technological practice. In particular, special attention should be given to the question of the specific nature of codes of ethics in comparison with occupational codes and broader codes defining the rights and duties of individuals. The answers to this question will no doubt underline the importance of adopting and applying codes of ethics but will also recognize the fundamental and founding role of the law, which protects life, individuals and societies and ultimately ensures that human rights are respected.

Conclusion

The major question

How can Africa be given the opportunity to develop laboratories and adequately funded research teams setting their own agendas and continuously engaging in moral and ethical debate, thus enabling researchers to contribute to the production and dissemination of knowledge and technology?

Political will and social demands

Although it is the researchers' wishes that lay the foundations, political will and commitment are indispensable, together with social demands expressed in a dialogue among scientists, politicians and society in which the scientific community's choices are explained and priorities are set jointly.

The drafting of codes for scientists and the establishment of bodies and mechanisms to regulate practice are urgent tasks that must go hand in hand with the introduction of social debate on the need to promote science and technology and all of their applications to benefit society and with development of ethical training for researchers themselves and for their students.

Endorsing the conclusion of a work on biotechnology in Senegal published by the Academy of Science and Technology of Senegal, which is applicable to science in general and to other African countries, we must stress that it is important for countries of the South to appropriate science and biotechnology and we draw attention to the issues of equity and ethics raised by their use. Scientific researchers in Africa have already begun to do so but strong new initiatives should be taken as soon as possible by the authorities to promote and develop science and biotechnology. In the meantime, researchers controlling powerful instruments should not lurk within the confines of state-of-the-art laboratories but must show strong determination to harness the new knowledge to serve the public and give practical effect to the idea of *knowledge-sharing* and to full respect for ethical principles. Science and biotechnology should also form the subject of genuine public debate to strengthen scientists' commitment to work on behalf of their societies and the living world. However, greater debate within scientific communities

in Africa cannot take place if there is no firm commitment, in exchanges among all scientific communities, to a fairer and more humane world. The commitment demonstrated by UNESCO and its Ethics of Science and Technology programme to tackling "unbridled scientific progress" that is "not always ethically acceptable" will "place such progress in a context of ethical reflection rooted in the cultural, legal, philosophical and religious heritage of the various human communities".

SONG SANG-YONG:
A CODE OF CONDUCT FOR SCIENTISTS: 1974 AND NOW

COMEST member

In an effort to pursue reflection on the code of conduct for scientists, COMEST has had a series of meetings since 2004. UNESCO made the Recommendation on the Status of Scientific Researchers in 1974, and it has never been updated. COMEST decided to utilise the Recommendation as the starting point of the work towards the code of conduct for scientists. In 2006, it held six consultation meetings on the UNESCO Recommendation in Tokyo, New Delhi, Geneva, Bangkok, Seoul and Belo Horizonte. This is a revised version of the background paper for these meetings.

The UNESCO Recommendation was made a generation ago. However, it still seems to be based on the concept of science that was prevalent in logical positivism and Mertonian sociology of science of the 1930s. The traditional view of science with its norms of "objectivity" and "disinterestedness" was seriously challenged by the post-analytic philosophy of the 1960s and the sociology of scientific knowledge of the 1970s. As a result of these criticisms of science, including the anti-science movement, the notion of the ethical neutrality of science became obsolete.

There is no consensus on the nature of science among philosophers. It is true that the new view of science has not been accepted, especially in the scientific community. The majority of scientists still cling to the traditional view. The "Science Wars" of the 1990s is a good example of the orthodox scientists' backlash against the supposedly subversive attempts of cultural studies of science and postmodernism. Nevertheless, the Recommendation should reflect the changing concept of science.

The Recommendation is focused on the status of researchers, and is mainly interested in the freedom of science and the rights of scientists. Ever since the trial of Galileo in the seventeenth century, some scientists have had difficulties with the church. Interventions in science by the church have been weakened considerably in recent time. Evolutionists in the United States, however, are still harassed by creation science, a pseudo-science. Freedom of science was severely threatened in Nazi Germany and the Soviet Union under Stalin. Aryan science and Lysenkoism were unforgettable nightmares for scientists. Even after World War II, the Cold War and problems such as racial discrimination brought forth the issues of freedom in the conduct of science. In response, ICSU formed the Standing Committee on the Freedom in the Conduct of Science (SCFCS) in 1963.

As the adverse aspects of science became apparent in the latter part of last century, a shift from freedom to responsibility was inevitable. This meant that ethics of science became a consideration of utmost importance. The creation of the Standing Committee on Responsibility and Ethics of Science (SCRES, 1996-2002) in ICSU and the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST, 1998) in UNESCO was a natural outcome. The World Conference on Science in Budapest (1999) was the turning point towards the social responsibility of scientists and the ethics of science. There is no doubt that the autonomy and freedom of science and the welfare and rights of scientists are as important as ever. The tension between freedom of research and government interest and the trend towards increased commercialisation are new problems. However, more emphasis on the responsibility and ethics rather than on the freedom and rights is essential. It is justified by the fact that "science which was seen as a positive force in securing justice, human rights and freedom is no longer what it used to be" (Fenstad, 2003).

The Recommendation mentions environmental problems, but it is not free from anthropocentrism. The time-honoured Cartesian distinction between humans and animals is now universally refuted. Animal issues were not included in the Declaration at the World Conference on Science in Budapest. The debates on animal rights are ongoing, but an increased concern for animal rights and animal welfare is badly needed. The concept of sustainable development, which was adopted at the UN Conference on Environment and

Development, Rio de Janeiro in 1992 and reaffirmed at the World Summit on Sustainable Development, Johannesburg in 2002, should also be added.

The accelerated development of bioscience and biotechnology after the 1970s raised various new ethical issues. Bioethics, dealing with the Human Genome Project, GMOs, test tube babies, cloning, stem cell research, etc., suddenly rose to an extremely important field. Western bioethics started with the reflection on the cruel human experimentations by Nazi doctors. The Nuremberg Code (1947) and Helsinki Declaration (1964) are perennial classics. The irony is that the Prussian government and Weimar government made even stronger and more extensive guidelines than the ones mentioned above in 1900 and 1931 respectively. New problems such as informed consent and institutional review boards or ethics committees appeared. Bioethics is very sensitive and controversial, since it is related to research with human subjects and human reproduction. The Universal Declaration on Bioethics and Human Rights in 2005 is a monumental achievement of the International Bioethics Committee (IBC) of UNESCO, in addition to the Universal Declaration on the Human Genome and Human Rights (1997) and the International Declaration on Human Genetic Data (2003). "Bioethics is no longer the exclusive concern of scientists, medical professionals or policy-makers. It concerns all people" (Ten Have, 2006). Bioethical issues should be given top priority. The Universal Declaration should be the basis to go further.

In the twentieth century, there were two cases of bacteriological warfare in East Asia. Japan conducted biological weapons research, including human experimentation, in China from 1932 till the end of World War II. During the Korean War, allegations that US Forces had used bacteriological warfare in North Korea and Northeast China were raised. Big powers continued the development of biological weapons and some developing countries joined the group.

After the September 11 tragedy, the possibilities of bioterrorism caught much attention. Bacteriological warfare is a serious threat to humankind. At the IVth International Conference on Bioethics (2005) in Gijon, the Declaration against Biological Weapons was adopted. Will the successful campaign for nuclear disarmament half a century ago happen again? Scientists should be encouraged to consider the problem sincerely. In general, scientists are in agonies with military research. Many research projects are somehow connected with the military. It is a grave problem for scientists to cut the military connections.

Breakthroughs in information and communication technology are changing human life in all respects. One billion people on earth are interconnected on the Internet. The digital revolution is regarded as a more significant event than the fall of socialism at the end of twentieth century. It is accelerating globalization and social changes. It also benefits productivity, economic growth and international cultural exchange (Evers, 2001). On the other hand it is suffering from the problems of privacy, alienation and cybercrimes as predicted half a century ago. The Internet calls for new ethics appropriate to a new era. It is the engine driving us towards increased inequality. International security is another problem to be solved.

Risks and uncertainties are two characteristics of contemporary society. The emergence of unpredictable and uncertain, but possibly catastrophic risks resulted in the development of an anticipatory model, the *Precautionary Principle*, to protect humans and the environment. It was a shift from post-damage control to pre-damage control of risks. The Precautionary Principle is useful not only for environmental ethics but also for the ethics of emerging technologies, including nanotechnology.

During the past decades, scientists, laypeople and politicians have become increasingly aware of the importance of ethics in scientific research. Several trends have contributed to these growing concerns. First, the press has covered stories on ethical issues raised by science. Second, scientists and government officials have investigated, documented and adjudicated cases of ethical misconduct. Third, science's increasing interdependence with business and industry has generated conflicts between the values of science and business (Resnik, 1998).

Scientific misconduct became a public issue in the United States in 1981 when the US House of Representatives held its first hearing on the problem. In 1989, the Public Health Service created the Office of Scientific Integrity in the National Institute of Health.

This means that research ethics began to be institutionalized. Similar institutions were made in Scandinavian countries, Germany and UK during the 1990s.

In the history of science, frauds and fakes are not rare. However, the recent scandal of Hwang Woo-Suk in Korea is one of the biggest considering its scope and impact. The collapse of research ethics in the Korean biotechnology is not only a severe blow to Korea, but also throws many problems to the whole world. In spite of the continuous criticisms from bioethicists, Hwang was a national hero and international star fully supported by the government, mass media and people. He looked invincible. Thanks to the information of a whistleblower and the tenacious investigation by the producers of MBC TV, his researches were revealed to be huge fakes. It was fortunate that the verification efforts of young scientists and prompt investigation by Seoul National University brought the case to conclusion. The Korean government hurriedly began to make a guideline for research ethics and research integrity committees are appearing in many universities. Increasing frauds and misconducts in research are big problems all over the world. Research integrity is a challenge to the scientific community.

Science and Society: Rights and Responsibilities, an ICSU Strategic Review (2005) emphasises the changing relations between science and society. It points out that with regard to expert understanding of the relations of science and society, there have been significant developments in academia in recent decades.

Problems of science today are too complex to be solved by scientists alone. This is the reason why cooperation with humanities and social science is indispensable. History and philosophy of science (HPS) was born in the nineteenth century and became a well-established interdisciplinary field by the 1940s. Science and Technology Studies or Science, Technology and Society (STS) has grown rapidly since the 1970s to be a remarkable discipline in and out of universities. Historians and philosophers of science and STSers tend to be critical of science, which makes them unpopular among scientists. However, it is expected that HPS and STS can help science in many ways. They have become sources of policy advice to governmental and corporate decision-makers. HPS and STS should be given more roles in both science education and ethics education.

The Recommendation sees science only in the service of humankind. Science cannot be a handmaiden to the economy. The values of science for its own sake should be taken into consideration. The "Two Cultures" problem has never been solved. The traditional dichotomy between science and culture is no longer tenable. Science itself is a culture. Science as a culture brings science to the general public by humanising it. Public understanding of science is best achieved by the notion of scientific culture. Popularisation does not mean enlightening ignorant people. It is necessary to develop flexible processes of two-way dialogue and communication instead of top-down lecture.

In the Recommendation, there is also no mention of the status of women scientists. During the last century the status of women in the world improved a great deal. Yet women remain under-represented in the scientific community. They face difficulties not only in entering science, but also in promotions and in getting fair salaries. Many ethnic minorities and disadvantaged groups are also largely excluded from science. Urgent measures are needed to abolish any kind of discrimination against these groups.

Ethics education is one of the priority areas for COMEST. Science education used to concentrate exclusively on science. It has recently been recognised that science education should include human and social implications of science. It is no wonder that STS is becoming an indispensable part of science education. Students who are taught only the positive aspects of science are destined to develop a distorted view of science. Well-balanced view of science is possible by teaching them the negative aspects as well. It is now necessary to add the ethics of science at all levels of science education. Furthermore the independent course of ethics of science should be compulsory for all science majors.

The Declaration on Science and the Use of Scientific Knowledge and Science Agenda – Framework for Action (1999) adopted at the World Conference on Science along with the Universal Declaration on Bioethics and Human Rights (2005) of UNESCO should be used as points of reference to reconsider the current usefulness and validity of the Recommendation. The perspectives of the ICSU *Strategic Review* (2005) are also very helpful.

At the consultation meetings in Asia, it is interesting to see the unanimous agreement concerning the need for a universal code of conduct. In Geneva and Belo Horizonte, however, there was considerable skepticism about a normative instrument on science ethics. Even in the case of the Universal Declaration on Bioethics and Human Rights (2005), many criticisms arose from the beginning. UNESCO eventually succeeded in making a declaration supported by all 192 Member States. A long march is expected to the code of conduct for scientists. I look forward to the positive contributions by African scientists and ethicists to this goal.

RUBEN APRESSYAN:
TEACHING OF ETHICS OF SCIENCE AND TECHNOLOGY

COMEST member

This paper consists of three short parts: a brief outline of my understanding of ethics teaching, its tasks and formats; UNESCO's understanding of ethics, specifically, the ethics of science and technology and its approach to the teaching of ethics; and a particular experience of building a core curriculum in Bioethics, specifically the project initiated by the Division of Ethics of Science and Technology of UNESCO in line with the advancement of ethics education as one of the priorities of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST).

Few general remarks on teaching of ethics

An initial question regarding teaching of ethics is: *What do we teach when teaching ethics?* Is teaching ethics the same as teaching virtues, values, and beliefs, and "teaching ethics" is just another expression for "moral education"? Or is it mainly communication of ethical concepts, training in correct reasoning on moral issues, and right understanding of criteria of evaluation in particular moral situations? Or is it presenting students different conceptions of the phenomenon of morality, its nature and function, rules and arguments, with their further normative and applied implications? Each of these interpretations of ethics teaching may be rational, expedient, and adequate in appropriate conditions. There are specific and particular tasks for teaching ethics in secondary school/high school and in higher education – for freshmen and postgraduates, for students of philosophy and for students of science or engineering.

As a basic course, ethics may be a means of teaching virtue or happiness or – in modern terms – integrity, specifically, professional integrity or to do the right things. Thus ethics may be an important factor for developing good character.

According to one syllabus on the Internet, teaching of ethics aims to promote developing the following skills in students:

- to understand that self and others have needs and rights, and be able to describe actions in simple ethical terms;
- to know that values can be applied to describe behaviour and acts within rules and norms;
- to know how to use values and emerging ethical principles when choosing to act and when exploring the behaviour of self and others;
- to understand how to use valid ethical principles to make choices in developing a personal position;
- to understand that ethical behaviour is demonstrated by caring about one's own actions and those of others;
- to understand that emotional response and social contexts influence evaluation of the actions of others and the modification of personal actions and beliefs (Darron, 2003).

These are very basic understandings and skills in morality. However, they are very important. I do not think that a teacher of ethics sets out to ensure that her/his classes would promote students' moral awareness, but I strongly believe that normative and value education should be a part of all levels of ethics education, including higher education. The question is what means would be the most appropriate for normative and value education.

When speaking about higher education, we should also be concerned about students' development towards their future profession. In regard to ethics, one could mention that during the last four or five decades, ethics has altered considerably as a university discipline. It has ceased to be exclusively a *philosophical discipline* and a part of *humanities education*. Today, ethics is usually presented as a kind of applied ethics, most often bioethics, medical ethics, business ethics, and many other versions of professional ethics. In its applied versions, ethics has become a more and more integral component of *professional education*.

In the 1960-70s, it was not unusual amongst university decision-makers to understand ethics as just moral

education and to be skeptical about the role of ethics in higher education, for the reason that universities as institutions of scholarship should provide knowledge, understanding, and skills, and should not pretend to be competent in the students' moral portrait. The attitude towards ethics has deeply changed in developed countries since that time. First, ethics of learning and research has been recognized as an important component of university spirit. Second, many of today's challenges raised by poor environment, scientific achievements, and the development of new technology have been understood as rooted in wrong decision making, as well as civil and professional misconduct. Therefore, ethics has also been recognized as an important component of professional education.

Unfortunately the situation in Eastern European countries has developed in the opposite direction. Twenty to thirty years ago, ethics education was rather common in universities and especially in colleges of education, or pedagogical schools. However, during the 1990s, owing to ideological changes and commercialization of higher education, its positions receded significantly. In the curriculum of many universities, ethics was replaced by the history of culture or religious studies and computer science. Still, one can catch sight of first springs of rethinking ethics in higher education in these countries. Though modestly, ethics has been restored in the form of different kinds of applied ethics, starting with bioethics and then business ethics, ethics of management, etc.

So, in answering the question of *what do we teach when teaching ethics*, summarizing the remarks above, I would point to a number of approaches:

a) as a part of moral education or in a broader sense, character education, and similar to civic education;
b) as a part of teaching social sciences and humanities;
c) as a part of philosophy education;
d) as a part of professional education.

The latter approach is of the most importance today. So far all kinds of professional activity have peculiar ethical aspects, which are very often not evident for common moral consciousness and everyday thinking. Therefore, teaching ethics in professional education should be considered a significant educational contribution to social sustainability and public wealth.

At the same time, one should realize that teaching a version of applied ethics or professional ethics does not yet necessarily mean making ethics a part of professional education. The fact is that popular versions of applied ethics are presented to students as part of general education. For instance a course of biomedical ethics, say, at a law school or an industrial college would have nothing or very little to do with professional education, but may contribute to the purposes of teaching social sciences or humanities.

UNESCO's concern

Reinforcement and amplification of ethics education is one of UNESCO's overall objectives. In 2004, UNESCO started its Ethics Education Program (EEP). In June 1999, UNESCO in cooperation with the International Council for Science (ICSU) held the "World Conference on Science for the Twenty-First Century: A New Commitment" (Budapest, Hungary). The Declaration on Science and the Use of Scientific Knowledge, which was adopted by the Conference, stated the following:

> "We all live on the same planet and are part of the biosphere. We have come to recognize that we are in a situation of increasing interdependence, and that our future is intrinsically linked to the preservation of the global life-support systems and to the survival of all forms of life. The nations and the scientists of the world are called upon to acknowledge the urgency of using knowledge from all fields of science in a responsible manner to address human needs and aspirations without misusing this knowledge." (Article 1) (UNESCO, 1999).

In the light of teaching ethics of science and technology, the last words of this statement are of particular significance. "[U]sing knowledge … in a responsible manner to address human needs and aspirations." The Declaration was adopted on behalf of scientists. Scientists apparently share initial responsibility for not misusing scientific knowledge. However, scientists are not the only professionals bearing this responsibility, as policy-makers are also responsible

for misuse of science and technology. In their decisions, policy-makers should be rational, thoughtful, precautious, just, and fair. Furthermore, civic society groups such as civil activists, independent experts (who are mainly scientists and scholars) and journalists are also responsible for proper use of science. It is important to understand that this kind of responsibility cannot be built in the family or religious community or by regular professional education.

In December 2003, COMEST published a report on *The Teaching of Ethics*, in which it stated:

> "[T]he central aim of the teaching of ethics should be to develop the students' ability to recognize and analyse ethical issues in order to be able to reach decisions on how to act ethically." (UNESCO, 2004a, p.11).

Various practical experiences show that though morality is often considered a matter of intuition or moral sense, in many particular activities, moral intuition appears to be insufficient. Here I am referring to activities within large-scale projects, complicated in structure, with diversified stakeholders' interests involved, with the use of natural resources or with uncertain impacts on the environment. Some particular kinds of responsibility and a broader ethical awareness may be achievable only through special reflection based on knowledge, understanding and critical thinking.

Ethics education is one of COMEST's thematic priorities. Among others are bioethics, ethics of nanotechnology, conduct of scientists, environmental ethics, and ethics of outer space. Fresh water and precautionary principle were also considered in the past. The analysis of each theme has been developed into a kind of normative document in the form of a declaration, strategic statement, report, or policy advice. Whatever form a document takes, it contains some important words about the ethical principles of conduct and policy in the related area, moral responsibility, and the necessity of reflection and rational choice.

Here are some examples on this point:

A. In a survey on the use of fresh water, Lord Selborne, Chairperson of the COMEST Sub-Commission on the Ethics of Fresh Water, suggested to consider water as an ethical issue, which should be strongly recognized as a matter of responsibility for politicians, industry, and professionals (Lord Selbourne, 2005).

B. Precaution is one of the principles of behaviour and policy in uncertain circumstances. What is interesting about precaution is that for centuries, precaution or prudence has been downplayed in moral philosophy. Immanuel Kant distinguished prudence and skill as principles of hypothetical imperatives, to which he opposed his categorical imperative. However, in the context of practical decision-making and activity in uncertain circumstances, precaution has become an important ethical principle called on to prevent harmful outcomes.

In the most basic version the Precautionary Principle reads:

> "When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm" (UNESCO, 2005a, p.14).

In the COMEST report on the Precautionary Principle, the latter is presented as

> "… a rational decision rule, based in ethics, that aims to use the best of the 'systems sciences' of complex processes to make wiser decisions" (UNESCO, 2005a, p16).

C. Another example comes from UNESCO's policy document on the *Ethics of Outer Space* (COMEST, 2004). The main concern of this document is to promote ethical criteria in decision-making and public assessment of human activities in space. In this regard, the most urgent issue identified is the environmental repercussions of rocket launches, particularly in the areas of carrier rocket trajectories. This has two ethical aspects: a) public good, b) human rights. The principle of public good requires efforts in preserving and maintaining the environment and securing sustainable development, especially in the context of future generations. The principle of human rights demands that the human right not to be harmed and to live in a healthy environment be honoured.

This policy document contains a section especially devoted to ethics education, in which it states that:

> "States should endeavour to foster all forms of ethics education and training at all levels as well as to encourage information and knowledge dissemination programs about outer space and the ethics of outer space. These measures should aim at specific audiences, in particular researchers and members of the space community, or be addressed to the public at large" (UNESCO, 2004b, p.7).

D. In October 2005, the *Universal Declaration on Bioethics and Human Rights* was adopted by the 33rd session of the General Conference of UNESCO. Among the documents, in my opinion, this one is the strictest in normative sense, formulating particular principles for activities in the sphere of health care and biomedical research. The Declaration also made the following appeal to States:

> "In order to promote the principles set out in this Declaration and to achieve a better understanding of the ethical implications of scientific and technological developments, in particular for young people, States should endeavour to foster bioethics education and training at all levels as well as to encourage information and knowledge dissemination programs about bioethics" (Article 23, a) (UNESCO, 2005b).

In other words, ethics is an overall COMEST agenda. In the given context, ethics is considered as sets of principles proposed for different practices. These principles are rational. They have been formulated by experts through long and sometimes hard discussions. They have been verified in consultation with the representatives of corresponding professions. So far, these principles are not evident from the point of view of common knowledge and morality; they are subject to purposeful learning and understanding. To this end, UNESCO has done a lot in promoting the advancement of moral awareness at the public opinion level and in supporting ethics education.

UNESCO core curriculum in bioethics

In 2005, the Division of Ethics of Science and Technology of UNESCO established an advisory commission for the teaching of ethics and invited a number of experts from different parts of the world to develop a core curriculum in bioethics. These experts are:

- Professor D. Balasubramanian (India), TWAS representative;
- Professor Amnon Carmi (Israel), UNESCO Chairs representative;
- Professor Leonardo De Castro (Philippines), IBC representative;
- Professor Don Evans (New Zealand), IBC representative;
- Professor Diego Gracia (Spain), COMEST representative;
- Professor Nouzha Guessous-Idrissi (Morocco), IBC representative;
- Professor John Williams (Canada), WMA representative.

I also had the honour of being invited to this Commission.

The Director of the Division of Ethics of Science and Technology, who initiated and coordinates the project, is also responsible for developing some parts of the curriculum.

Since March 2006, the Commission has met three times and developed the first draft proposal for a core curriculum in bioethics, which is currently being edited and revised.

Let me briefly describe the philosophical, structural and didactical ideas of the curriculum.

1) The curriculum is almost completely congruous to the principles of the Universal Declaration on Bioethics and Human Rights. The main idea is to develop the core curriculum on the basis of the Declaration, specifically referring to its principles. This is a novel way in teaching ethics, especially bioethics as a form of applied ethics. It changes the approach to teaching biomedical ethics by challenging the traditional thought process familiar to bioethicists. To explain this, I will give just a simple example. Over

the years, a number of principles have won common acceptance as relevant to the moral analysis of ethical issues in health care and biomedical research on humans. These are the principles of respect for autonomy, nonmaleficence, beneficence, and justice. Reference to the Universal Declaration on Bioethics and Human Rights required certain changes in the bioethical discourse. Now, "principles of bioethics" are those contained articles 3 to 17 of the Universal Declaration, and around which the core content of the curriculum is built.

Units	Title	**Hours** (60 mins)
1	What is ethics?	2
2	What is bioethics?	2
3	Human Dignity and Human Rights (Article 3)	2
4	Benefit and Harm (Article 4)	2
5	Autonomy and Individual Responsibility (Article 5)	1
6	Consent (Article 6)	2
7	Persons without the capacity to consent (Article 7)	2
8	Respect for Human Vulnerability and Personal Integrity (Article 8)	1
9	Privacy and Confidentiality (Article 9)	2
10	Equality, Justice and Equity (Article 10)	2
11	Non-Discrimination and Non-Stigmatization (Article 11)	2
12	Respect for Cultural Diversity and Pluralism (Article 12)	2
13	Solidarity and Cooperation (Article 13)	2
14	Social Responsibility and Health (Article 14)	2
15	Sharing of Benefits (Article 15)	2
16	Protecting Future Generations (Article 16)	1
17	Protection of the Environment, the Biosphere and Biodiversity (Article 17)	1
	TOTAL HOURS	**30**

As can be observed, all four "traditional" principles are included directly or indirectly in the articles of the Universal Declaration. However, the understanding of the principles has been changed as well as the logic of presenting the content of bioethics.

2) The core curriculum is targeted at teachers in bioethics, with a realistic perspective about the situation of teachers in this discipline. According to the data collected by Professor Amnon Carmi of the International Center for Health, Law and Ethics, University of Haifa, a vast majority of those who are commissioned to give courses in bioethics in medical schools have insufficient or even no background in ethics and philosophy. Most often they are teachers in the history of medicine, medical law or clinical medicine.

The core curriculum is limited in size, but it is designed to give a teacher the main ideas and the main directions of discussion on a topic. Each unit contains the following sections:

a) *learning objectives*, which are formulated in terms of the student's abilities and skills;
b) *outline of the content* with the main thesis of a unit;
c) *teacher manual* unfolding the unit thesis;
d) *study materials* (cases, readings, video/movie, role play, group discussion), including the main literature and sources on the unit topic, preferably available on the Internet.

3) What is expected out of the course for students? The learning objectives are:

- In general, "students should be able to apply the principles of the Universal Declaration on Bioethics and Human Rights".
- Specifically, students should be able:
  - to recognize an ethical issue,
  - to reason about ethical issues,
  - to justify ethical decisions,
  - to implement ethical principles in medical practice.

4) In addition to principles, a traditional bioethics curriculum usually contains discussions on problems such as euthanasia, abortion, organ transplantation, status of embryos, ethics committees. Currently, there are good examples of teaching bioethics around these main problems. However, the UNESCO curriculum is arranged in a different manner and it was a challenge for the curriculum team on how to reflect these bioethical problems within the selected framework, and how to disseminate the problems amongst the units associated with articles of the Universal Declaration. These core bioethics problems are certainly reflected and discussed in the curriculum, but they are given either relative to the principles or in study materials.

This approach develops the content of bioethics in the form of guidelines for professional behaviour rather than a sum of knowledge applicable in practice. Therefore, students are directed to ethically competent professional behaviour rather than to a double (separate) competence of professional and ethical behaviours, as has been sometimes criticized in discussions on teaching bioethics, and in a broader sense, ethics to future professionals.

5) Significant attention is paid to study materials in the forms of case studies, role-play, and group discussion. Students learn not only through listening and reading, but also more effectively through thinking, analysing, discussing, and conducting research. All these activities are important for personal transformation and character development.

This brings us back to the above classification of different approaches in teaching ethics:

a) as a part of moral education or in a broader sense, character education, and similar to civic education;
b) as a part of teaching social sciences and humanities;
c) as a part of philosophy education;
d) as a part of professional education.

I would like to underscore that teaching bioethics through principles stated in the Universal Declaration is an appropriate way for both professional and moral education. Coupling of these two tasks is the most adequate and effective way of teaching ethics of science and technology.

CLIFFORD TAGOE:
TEACHING OF ETHICS OF SCIENCE AND TECHNOLOGY: DIVERSITY IN ETHICS TEACHING IN AFRICA

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Ethics of science and technology

Ethics, the philosophical study of the moral value of human conduct and of the rules and principles that ought to govern it (moral philosophy), or the social, religious or civil code of behaviour considered correct, especially, that of a particular group, profession or individual, has been known to man for over two and a half millennia. Its best known form, *medical ethics*, traces its roots to several early codes of ethics such as the Greek Hippocratic Oath, which required physicians above all to "do no harm"; professional codes of ethics such as the one written by English physician Thomas Percival in 1803, which provided a foundation for the first code of ethics established in 1846 by the founders of the American Medical Association; and the Nuremberg Code for research ethics on human subjects, which was established during the war crime trials at the close of World War II (1939-1945) in response to the gross abuses in human experimentation performed in Nazi Germany. The advent of new medical and reproductive technologies after the 1950s further complicated the moral and societal issues of medical research and practice.

Ethics of science and technology include *bioethics* and *scientific misconduct*. Since the late 1960s to early 1970s, bioethics has gradually assumed centre stage (see Potter, 1971). However, the concept comes from human heritage thousands of years old. There have been discussions of abortion, euthanasia, communication between doctors and patients, and conservation of resources and biodiversity, in almost all cultures, philosophies and religions. Rapid advances in the life sciences and the global environmental crisis have led to the development of the academic field of bioethics.

Recent ethical discussions centre on the consequences of the application of modern and emerging technologies in health. Technologies such as stem cell research, genetic testing and cloning, indicate tremendous progress in the life sciences and offer human beings new power to improve health and control the development processes of all living species. However, these have generated debates because of concerns about the social, cultural, legal and ethical implications of such progress.

Scientific misconduct has been defined as the "violation of the standard codes of scholarly conduct and ethical behaviour in professional scientific research" (Wikipedia). Its forms include fabrication/falsification of research data, plagiarism and violation of ethical standards regarding human and animal experiments, for example the issue of informed consent. Deliberate suppression, failure to publish or selective release of the findings of scientific studies may also fall under this heading.

State of research ethics in Africa and the case for teaching ethics of science and technology in Africa

Much has been said about the lack of documentation of practice of research ethics in Africa. For instance, it was noted at the Dakar Meeting on Promoting Bioethics in Africa that "scientific meetings on bioethics issues in Africa are still rare" (Becker, 2005).

The issue of ethics of science may well be considered esoteric in Africa in the face of poverty, strife and disease. It is said that less than 2% of world research output comes from Africa. So, why bother about ethics? What's the big deal? However, it may be for the same reasons that it should be an issue as these conditions make Africa vulnerable to abuse.

After years of neglect, African higher education institutions have found favour again with their governments and also with the World Bank, and funding is gradually being increased through various mechanisms. Efforts are also being made to attract well-qualified Africans in the Diaspora to take up teaching and research positions at home. This trend, if continued,

is likely to result in increased research output through graduate and postdoctoral training, as means of finding African solutions to African problems. The presence of more qualified scientists on the continent will encourage more outsourcing (e.g. vaccine trials), and collaborative research involving existing traditional knowledge (e.g. traditional medicine) will raise the issue of intellectual property rights. The use of biotechnology to solve important issues such as hunger (GM foods) will encounter ethical problems.

Many African countries have accepted the necessary role of science and technology in development and opportunities for this are being provided by NEPAD. It is also widely recognized that the Millennium Development Goals are unlikely to be achieved without science and technology.

Therefore, the need for increasing the ability of young African scientists to distinguish between right and wrong and to feel responsible for society and the environment has never been greater.

The issue of ethics education has engaged a number of people and organizations over the years. In Africa, medical schools and colleges as well as training institutions for other health professions have subjects on professional ethics in their curricula. Teaching is usually crowned by the taking of an oath, for example the Hippocratic Oath by medical students on graduation, or at induction in the case of the other professions. There is, however, no evidence that students in other science-based subjects or professional areas undergo similar instruction, let alone taking an oath. However, "science" is now generally accepted as a profession (see Resnik, 1998).

The case for ethics in science was made by the 1999 World Conference on Science in Budapest. The need for ethics education or teaching of ethics was also well articulated by the COMEST Working Group on Teaching of Ethics at its meeting in January 2003 in Paris.

There is hardly any health programme on the continent that has integrated some bioethics components to the extent found in the developed countries. This means that a significant percentage of each graduating class at the higher level of education has not been exposed to a systematic and sustained analysis of ethical issues in their field, led by a faculty member with sufficient training in ethics. Ethics continues to be given as occasional lectures and symposia in many institutions.

Even though we have witnessed dramatic expansion of bioethics in the developed countries very little has been achieved in Africa. In most African countries, bioethics as is practiced in the developed countries is either non-existent or at best not organized (Ogundiram, 2004). Surprisingly, very little formal guidelines are known about physician–patient relationship or a proper documented moral framework for the interaction between patients and health care workers in most African countries. Much more needs to be done if there is going to be serious study and discussion of the myriad ethical issues arising in health care delivery and science and technology research.

Teaching of ethics of science and technology in Africa: what to do?

1. Political commitment

It is important to obtain firm commitment from the highest political levels, as some of the issues will require legislation. Governments must also see this as a social responsibility. African governments and policymakers should consider, among other things, ways of strengthening the weak ethical review processes in the region and other essential ethical concerns such as the treatment of human subjects in research, including the choice of appropriate research questions and design; ensuring prior scientific and ethical review of the protocols to be used; the equitable selection of participants; and obtaining the voluntary informed consent of participants. Routine research entails a number of interventions and policies designed to prevent harm to individuals and to lower health risks within the population. Where ethical committees do not exist, UNESCO and WHO must urge countries to put them in place without further delay. Governments' responsibilities should include passing appropriate legislation and providing ICT infrastructure for communication.

2. Training of the trainers

Efforts must be made to train a critical mass of trainers. There will be a need to re-tool existing faculty

members with expertise in science ethics and bioethics so that they can also facilitate its introduction into the mainstream academic programmes.

For the training, advantage may be taken of already existing formats as provided by the Poynter Center for the Study of Ethics and American Institutions (Indiana University Bloomington; see Website) and Online Ethics for Engineering and Science at Case Western Reserve University (An Instructional Guide for Secondary School Science Teachers with Model Lessons for Classroom Use). UNESCO publications on the subject such as *Classroom Communication* (Keider, 2005) and *Informed Consent* (Carmi, 2003) will be useful.

UNESCO and WHO must collaborate in supporting, sponsoring and facilitating the process.

3. The core curriculum

In developing curricula for teaching of ethics of science and technology, cognisance must be taken of the diverse professions existing on the continent. There will be need for a *core curriculum* with general courses on the history and philosophy of science, as well as basic principles concerning honesty, openness, respect for subjects, assigning credit where due, misconduct and its reporting, conflict of interest, and issues relating to publication. The core curriculum must have a multidisciplinary character by including appropriate or relevant topics from the fields of sociology, philosophy, law, politics and theology, among others.

4. Diversity and specific curriculum

Although professional fields of medicine, dentistry and nursing deliver courses on *professional ethics* as part of their curricula, these are not adequate, as they do not cover the entire range of topics required (e.g. topics dealing with research). These professions must therefore be included in any programmes aimed at imparting the principles of research to young scientists. Specific curricula for *all* the various health professions should contain the tenets of UNESCO's Universal Declaration on Bioethics and Human Rights (2005).

A review of syllabi in medical schools and other institutions training health professionals will be required to ensure that students are introduced to rudiments of bioethics reasoning and grounded in the principles of bioethics so that they can advance bioethical solutions to dilemmas that arise in the practice or research in health in our countries.

The accreditation process for schools should involve an increase in ethics instruction requirements.

4.1 Basic sciences and non-medical professions

The basic sciences and non-medical professions like engineering and ICT, in addition to the core curriculum, must have ethics courses designed to suit the subject area (e.g. chemistry) and taught at the appropriate levels.

As is done by the medical professions, all science students must take an appropriate oath at graduation.

5. Where or when to teach/Levels of instruction

The teaching of ethics of science and technology must take place from the secondary school level through undergraduate, postgraduate and post-doctoral levels. Space must be made available on timetables for teaching ethics. At the pre-tertiary levels of education, student clubs, such as those concerned with wild life and the environment, are captive groups for the propagation of ethical issues; advantage must be taken of these. Tertiary institutions here include the polytechnics, teacher training colleges and universities.

6. Culture and ethics

It must be borne in mind that Africa is a continent of diverse cultures and cultural issues must impact on the content of ethical issues. Teachers of science and technology ethics must recognize this and exhibit flexibility in delivering the curriculum.

7. Role of ICT

Many African higher education institutions have developed moderate ICT infrastructure. These facilities will be beneficial in providing opportunity for ethics instruction by e-learning techniques. Governments must be encouraged to expand ICT infrastructure for all institutions.

8. Regional and sub-regional networking

The importance of sub-regional and South-South collaboration to share ideas and best practices cannot be over-emphasized. Advantage must be taken of recent formations in some African countries and regions of Research and Education Networks (RENs) such as GARNET, which links all six public universities in Ghana. The Pan African Bioethics Initiative (PABIN) meetings can foster the development of bioethics in Africa with a particular focus on research ethics.

9. Collaboration with institutions in the North

Many African higher education institutions have academic and research links with counterparts in the North and these relationships ought to be exploited to facilitate development of research ethics. Compatriots working in the North would also be useful as facilitators in forming new links.

Conclusion

The case for teaching of ethics of science and technology in Africa is overwhelming. It is important that governments commit themselves to providing the necessary enabling environment for ethics teaching to take place. It may be premature at this time to mandate that all students take required course work in ethics, but all schools should give priority to ethics in their curriculum development planning. Ethics-related learning objectives could at least be incorporated into existing courses in the curriculum. This indirect approach should give way to more systematic instruction once it is established. There is value in having in-service programmes conducted at workplaces so that discussions can involve multidisciplinary and multilevel co-workers. With the right support and leadership, such sessions can create an atmosphere of trust and candour so that problems can be addressed and solutions sought. Both UNESCO and WHO have critical roles to play in making the teaching of ethics of science and technology in Africa a reality.

KWAMI CHRISTOPHE DIKENOU: PROMOTION OF DIVERSITY IN TEACHING THE ETHICS OF SCIENCE AND TECHNOLOGY

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Introduction

UNESCO has made the promotion of education in the ethics of science and technology one of its principal objectives in the years to come. In 1999, the World Conference on Science and the Use of Scientific Knowledge organized by UNESCO and the International Council for Science (ICSU) adopted the Declaration on Science and the Use of Scientific Knowledge. The World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) has set itself the task of implementing the Declaration and, in 2003, produced a report entitled *The Teaching of Ethics*. This high-quality document paid particular attention to the objectives of ethics education, curriculum components, quality criteria, evaluation and curriculum certification. It also underlines the importance of cultural diversity: "It is important that the ethics courses are open to cultural and traditional differences" (COMEST, 2003, p.12). As priorities differ from one continent to another owing to socio-cultural and regional differences, the question arises as to how educational content, teaching methods and research in respect of the ethics of science and technology can reflect cultural diversity. The COMEST document mentioned above proposes no answer to this question. This presentation therefore aims to contribute to the enrichment of curriculum components, of approaches to them and of research in the ethics of science and technology in African universities.

Diversity in teaching the ethics of science and technology

1. Diversity of content

Seven factors, according to the same COMEST document, lie behind the revival of interest in ethics education. One factor, concern over the environment, would seem to be a priority in the African context. Indeed, in view of the existential concerns of African societies, the management and protection of the environment with a view to sustainable development constitute one of the continent's major concerns.

In the Lagos Plan of Action (1980) and NEPAD and through their commitment to several international texts, in particular the Johannesburg Declaration (2002), African leaders have therefore expressed a common will to act with a view to sustainable development. Ethics education for scientists should therefore give priority to issues of environmental ethics. Issues concerning the personal and professional responsibility of students and specialists in environmental science, in science and technology, students training as professionals who tackle environmental problems directly, such as forest rangers, agronomists, hydrologists and ecologists, and students whose future work will indirectly influence the management of rural and urban environments, such as engineers, architects and town planners.

Let us consider the ethical questions that the management and protection of the environment raise in seven main areas: biodiversity, forests, freshwater, land, coastal and marine environments, urban areas and the atmosphere.

Biodiversity. The use of biodiversity resources is the pillar on which African economies and the survival of the great majority of poor populations rest. Four main threats to biodiversity are the loss of natural habitats, the extinction of species, invasion by foreign species and a lack of recognition of the property rights and the knowledge of the local population. According to the IUCN, 126 animal species have become extinct in Africa, 2,018 species are endangered, 123 plant species have disappeared and 1,771 are endangered (IUCN, 1997).

In resolving the issues, science and technology alone do not suffice because they raise, *inter alia*, the following ethical questions: What is the real

value of biodiversity (Rolston, 1988; 1994)? How are the participation and inclusion of indigenous people and of positive indigenous knowledge and practices in the management of African biodiversity best to be achieved? What must be conserved of African biodiversity and for whom? What is the best way of involving stakeholders to increase justice and international solidarity in the use of African biodiversity? These, then, are the ethical questions that must be addressed when training biodiversity conservation and preservation professionals in the African context. The teaching of environmental ethics can be an important contribution to this.

Forests. As the "lungs" of the planet and an immense reserve of genetic resources, forests are today of worldwide importance. They are important to the African region for several reasons: the survival and prosperity of the people depend on them; they are a source of food for humans and animals alike, medicinal plants, construction materials and fuel. Forests and woodlands slow down soil erosion, regulate the climate and play a key role in socio-economic activities: the international trade in tropical wood is a major economic and ecological issue. The continent is, however, undergoing rapid deforestation, aggravated by the illegal exploitation of forest resources. "Forest loss between 1990 and 2000 was over 50 million hectares, representing an average deforestation rate of nearly 0.8% per year over this period" (UNEP, 2002, p.133).

These problems have given rise to some ethical questions: (1) What are the best practices for bringing principles of sustainability into forest management? (2) How can the practice of intergenerational justice (Birnbacher, 1994) be brought into play in meeting the needs of future generations for food, building materials and other products? (3) How can the real value of African forests (social and economic justice) be equitably incorporated into the price of forest products and services? (4) What can be done to ensure that the profits generated in the marketing of forest products reach all citizens, in particular those known as "forest peoples" (distributive justice)?

Although universal principles are enshrined in a number of international agreements on the environment, such as the Convention to Combat Desertification (CCD) or the Convention on Biological Diversity (CBD), it is important to note that the formulation of principles is not an end in itself: they must be integrated into systematic education to ensure commitment to ethically motivated action. The teaching of environmental ethics could contribute effectively to this educational task.

Freshwater. Although freshwater is vital to all living beings, its availability and quality are causes for concern throughout the continent: precipitation is higher in West Africa and Central Africa than in North Africa, the Horn of Africa and Southern Africa. "Average water availability per person in Africa is 5,720 m^3/capita/year compared to a global average of 7,600 m^3/capita/year" (UNEP, 2002, p.157).

The contamination of freshwater not only threatens the natural balance of water ecosystems but also results in water-borne diseases. Access to freshwater and the improvement of water quality are priority social questions in African countries and necessitate well thought-out measures of social and economic justice. Water conflicts cannot be managed if the principle of fairness is not respected. The International Decade on Drinking Water Supply and Sanitation under the auspices of the United Nations (1981-1990) and Africa's Water Vision (2000) emphasize the need for a change of attitude to water supply and consumption. The "polluter pays" principle has been adopted as part of the framework of policies and laws in several countries and public-private partnerships. It would moreover be appropriate to bring UNESCO's outstanding work on the ethics of freshwater (COMEST, 1999) to the notice of most ministries in charge of water issues, above all in the hope that they will take ethically motivated action. The teaching of environmental ethics can effectively counter the failure to apply principles and translate them into action. It can help to make Africa's Vision come true.

Land. In Africa, land and land resources have great economic, ecological and social value. Indeed, agriculture contributes substantially to the formal economy, to the subsistence of populations and to employment. "In 1999, agriculture contributed more than US $64,484 million to the economy of sub-Saharan Africa (18% per cent of GDP for 1999), and US $26,188 million to northern Africa (13% of GDP in 1999)" (UNEP, 2002, p.190). African agriculture accounts for a substantial

share of international trade: "In 2001, for example, Africa produced 67% of the world's cocoa, 16% of the world's coffee, and 5% of the world's cereal production" (*Ibid*).

Agricultural production in Africa could have led to economic growth through positive impacts on industry, transport and other services, if gains in the last 30 years had not been cancelled out by population growth and the rising demand for food and the extension, degradation and even destruction of arable land.

Periodic droughts and inappropriate cultivation techniques are factors that compromise the conservation of the quality and productivity of arable land. At the same time, desertification is reducing the surface area of arable land. To improve the quality of cultivated land and combat desertification, "African countries were largely instrumental in establishing the United Nations Convention to Combat Drought and Desertification (UNCCD) in 1992" (UNEP, 2002, p.194). National and subregional action plans have been adopted. Serious conflicts have however been seen in some African countries as a result of the illegal occupation of land. Land management raises ethical questions that must be resolved with skill and diplomacy. How, for example, can the marginalization of women from access to land ownership be reduced? How can land management guarantee social justice within and between generations?

Coastal and marine environments. Marine and coastal resources are extremely important both locally and worldwide. "In 1997, total marine fish catch exports from Africa contributed US $445 million to countries' economies" (UNEP, 2002, p.94). In Cape Verde and Seychelles, fisheries employ one third of agricultural workers. Fishing is an important source of income for coastal communities. Fish is the principal source of protein for the majority of African population groups. The economic value of the resources of coastal and marine ecosystems leads to population growth, industrial expansion and development of infrastructure in coastal areas. All of these activities exert pressure on fragile ecosystems. The major problems facing coastal countries in Africa are coastal erosion, overexploitation of resources and pollution.

Integrated Coastal Zone Management (ICZM) is one of the measures adopted by coastal countries in order to reduce coastal erosion. Coastal erosion is being combated in some countries through a more rational water catchments management, more environment-friendly agricultural practices, and soil conservation programmes. International agreements among various African countries have been signed to ensure sustainable harvesting of marine resources such as fish and shellfish. Nevertheless, in spite of international conventions such as the Convention for the Prevention of Pollution from Ships (1978) (MARPOL), the Jeddah Convention (1982), the Abidjan Convention (1981), the Nairobi Convention (1985) and the United Nations Convention on the Law of the Sea (1973) (UNCLOS), the resources of African countries are constantly being illegally tapped by foreign fishing fleets. This situation raises ethical questions of injustice and international solidarity. The teaching of environmental ethics could help students to analyse objective factors in the evaluation of the justice or injustice of stakeholder activity in the use of African coastal and marine environments.

Urban areas. Urbanization rates in Africa are increasing rapidly. "Thirty-eight per cent of Africa's population, that is to say 297 million people, live in urban areas. By 2030, this is expected to grow to approximately 54% of Africa's projected population of around 1,405 million" (UNEP, 2002, p.226). Home to the lion's share of economic, administrative and educational activity, African cities consume the greatest part of natural resources and produce most waste and pollution. These problems are worsened in shantytowns, which lack public services, adequate housing, water supply and sanitation. The health of many millions of people is affected by these problems, which raise ethical questions such as the "polluter pays" principle, the right to adequate housing and a clean environment for all, the Environmental Impact Statement (EIS) before the construction of housing, commercial buildings and roads, in a word, better urban development practices. The United Nations Commission for Human Settlements (Habitat) (UNCHS) was established to meet this need and its mission is to promote socially and environmentally sustainable development of human settlements. The integration of environmental ethics into their curricula could help architects and town planners reflect on ethical issues.

Atmosphere. As well as being used for communication purposes (radio waves, etc.), the atmosphere is crucial to the survival of human and other living beings. In this regard, Africa faces three main problems: climate variability which triggers phenomena such as flooding and drought, climate change and air quality. The air in urban centres, where industrial and population growth is concentrated, is polluted by waste, industrial and domestic emissions and exhaust fumes from vehicles. Another source of air pollution in both urban and rural areas is the domestic combustion of wood, coal, paraffin, agricultural waste and refuse. The social consequences of atmospheric pollution are significant and involve such ethical questions as the survival of humanity and intergenerational and environmental justice. African countries lack the means to combat pollution and correctly apply the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and national regulations. In ethical terms, this situation places environmental problems in the realm of greater international solidarity, and of international environmental justice, equity and distributive justice in terms of greenhouse gas emission quotas.

The teaching of environmental ethics can help students to become aware of ethical problems relating to environmental management and protection and to forge their own ethical stance. In view of the numerous environmental problems that beset Africa, the continent simply has everything to gain by building up ethical competence. As part of its standard-setting action, UNESCO should draw up a universal declaration on environmental ethics in order, among other things, to raise awareness among scientists, agronomists, forest rangers, engineers, town planners and architects of the environmental and social impact of their professional activities.

2. Diversity of methods

While it is desirable to enrich the content of education in the ethics of science with inputs on the continent's priority environmental problems, teaching methods in that field may similarly be enriched through analyses of social ethical references specific to African cultures and traditions.

The best method of the teaching of the ethics of science and technology is still one that is consistent with the method recommended by the founder of ethics, Aristotle: deliberation. An excellent statement on this theme was made by Professor Diego Gracia at the Fourth Session of COMEST (COMEST, 2005b). For Aristotle (1970), moral education should enable the individual to become good (*spoudaios*) as opposed to worthless (*phaulos*). Moral education helps the individual to become wise and prudent (*phronimos*). Such a person is distinguished moreover by the maintenance of prudence through moderation and proper deliberation on what brings happiness to one's life and that of others. We are all required under the Millennium Development Goals to act accordingly in our environmental and social endeavours: Prudence must be shown in the management of all living species and natural resources, in accordance with the precepts of sustainable development. Only in this way can the immeasurable riches provided to us by nature be preserved and passed on to our descendants. The current unsustainable patterns of production and consumption must be changed in the interest of our future welfare and that of our descendants (United Nations, 2000, p.2).

Although no one doubts that deliberation is the best method of teaching ethics, it does require the ability to take a critical and creative approach. In the African context, it is crucial that ethics teaching develops such a turn of mind to set reflective morality (Dewey) against morality that is imposed or suffered.

Indeed, we can safely say that Africa has not neglected moral education: for centuries it has been fundamental in education in the family and in social groups such as initiatory groups and religious communities. It is however fair to say that the transmission of moral principles within these ramparts of morality was mainly based on indoctrination, discipline, submission to the group and respect for tradition. African children and young people were educated to respect traditional values. The duties handed down by tradition had to be instilled, memorized and respected without giving thought to their content or foundation. In today's Africa, which is trying to appropriate the democratic values of the rule of law, incoherent and even contradictory mores (ways and customs) are often in evidence and take precedence over positive law. An almost melancholy worship of the past is not without political resonance: today's political systems

of government lack democratic traditions to varying degrees, hence the need for ethics education in Africa to contribute to the development of a critical and creative turn of mind to facilitate the recognition and analysis of ethical problems and reveal the weaknesses and strengths of various cultures and traditions.

Another characteristic of traditional ethics is the influence of emotions. Can we rely on emotions to decide what is just with regard to the numerous ethical questions relating to environmental problems? What type of biological diversity should be preserved, for example? Which technologies should be chosen? How should the environmental impact of a development project be appraised?

One last characteristic of traditional ethics in Africa is that it does not permit criticism of authority, whether such criticism be scientific or otherwise. In some African cultures it is inadmissible to express disagreement in the face of authority. This is a question of honour. This attitude often influences how teachers of ethics are viewed by students who do not dare to ask questions, let alone criticize the "master's" point of view. In ethics classes in Africa it is not unusual for students to remain mostly silent. The authority of ethics teachers in the African context must be discussed. For although, following in the steps of Hegel and Gadamer, it is reassuring to situate oneself in a tradition of deliberation, that tradition is one that embraces openness, dialogue, argument and creativity as opposed to a tradition that is fixed, conservative and reassuring for "men of little worth" (Aristotle) who are incapable of adapting to change. Only a critical approach enables students to be discerning and to take the distance required for ethical awareness. It is a question of stepping back and taking a critical approach to institutionalised systems of norms and rules of conduct, and to the cultural, religious and philosophical heritage. Although these references constitute a real heritage of wisdom, none of them can be substituted for a student's critical awareness or openness to a universal vision made up of "universal values" based on fundamental human rights and freedoms, democratic equality and solidarity among human beings and between human beings and ecosystems. By helping students to establish such a universal point of reference, ethics education can enable them to affirm their place as members of the human race within the ecosystem of the planet while enabling them to distance themselves from particular values by developing an awareness of the planet as a whole. Universality constitutes one of the best guarantees of critical and creative thinking.

3. Diversity of research

University teaching goes hand in hand with research. In the context of African universities, research must allow the strengthening of local environmental ethics within a framework of respect for cultural diversity.

Principle 22 of the Rio Declaration on Environment and Development states that: "indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development" (UNCED, 1992). It is through critical and creative thinking that local environmental ethics can be objectively reinforced, enhanced and developed. Baird Callicott (1994) has endorsed this view, stating that traditional environmental ethics can thus be revived, and validated and verified by the affinity of new ideas of contemporary science.

One of the key principles of traditional eco-ethics, which Africa exemplifies and which underlines other principles such as the respect for nature and all life, is the interdependence of the anthroposphere, the biogeosphere and the theosphere (realm of the divinities). This is a holistic vision of the world (Callicott, 1987; Marietta, 1995). In African culture, respect for nature, prudent behaviour towards nature, is based on awareness of this life-giving interdependence and holistic rationality.

> "The fisherman who throws some of his catch into the sea after a fishing expedition in Ghana is expressing the responsibility which he has, as a member of the community, in ensuring that the fish population in the sea is not depleted. He, therefore, throws some of the live fish back into the sea so that they may continue to breed. And so each time he goes fishing, there will be fish in the sea.

> At the same time, the fisherman is expressing gratitude to Bosompo, the divinity of the sea, for giving him some of his fish. If the fisherman does not give back some of his catch to Bosompo, he will feel that he has been negligent of an important cultural value – gratitude. The fisherman's action is based on the proverb: "*Bosompo ankame wo nam a'wo nso wonkame no abi"* – 'If the divinity of the sea does not begrudge you of his fish, you do not begrudge him of your catch.'
>
> And so, while the fisherman is expressing gratitude in conformity with a cultural value dating from antiquity, he is also expressing a concern for the environment by ensuring that there continue to be fish in the ocean and by acknowledging that human beings are responsible for their environment" (UNEP, 2002, p.269).

Awareness of interdependence is based specifically on the many ways in which Africans use nature to feed, heal, clothe and house themselves and for commercial trade. Respect for the value of biodiversity is therefore of capital importance in Africa where the defence, in environmental ethics, of the real value (ecological, economic, aesthetic and cultural) of the continent's immense natural resources would effectively reduce the degradation and over-exploitation of these resources; different life forms have particular qualities and this is what makes them useful both to men and to other species.

One quality in nature to which traditional cultures ascribe importance is *aesthetic value*, which should be taken into account in the development of local environmental ethics and sustainable ecotourism on the continent. Indeed, natural beauty is indispensable to the survival of peoples living in direct contact with nature. They see such beauty in the continuous renewal of the surrounding flora and fauna. Leopold (1966) and Callicott (1987) consider the "land ethic" to be inseparable from the "land aesthetic". The intrinsic value of the beauty inherent in nature demands our love and respect. Owing to the symbiotic relationship between man and nature, the conservation of natural beauty is one criterion for evaluating the morality of our relationship with nature and society. Hargrove (1989) has endorsed this very view by affirming that environmental ethics is rooted in aesthetics.

Conclusion

In this paper, we have shown, first of all, that while courses in the ethics of science and technology must be open to cultural and traditional differences, such openness must be reflected in educational content and methods and in research. In the African context, priority should be given to existential problems linked to environmental management and protection with a view to sustainable development.

Secondly, we have shown that while the reflective method can be universally considered to be the best approach, in the African context emphasis must be placed on the cultivation of a critical and creative approach to enable students to stand back and look critically at the moral reference points of their own cultures and to be open to universal values. In that regard, we have pointed out that the influence of traditional ethics is deeply rooted in African culture (a fact often ignored) and calls for reflection and deliberation. Ethics education must therefore avoid two pitfalls:

- the risk of an indoctrinating paternalism that would not cultivate critical and creative thinking in regard to cultural and traditional diversity;
- the risk of holding up cultural and traditional differences as relative alibis that obscure interculturality and receptivity to human universality, which enriches and reconciles values of the past with those of the future.

Thirdly, we have stated that the exercise of critical and creative judgement is instrumental to the development of local environmental ethics in a context of cultural diversity. One of the founding principles of environmental ethics is interdependence.

Given the shortage of qualified ethics teachers and the lack of educational resources for ethics courses on the continent, capacity-building would be a particularly suitable task for UNESCO in the years to come, in cooperation with international, regional and national organizations. UNESCO could work, at the regional level, with the Association of African Universities

(AAU) and the United Nations University Institute for Natural Resources in Africa (UNU-INRA), the mission of which is to improve Africa's endogenous capacities for a sustainable use of the continent's natural resources. The Advisory Expert Committee (if it becomes functional) could work with the African and Malagasy Council on Higher Education (CAMES) on the certification of ethics education on the continent. Collaboration between UNESCO and the Agency of Francophone Universities (AUF) would be useful in enabling Francophone universities, which have a long tradition of teaching philosophy and ethics, to become effective partners in teaching the ethics of science and technology.

We should like to conclude with an African proverb: "Knowledge is like the trunk of a baobab tree. No one individual but several can encircle it with their arms." Together, through constructive debate, we will succeed in finding the best ways of teaching the ethics of science and technology, while respecting diversity and pluralism and taking into account the real concerns of societies and of the Member States of UNESCO.

JOHAN HATTINGH: ENVIRONMENTAL ETHICS: HISTORY, CONTEXT AND INTERNATIONAL ACTION

COMEST member

Introductory remarks

During the last three years, COMEST has embarked on a study of environmental ethics with a view to initiate international action in this field. During 2004, a group of experts in environmental ethics met twice to discuss the state of the art in environmental ethics, and to make proposals towards possible actions that member states could consider to take up within their own fields of jurisdiction. The results of the discussions in 2004 were two documents: in the first place, a book *Environmental Ethics and International Policy* (Ten Have, 2006) was published towards the end of 2006 in which the group of environmental ethicists each contributed a chapter, and in the second place, a discussion document was drafted in which the contours of a possible policy declaration on environmental ethics were outlined. The latter document generated a lively discussion at the Fourth Ordinary Session of COMEST that was held in March 2005 in Bangkok, Thailand, as well as the extraordinary meeting of COMEST that was held in June 2006 in Paris, indicating the need for further discussion and consensus building on the topic of the basic principles that should inform an international environmental ethics.

The purpose of this paper is to provide a broad framework within which the contributions to the environmental ethics book and the discussions of the principles of environmental ethics within COMEST can be interpreted. This framework is not intended to be prescriptive, but rather is constructed from a descriptive overview of the historical emergence of environmental ethics as a field of inquiry since the early 1970s. The argument that I will develop in this paper is that the basic task and the central issues of environmental ethics have been formulated in different terms, depending on the historical and spatial context that is focused upon. I further argue that the history and context of environmental ethics, as well as its implications for international action can be brought sharply into focus if the challenges of sustainable development and environmental justice are conceptualised with experiences from the African continent in mind. My contention is that if history, place and context are taken seriously in environmental ethics, classic theoretical debates about the tensions between theory and practice in environmental ethics, about the question whether we need a new ethics instead of extrapolating a conventional, human-centred ethics to a new field, or about the viability of rejecting instrumental value theory in favour of intrinsic value theory (in which the notion of intrinsic value is not exclusively reserved for humans), acquire a critical edge that they would not otherwise have had.

Accordingly, this paper will start with a short discussion of the historical emergence of environmental ethics in the early 1970s. In this section, an overview will also be given of the typical theoretical and political debates that can be associated with this historical emergence. In the next section, I will focus on the importance of place and time, i.e. context, in environmental ethics, and then will proceed to a sketch of the set of issues that can be included in the discussions of environmental ethics when the context of Africa is invoked. The latter perspective is taken further in a short overview of the historical emergence of the discourse around sustainable development, and the issue of environmental justice. Thus a foundation will be laid to define the task of environmental ethics as a radical questioning of the conditions under which patterns of unsustainable development and distributive injustice are established, justified and perpetuated internationally.

The historical emergence of environmental ethics

With a few earlier precursors as exceptions (for instance Aldo Leopold's land ethic [Leopold, 1949]), environmental ethics as a field of theoretical reflection, emerged during the early 1970s, mainly in response to the experience of people in industrialized

countries in the northern hemisphere who became more and more concerned about resource depletion or destruction (Norton, 1994; Eckersley, 1992). In this historical phase, environmental problems were mainly associated with single point problems, for example a polluting industrial facility, or the prospect of completely running out of oil, or the negative impact on a particular species, bringing it to the brink of extinction. The hunting of whales could serve as an example of the latter. Referring to this as first generation environmental problems, Norton (1994) defines second-generation environmental problems as those that have a systemic effect. From a systemic point of view, the effects of pollution in a river is not seen as a localized issue with one single point as a cause, but one that may have an array of different causes, and impacts on populations of humans and non-human living entities further downstream, affecting a whole region. From this perspective, the connections and interactions of human endeavours are brought to the fore, emphasizing their cumulative effects on many different levels and on many different individuals and groups of people, species of non-human living entities, populations of fauna and flora, as well as the ecosystem that sustains them.

While acknowledging that first and second-generation environmental problems can exist alongside one another, Norton (1994) also identifies third-generation environmental problems. These consist of disastrous effects that will be suffered at some stage in the future by large numbers of people spread over vast geographical areas as a consequence of small, incremental decisions made by large numbers of people living at present. Where first and second-generation environmental problems occur at local and regional scales respectively, third-generation environmental problems occur at global scale, affecting the entire biosphere. Vast numbers of people making use of electricity or motorized transport in their daily lives, thus contributing to the burning of fossil fuels and CO_2 emissions that in turn contribute to climate change that can have disastrous effects on the entire earth, can serve as an example in this regard. The small decisions that occur within this context entail mostly flicking on a switch to turn on an electric apparatus or a motorcar engine. Another example could be the creation of multiple drug resistant micro-organisms by careless prescription or use of antibiotics by people living now, thereby rendering humans and animals living in the future vulnerable to infections for which there may be no effective treatment.

A very peculiar characteristic of third-generation environmental problems is that they are, generally speaking, caused and suffered respectively by people who may not have lived in the same timeframe. Another way to make the same point is to observe that third-generation environmental problems may negatively affect people who are on the receiving end of actions that others have taken in the past, and about which nothing could be done in the present. Thus, those affected suffer negative consequences, without sharing in the benefits of these past actions. From this point of view, third-generation environmental problems are structurally different from first and second-generation environmental problems, and thus will require different forms of analyses, strategies and practical responses than those that may effectively be used to mitigate or remedy first and second-generation environmental problems. Accountability, for instance, seems to be much easier to determine for first and second-generation environmental problems; while in the case of third-generation problems it may well be that no one could be held accountable at all.

With this as background, we can now turn to some of the theoretical debates that have taken place since the historical emergence of environmental ethics, many of which are still unresolved. For the purpose of this paper, I will confine myself to only three of them. One of the oldest theoretical issues in environmental ethics is whether we should hold on to our older and more conventional human ethics, but extend it to the new area of environmental problems, or whether we should develop a new, nature centred ethics along different lines than we have become accustomed to (Routley, 1973; Naess, 1973; Passmore, 1974; Attfield, 1983; Hargrove, 1989). The tension between these two options has to do with the realization that we as humans have moral obligations that stretch further than other human beings only, together with the doubt whether a conventional human-centred (anthropocentric) ethics can do justice to new objects of concern such as animals and plants, and species and ecosystems. Many of the debates within this context, therefore, revolved on the one hand around the question whether an anthropocentric ethics can ever be a legiti-

mate environmental ethics, or whether a biocentric or ecocentric environmental ethics is not doomed from the start to a stance in which humans are undervalued and neglected.

Very much related to the first theoretical debate, a second one raged from the inception of environmental ethics around the question whether instrumental value theory should be replaced with intrinsic value theory (Rolston, 1988; Hargrove, 1989; Sagoff, 1988 and 2004). The tension between these two options has to do with the question how we value the environment, i.e. non-human entities such as animals and plants, species and ecosystems, landscapes and even something like land. Do we follow the path of instrumental valuation in which everything is assessed in terms of its use-value to humans, or do we follow the path of intrinsic valuation that leads us to protect, cherish and promote non-human entities for their own sake, regardless of any use-value that they may have for us as humans? Both theoretical paths, however, have their own problems. Instrumental value theorists are often criticized for the fact that their stance is too weak, not providing the protection to the environment that is actually required. Intrinsic value theorists, on the other hand, are often criticized for coming over too strongly. For many, the notion of intrinsic value says too much, claiming too much protection for non-human entities. To this, many intrinsic value theorists retort by saying that an environmental ethics in which the intrinsic value of non-human entities have no place is no environmental ethics.

A third line of theoretical inquiry characterising environmental ethics is the tension between environmental ethics as theory, and environmental ethics as practice. While many environmental managers and activists may be skeptical about the value of environmental ethics as a theoretical enterprise, claiming that its debates are only accessible to professional philosophers, many environmental philosophers and ethicists respond to this challenge by pointing out that environmental management and environmental activism can bring more harm than good if the value positions informing them are not subjected to rigorous critical analysis. Environmental philosopher Holmes Rolston III (1994), for one, alluded to a division of tasks when he observed that the practical task of environmental ethics is to ensure the continuation of life on this earth; its theoretical task is to find a value theory profound enough to support this task.

On a philosophical level it can be observed that Rolston articulated but one possible practical task for environmental ethics, and that other equally important tasks can be identified, for instance to keep the creative fabric of cultural and natural evolution alive (Norton, 1994 and 1996). But this would only be an indication of another important philosophical point, namely that we can never assume that we have completed the agenda of any environmental ethics. Similarly, it can be observed on a philosophical level that no single value theory can ever hope to give a final justification for any practical task of any possible environmental ethics. The dialectical nature of the relationship between theory and practice, and the plurality of values informing our decisions and actions in any and every context, seems to suggest this very strongly, calling thus for a continuous acknowledgement that a rigorous and critical discussion of the ways in which we place items on the practical agenda of environmental ethics, as well as the ways in which we justify that from any value position, is one of the most valuable practical contributions that environmental ethics in its theoretical format can make to society (Wenz, 1993).

To bring this overview to a conclusion, I would like to point out that environmental ethics is a fairly young and emerging field of inquiry within the arena of applied ethics (Weston, 1995). While much has been achieved by environmental philosophers within the span of about 35 years in the sense of clarifying certain concepts and principles that could stand central in a practical environmental ethics, environmental philosophy and ethics is still in the embarrassing position of struggling to communicate these gains in a language that is accessible to decision-makers and policy formulators in the fields of science and technology, business, production and manufacturing, and government (Norton, 1994; 2003; 2005). This struggle to find an appropriate language within which to articulate the nature and meaning of our environmental concerns, as well as our responses to them (Attfield, 1994), however, seems to me to call upon all of us to take a very critical look at the practices and values that characterize our interaction with the environment. Something of this critical edge, I believe, emerges if we take into account

the importance of place, time and context in the deliberations of environmental ethics. This I would like to demonstrate with reference to the context of Africa and the challenges it faces with regards to unsustainable development and environmental justice.

The importance of time, place and context in environmental ethics

It goes without saying that every environmental problem occurs at a specific place and a specific time in history, and within a particular context of circumstances. According to Norton (1996; 2003), this truism acquires a special meaning if we take into account that place and time and context can be viewed in terms of smaller and larger scales. On the smallest scale he makes provision for a zero to five years time-scale in which we act as consumers in order to maximize our well-being. Within this time scale, we will typically make use of a cost-benefit calculus to inform our decisions. The next time-scale that Norton differentiates is the intermediate one of zero to 200 years. Within this horizon, he argues, we typically act as citizens of cultural or political communities, taking into account how our options have been conditioned by the choices of those who lived two to three generations before us, and how our decisions will affect the prospects of those who live two to three generations after us. The geological time-scale stretching from zero to infinity is the third time horizon that Norton distinguishes, and here he argues, we act as citizens of the community of life, being affected as we are by, and impacting on evolutionary processes that have began eons before our own lifetimes, and stretching far beyond what we can properly imagine. It is within this geological timeframe that natural evolution takes place, and within which the future evolution of the community of life is affected by the choices that we as humans make in the present.

This model allows Norton to make the salient point that each and every one of our actions simultaneously takes place within a multiplicity of scales, affecting different and ever widening spheres (or contexts) of our lives in different ways. The choice for the consumption of a certain product, for example, not only have economic implications in the 0 to 5 year time-frame for those producing and consuming it; it also impacts on the socio-political sphere of cultures and nations in a much wider scale of time and place, as well as on the slow evolutionary processes taking place within the biosphere in the zero to infinity timeframe. Accordingly, Norton (1984; 2003) argues for an ethics in which we replace the satisfaction of felt (or currently expressed) preferences with the satisfaction of well-considered and publicly tested preferences. In concrete, practical terms, he thus calls for decision-making based on democratic dialogue that seriously considers not only a single spatial-temporal horizon, but also all scales in which human actions have impacts. By this it is acknowledged that a decision driven by a single set of values, for instance that of the preference satisfaction of consumers, can have severely disruptive effects in other wider spheres such as that of culture or the political life of nations, and similarly, that decisions driven by certain cultural or political values alone, can have detrimental effects on the biosphere, as well as on the smaller scale of economic activity. So, what Norton argues for is a life in which considered preferences are satisfied, meaning that we consider, in a shared dialogue with others, each and every preference that we feel is important by placing it in, and relating it to, smaller as well as wider scales of place and time within which it may have an effect. Accordingly, the ethical advice that he gives us, is that we should strive to only do that which makes sense in a multiplicity of place and time scales, and that we should refrain from doing that which may have disruptive effects in smaller or wider scales of place and time.

As such, Norton develops an environmental ethics in which complex and dynamic interactive processes are central considerations, and in which felt preferences are subjected to the test of multiple-level experience and deliberation, i.e. determining whether a decision will, and in fact does make sense in multiple scales of place and time. When it comes to sorting out differences between people about what makes sense, Norton (2003; 2005) suggests a process of shared, democratic dialogue in which everyone with a determinable stake in what happens at a particular place at a particular time, participates to set parameters for what can and what cannot be done. From this point of view, any dialogue in which pertinent stakeholders are left out of the process, or in which the voices of some stakeholders dominate that of other stakeholders, will be fundamentally flawed – so much so that inappro-

priate or disruptive decisions could be reached. This, I believe, can be illustrated by bringing the context of Africa into our discussion, as well as the challenges that are experienced in Africa with regard to unsustainable development and environmental injustice.

Africa, unsustainable development and environmental injustice

With no intention whatsoever to contribute to the discourse of Afropessimism, it would be disguising the truth not to mention the history of slave trade and colonization that Africa has suffered, and the devastating effects that this has had on the economic, political, social and cultural fabric of the continent. Many refer to this history as a history of underdevelopment, referring to the extraction of resources from Africa for the benefit of colonial powers, while leaving the majority of the population of the continent with little, if any power or opportunities to share in the riches of their continent (Seligson and Passé-Smith. 2003; Isbister, 2006). Many commentators will argue that the post-colonial era has not changed much to this scenario for the majority of the people living in Africa. In fact, many will argue that Africa is currently in the midst of a neo-colonial era in which the wealth of the resources of Africa is again monopolized and carted away by foreign countries under the guise of trade and direct foreign investment.

It would also be to paint an inaccurate picture if no mention were made in this context of internal differences and strife between the people of Africa to gain political power, or the control of regions or certain resources. Similarly it would be inaccurate not to refer to the HIV/AIDS pandemic in Africa and the devastating effects this has on millions of individuals, as well as the social, economic and political fabric of which they form an integral part. At the same time, we cannot be silent about the temptation experienced by many governments or government officials in Africa to allow highly destructive extractive operations in their countries, or polluting industries, or even the dumping of toxic waste.

However, it would be equally untruthful not to mention in this context the vast deposits of natural resources of the continent of Africa on which its future development can be based. Non-renewable resources like oil, gas, coal, metals, minerals and gemstones are found in abundance across the whole of the continent, and the same applies to renewable resources like forests, fish stocks, its wildlife and biodiversity, as well as numerous rivers with the potential of generating hydro-electricity. In addition, the stock of human capital found in the diversity of indigenous cultures, and in the creative energy of the youth are all positive factors that can contribute to unlocking the potential of the continent.

Against the background of this picture, it is evident that the continent of Africa has experienced in the past, and is currently still experiencing, the challenges of unsustainable development and environmental injustice. In terms of definitions of sustainable development used the world over, it can be demonstrated in many instances from across the whole of the continent that neither is Africa experiencing a harmonious and well-balanced integration of economic, socio-political and environmental considerations in the extraction and use of its natural resources, nor is Africa the main beneficiary of the resource use and extraction that in fact do occur in the continent. On the contrary, it can be demonstrated in many instances that the costs of this resource extraction and use stay within the continent, while the benefits that are exported to offshore countries are captured by a small elite of the population of Africa. In addition, it can also be demonstrated in many instances that ordinary people of Africa are often bearing the costs of resource use that have taken place in other parts of the world. One of the latest cases in point is the dumping of toxic waste in the city of Abidjan in Côte d'Ivoire, which is but one example of a series of others that can be quoted.

Formulated in terms of distributive justice, this clearly entails an unfair state of affairs. This could be referred to as a situation of environmental injustice in so far as the costs of resource use are shifted onto the poorer people and countries of the African continent, while the benefits are reserved for a small elite, or exported elsewhere (Bullard, 1990; Schlosberg, 1999). While many leaders in business and government the world over are starting to acknowledge how fundamentally unjust this pattern of distribution is, and while international organizations such as the United Nations have formulated and set in motion mechanisms to implement potential remedies to this

in the format of the Millennium Development Goals, there still seems to be a long road to travel before the adjustments required in the world's economic structures and trade rules to reverse this situation will be implemented.

Sustainable development: its history and fundamental principles

Against the background of the previous section, it is revealing to note that the concept of sustainable development has emerged from two distinct historical contexts (Achterberg, 1994). The one context can be linked to the concerns expressed in the industrialized countries of the north about the depletion or destruction of its resource base. Accordingly reports were published in which the limits of material growth were proclaimed, and calls went out for a steady state economy in which resource use and population growth are kept under strict control, either by national governments, or by some kind of international government system (Daly, 1992).

The second historical context in which the discourse of sustainable development emerged was that of developing countries and international organizations like the United Nations, the International Union for the Conservation of Nature (IUCN), and the Worldwide Fund for Nature (WWF). Within these circles the interests of the poorer nations of the world were articulated, emphasizing the necessity of addressing worldwide poverty and global injustice. Within this context it was impossible to support the idea of a world economy with a 0% growth rate, because this would not only entrench global patterns of injustice, but also place a death sentence on millions of people from the poorer nations of the world (Eckersley, 1992).

The United Nations Conference on the Human Environment held in Stockholm in 1972 could be seen as one of the starting points of this second context, which also include the United Nations Conference on the Environment and Development that was held in 1992 in Rio de Janeiro, as well as the United Nations'World Summit on Sustainable Development that was held in Johannesburg in 2002. It is within this context that the well-known definition of sustainable development that is used now the world over has emerged. It was formulated for the first time in 1987 in *Our Common Future*, the report of the Brundtland Commission, and reads as follows:

> "Sustainable development is development that meets the needs of present generations without compromising the ability of future generations to meet their needs" (Brundtland, 1987, p.43).

What are often forgotten when this definition is used are the two qualifications that were added to it. The first is that the needs of the poor should receive priority when it comes to needs satisfaction, and the second is that the state of science and technology, as well as social organization in societies are the primary limitations on levels of needs satisfaction (not the carrying capacity of nature). While this second qualification has been severely criticized for the impression that it creates that environmental concerns are not important in sustainable development, the rest of the Brundtland Report is actually devoted to identifying conservation measures without which sustainable development would be impossible to achieve.

It is furthermore important to note that the different emphases of the discourses embedded in these two historical contexts converged in 1991 with the publication of *Caring for the Earth*, jointly produced by the IUCN, UNEP and the WWF. In *Caring for the Earth*, the emphasis falls on sustainable living, which is defined as living without compromising the ecological basis making that living possible in the first place. Also emphasizing that sustainable development entails development that is economically viable, people oriented, and conservation based, the nine fundamental principles of sustainable living of *Caring for the Earth* yield an important merging of the conservation agenda of the first historical context mentioned above, with the development agenda of the second historical context. These nine principles read as follows:

1. Respect and care for the community of life
2. Improve the quality of human life
3. Conserve the earth's vitality and diversity
4. Minimise the depletion of non-renewable resources

5. Keep within the earth's carrying capacity
6. Change personal attitudes and practices
7. Enable communities to care for their own environments
8. Provide a national framework for integrating development and conservation
9. Create a global alliance

Concluding remarks

If these nine principles of sustainable living are read against the background of the environmental challenges facing the context of Africa, it is evident that the agenda of environmental ethics would be defined too narrowly if it is devoted only to the conservation of nature, and too widely if it is only devoted to the agenda of development and poverty alleviation. From the above it is also evident that nature conservation and development to alleviate poverty are in fact not two separate, mutually exclusive agendas, but rather flipsides of what is the same agenda. Poverty and environmental injustices indeed have very destructive impacts on the natural environment, which means at the same time that environmental issues and ensuring the conservation of the natural environment cannot be adequately addressed if nothing is done about poverty alleviation and overcoming environmental injustices.

Reflection on the agenda of environmental ethics from the continent of Africa, I believe, adds a further dimension to it, namely the challenge to find intellectual resources on the basis of which current patterns of unfair distribution in the world, as well as trends leading to environmental injustices and unsustainable development can be identified, questioned and challenged. In this regard, environmental ethics can gain a lot from work already done by those theorists who challenge conventional, neo-liberal conceptions of justice, and by those environmental philosophers who explore notions of self and self-realization that can serve as viable alternatives to the notions of self and self-realization that are advertised into existence by consumerist society (Naes, 1989). Similarly, environmental ethics can learn much from those who devote their intellectual energy to critical analyses of power relations and ideologies (Warren, 1990; Plumwood, 1993; Bookchin, 1980), or exploring the environmental wisdom that we can gain from indigenous knowledge systems that are currently fast disappearing before the onslaughts of modernization on all continents (Kelbessa, 2001).

Accordingly, I would like to submit that one of the most important tasks of environmental ethics these days, if not the most important one, is to help recognize patterns of unsustainable development and unjust distribution wherever they occur, to help identify and unmask the ideologies by which we establish, justify, and perpetuate these patterns, and to promote alternative paradigms of thinking and doing when it comes to resource use and our interactions with the environment.

These perspectives, I believe, are not only important for an adequate conceptualization of the agenda of environmental ethics in Africa, but also could inform the deliberations of COMEST and the debates between member states of UNESCO when it comes to identifying the principles of an environmental ethics that is strong enough to make a difference to what is going on in the world today.

YVELINE MARIE-THÉRÈSE HOUENOU-AGBO: A QUESTION OF TOXIC WASTE IN AFRICA

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Introduction

Environmental ethics is a branch of applied ethics that "seeks to specify the nature of the relationship between humans and the natural environment". It includes ethical questions in areas such as "world governance, the organization of States and local communities, education and the management of companies". Environmental, economic and social questions constitute the three pillars of sustainable development (Wikipedia, 2006).

The events in Abidjan involving toxic waste on 20 August 2006 are a good starting point for reflection on environmental ethics in Africa. On that day, a section of the population of Abidjan fell ill, fumes of toxic gas began to waft into the city and, a few days later, strong nauseating, suffocating odours revealed the presence of toxic waste that had come from the Russian ship "Probo Koala". The threats to human health and the environment were thus revealed and brought dramatically to the notice of individuals and the community alike. This still topical ecological disaster is not an isolated occurrence; it raises the problem of the cross-border movement of hazardous waste into poor countries. In view of the problems raised, reflection on environmental ethics must necessarily include not only the role of international organizations and the application of conventions on the subject, but must also attempt to determine local and national responsibilities and provide answers to vital questions. What roles are young African scientists to play? What approaches to solutions should be suggested for the future or supported when they are in place, notably in terms of research and education? The latter question will be discussed in the light of the Ecosystem Approaches to Human Health Programme Initiative and the need to promote the United Nations Decade of Education for Sustainable Development.

TOXIC WASTE IN AFRICA

1. The case of Abidjan

For financial reasons, the international trading company Trafigura, based in Amsterdam (Netherlands), chose to dump its waste in Abidjan rather than in the ports of Amsterdam or Rotterdam. It apparently informed the relevant authorities of the toxic nature of the waste to be "handled with care" (Saliby, 2006). The waste was dumped in sludge form (difficult to clean up) in several places in the city of Abidjan; 17 open sites were officially identified, in particular at Vridi (Tri-postal), at the unregulated Akouédo landfill, at Zoo, in the lagoon, the sea and near market garden areas.

The waste, with a mass-per-unit volume and organic carbon composition close to that of pure petrol, contained large quantities of hydrogen sulphide (H_2S), mercaptans, caustic soda, phenols and organochlorates. The presence of heavy metals was not confirmed.

The consequences have been very serious in health, social and political terms: a sort of psychosis reigned over the people of Abidjan, with families forced out of their homes, working days lost and the possibility of chemical warfare was even mentioned. By 30 September 2006, there had been eight deaths, thousands had fallen ill, 69 of whom had been hospitalised, and almost 100,000 medical consultations by persons intoxicated by the fumes from the toxic waste (OCHA, 2006a). Specific environmental consequences are feared: the contamination of the water table and the food chain and more or less long-term health implications. It was a serious public health problem that necessitated a response from State authorities and the international community.

Under the national action plan to combat the problem of toxic waste, the Government set up an operational coordination unit composed of the Ministries of the Environment, Water and Forests, the Ministries of Defence, Health and Sanitation, enlarged to include

the Côte d'Ivoire Antipollution Centre (CIAPOL) and the laboratory of the Société ivoirienne de Raffinage (national refinery services company). Measures were taken by the Ministry of Health and Sanitation, the technical staff of which made arrangements for patients to be treated free of charge and for epidemiological monitoring by the National Institute of Public Health (INHP). A government information campaign for the general public was broadcasted by the media with emphasis on the line of conduct that should be followed in regard to dangerous and even household products. Helplines were opened to provide information on waste. The Ministry of Animal Resources and Fisheries applied the precautionary principle, leading to the incineration of some products, the protective cordoning off of the market gardening areas and the banning of fishing in affected areas. Civil society and NGOs rallied round to build awareness, solidarity and advocacy. Environmental researchers are gathering information to monitor and assess the long-term environmental impact. The political authorities have taken drastic administrative and legal measures (WHO, 2006; OCHA, 2006a).

At an international level, the Government of Côte d'Ivoire officially requested international assistance comprising: French civil protection experts including at least one pharmacist, one geologist, one water analysis expert and one toxicologist; a Swiss waste toxicologist from the Environmental Emergencies Unit of the United Nations Office for the Coordination of Humanitarian Affairs (OCHA); a team of three experts from the United Nations Disaster and Assessment Coordination (UNDAC) unit to strengthen technical strategies and information management regarding toxic waste and health safety measures. The United Nations Industrial Development Organization (UNIDO) mobilized a crisis unit, the "Clean Production and Environmental Management Branch" (CPEMB). Two WHO experts provided support to the Côte d'Ivoire Office in its endeavour to analyse the situation, participate in epidemiological monitoring, mobilize resources, draw up information documents and monitor the food chain. Clean-up operations were carried out. The request for international financial assistance reportedly amounted to $13.5 million. The Swiss Centre for Scientific Research (CSRS) has offered to study the impact of the toxic waste. Surveys by the UNEP and the Basel Convention secretariat are still under way. At the international level, donations in kind, above all of medicines, and financial aid have been received (OCHA, 2006b; WHO, 2006; UNEP, 2006).

2. In Africa (Lo and Toure, 2005)

The Côte d'Ivoire scandal reveals the scale and complexity of the illegal worldwide traffic between rich and poor countries. The question of toxic waste concerns a group of products generated primarily by developed countries. Between 20 and 50 million metric tons of electrical and electronic waste are produced each year worldwide. In 2003, 7.5 million metric tons of such waste were exported, and the disposal of 1 million metric tons was in line with environmental and health standards. Other types of waste are exported to Africa to be recycled, including out-of-date or undesirable food and pharmaceutical products, aging and/or badly maintained vehicles and banned pesticides.

Africa is already in a precarious situation in which poverty is inextricably linked to environmental degradation. It has a high population growth rate (3%), little access to drinking water and sanitation and a low literacy rate. It also faces the great global challenges of greenhouse gas emissions, climate change and its consequences (drought, flooding and so on) and deforestation; it is affected by the negative impact of globalisation and rapid economic change. While skilled human resources are rare or caught up in the brain drain, armed conflicts continue to ravage the continent. The result of these scourges is an unacceptable level of morbidity and mortality, with rates among the highest in the world, affecting the most vulnerable sectors of the population, women and children. The international community has, however, proposed development programmes, conventions, protocols and recommendations.

INTERNATIONAL RESPONSES

1. Programmes and initiatives

The New Partnership for Africa's Development (NEPAD), a commitment by African leaders portrayed as a vision and a strategic framework for the social and economic development of Africa, has the same objec-

tives as the United Nations Millennium Development Goals. This initiative has identified six priority areas, including the environment and the development of human resources – which implies health. In drawing up the environmental action plan, the emphasis was laid on the link between health and the environment; the main lines of the projects adopted at Dakar in 2003 include the question of toxic waste.

2. Agreements and conventions

Several agreements and conventions deal with issues relating to toxic waste. In 1957, the United Nations Committee of Experts made recommendations, updated every two years, on the transport of dangerous goods. The overall objective of the 1989 Basel Convention on toxic waste was to protect human health and the environment against toxic waste, which must be treated and disposed of as close as possible to the place where it has been produced. At the regional level, the Basel Convention has been strengthened by the establishment of regional centres and a series of agreements binding Heads of State: the Bamako Convention of 30 January 1991 for Africa, the African Convention on the Conservation of Nature and Natural Resources, Algiers (1968), the Cairo Guidelines and Principles for the Environmentally Sound Management of Hazardous Wastes adopted by UNEP in 1987 and the Lomé IV Convention regarding the international transfer of hazardous and radioactive waste. The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region in the Mediterranean, the United Nations Framework Convention to Combat Desertification, the United Nations Framework Convention to Combat Climate Change and the Kyoto Protocol concern the continent of Africa to a certain extent.

In spite of all of these measures, how can the failure to apply instruments recognized and adopted for the purposes of policy decision-making be explained? Three remarks must be made and they concern the ratification and dissemination of convention texts, the importance of intrinsic values and the role of universities and research institutions, particularly in Africa.

a. Ratification and dissemination of conventions

Conventions are the outcome of mature reflection that does not really concern or commit the main actors. The amendment banning all cross-border movement of hazardous materials, proposed by the developed countries, has been approved by only 65 countries, including all members of the European Union. The Basel Protocol concerning the implementation of a comprehensive regime on liability and compensation for damage relating to trade in hazardous waste has been ratified by seven countries only, while twenty ratifications are required so that it may come into force. The Executive Director of UNEP has appealed to the international community to encourage its ratification and accelerate its entry into force. The meeting in Nairobi, held from 17 November to 1 December 2006 to update the Convention, was attended by 160 countries. Intentions are good but the difficulties encountered in terms of adoption and execution include poor dissemination and the lack of monitoring (Saliby, 2006). This in spite of the fact that Member States are responsible for dissemination and implementation, the subject of an annual report (UNESCO, 1974).

b. Absence of intrinsic moral value

Environmental ethics is, according to Johan Hattingh, based on distinctions between "right and wrong, good and bad, what deserves respect and what does not". It draws on the moral principles of right and duty, justice and dignity, solidarity and sharing, the search for peace and prosperity for all. These intrinsic moral values are not taken into account although they are implicit in the recommendations. They should be included in clear terms to add weight to the application of conventions and to answer the charge that conventions are "ideological ploys to further the sectional interests of the dominant political and economic powers in the world" (Hattingh, 2005).

c. Role of universities and research institutes

In 1974 UNESCO drew up recommendations on the status of scientific researchers. Their role is clearly defined in these recommendations, as are the conditions necessary for success. Researchers should aim to achieve national objectives and participate

in national policy-making and implementation and in the dissemination of scientific knowledge needed by the population. This requires that researchers and decision-makers be trained and educated in scientific research in a spirit of integrity and devotion to service to the community. They thus acquire the right to receive moral and material support from the State. These recommendations have not been applied properly for 32 years and research remains the poor relative of higher education. It is thus understandable that, lacking the means, researchers contribute little to the solution of their communities' problems.

POSSIBLE APPROACHES TO SOLUTIONS

1. Scientific output in the service of decision-making

The new global initiative to build linkages between health and the environment, the Health and Environment Linkages Initiative (HELI) has, through pilot projects, begun to introduce decision-making tools with a view to moving from knowledge to action (WHO, 2007). Currently, the promotion of lead-free petrol is one of the results of science in the service of policy decision-making. In the last three years, through a series of thematic workshops, the IDRC has been building synergy between researchers and decision-makers in West and Central Africa. The themes already discussed are agriculture (Dakar), education (Ouagadougou), private sector development (Accra), drought and desertification (Bamako) and governance (Cameroon) (IDRC, 2007). The results of these workshops will be published and could be useful to other countries. Other more subtle factors, however, play a part in decision-making and in policy and institutional issues. While these difficulties are considerable in terms of national policy decision-making, it is at least possible, in the context of decentralization, to encourage research at community level.

2. Scientific output in the service of community development

African institutions are involved in capacity-building in environmental sciences in Côte d'Ivoire, Benin, Burkina Faso, Senegal, Cameroon, Ghana, Nigeria and other African countries. The ecosystem approach to human health, which has been successful on several continents under the auspices of the IDRC, has been tested in particular to establish linkages between the environment and human health (Lebel, 2007). It is an approach that meets the training and education needs of decision-makers, scientists and the community. Broadly speaking, the ecosystem approach to human health explores, first of all, the existing relationship between the various components of a given ecosystem, and defines and assesses the priorities that determine human health and the sustainability of the ecosystem. It is based on three principles: its transdisciplinarity, community participation and gender parity.

The term "transdisciplinarity" refers to research carried out by teams of experts from complementary disciplines, through a process which enables researchers to create a "virtual discipline" which has its own assumptions, theories, models, research protocols, new methods and insights derived from the synergy achieved by working together throughout the project. This calls for a team of researchers who wish to work directly for the welfare of communities and who embody the values of environmental ethics, integrity, maturity, and moral and intellectual qualities.

Participation is the process through which beneficiaries influence and take part in the management of development initiatives, decision-making processes and the resources that affect them. That requires the community to be ready to collaborate with scientists, research being perceived as a development tool. The ecosystem approach to human health ascribes as much importance to local knowledge as to that of the scientific team because the sharing of knowledge leads to viable solutions. It is vital to target the representatives of the various social groups and sometimes facilitate negotiations so that stakeholders are correctly represented in accordance with their roles. Community decision-makers must be able to give time, knowledge and expertise to the consultation process.

The quest for equity guarantees the success of the action undertaken. Owing to the inclusion of the concept of gender, a framework can be designed to promote understanding of local knowledge by revealing differences in how men and women, young and old, participate in their community's development. This approach is illustrated in the Buyo case study.

3. Buyo case study

Buyo is a region in the west of Côte d'Ivoire. The research carried out by the Environmental Science Laboratory of the University of Abobo Adjamè, in collaboration with a team from the Medical Sciences Training and Research Department of the University of Cocody, has found that agricultural activities relating to coffee and cacao, heavy users of fertilizers and pesticides, the construction of a hydroelectric dam and related fishing activities have, within one decade, from 1980 to 1990, led to the degradation of forest and water ecosystems (Houenou and Houenou-Agbo, 2001). The social, economic and health consequences include radical changes to the social fabric owing to population displacement and massive immigration, the impoverishment primarily of indigenous women, the scarcity of drinking water and the high incidence of disease, particularly diarrhoea and malaria. Emergency solutions have been found with the population. The challenge taken up by researchers, partly under the ecosystem approach to human health, was to assess the quality of human health and of ecosystems in and around Buyo in order to contribute to making improvements. After the preliminary results were released to the population, which was represented by all social classes and had set the priorities itself, a transdisciplinary team provided technical and scientific support to improve welfare on the basis of the research findings. This experience contrasts with conventional research, goes further than the mere identification of problems, guarantees project follow-up, the promotion of sanitation by population groups themselves, the involvement of local decision-makers, optimum management of ecosystems and greater social cohesion. Academics, highly motivated to study ethics based on respect for nature, humanity and spiritual and cultural values, regard research as an excellent means of finding realistic solutions to the needs of the community: supply of better drinking water, education on toxin levels in fish and on the best cooking methods to reduce food-related risks, public sanitation and primary health care. This research will provide reliable indicators for information, awareness-raising, formal and informal education and advocacy for change. We all have responsibilities in that regard, especially the researchers who carry out research and must come down from their ivory towers.

4. Education for Sustainable Development (ESD)

The Decade of Education for Sustainable Development, 2005-2014, for which UNESCO was designated lead agency, provides a framework for action. In partnership with UNEP, a training programme "Mainstreaming Environment and Sustainability into African Universities" (MESA) has been drawn up in order to make African academics aware of their role as ESD leaders.

The IDRC has just approved a large community research and action training project on the management of household waste in urban and periurban environments in West and Central Africa for NEPAD under the "Ecohealth" approach. It will be developed in pilot phases in Benin, Burkina Faso, Cameroon and Côte d'Ivoire. The project requires the prior commitment of the States involved: the principal implementation stakeholders are the Network for Environment and Sustainable Development in Africa (NESDA), the teachers and researchers of the Community of Practice for Ecohealth (COPEH) in West and Central Africa, the Interim Secretariat of NEPAD for the Environment (SINEPAD) enlarged to include African research partners (UNESCO, 2007).

Conclusion

The question of toxic waste in Africa has strengthened our individual and collective awareness of environmental ethics. It encourages us to be committed and responsible in respecting environmental ethics. The "Ecohealth" approach encompasses the values of good governance, respect, equity, solidarity, devotion and, above all, humility within a transdisciplinary framework. It is a tool to be promoted, internationally and nationally, in the private and public sectors and, of course, at the community level. It enables us to invest in our own development while being committed to the Decade of Education for Sustainable Development, which should lead to a better definition of policies and strategies for the welfare of people in Africa and bring researchers and decision-makers closer together.

JEREMY T. OUEDRAOGO: INTERACTIONS BETWEEN BIODIVERSITY, GMOs AND BIOTECHNOLOGY: AFRICAN PERSPECTIVES

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Introduction

Biological diversity is a term that can be used to refer to diversity within genes, a species, a community of species or an ecosystem. The term "biodiversity" is a commonly used contraction that refers to the overall biological diversity of a particular zone or the whole planet. Biodiversity includes all life on earth, from microorganisms to plants and animals. According to the Convention on Biological Diversity, "biological diversity" means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity, 1992; Johnson, 1993). Biodiversity is the fruit of 3.5 billion years of evolution. It is measured in terms of numbers of species but also in terms of quantity (biomass).

Natural selection and human intervention have led to large-scale cultivation of five plant species (wheat, corn, rice, soya and barley) that provide most of the world's food. Biodiversity loss is quickening apace as human activity expands. In the last fifty years, the increase in world population, urbanization and industrialization has altered the ecological balance of many parts of the world. The rise in world population to 6 billion people (from 2.5 in 1950), 80% of whom live in countries in the South, has caused demand for food to rise exponentially, prompting new, efficient agricultural methods, while also bringing about significant ecological changes (biotec actu, No. 9, 2004). It is vital to maintain and conserve biodiversity enduringly.

Biotechnology may be defined as use of a biological system to make a product. The biological system may be a plant, an animal or a microorganism (bacterium, fungus, virus).

Genetically modified organisms are living organisms whose genetic makeup has been modified by inserting genes from other organisms. For farmers, the most important group of GMOs are transgenic plants (genetically modified plants). A transgenic plant is a plant which has had foreign genetic information (a foreign gene or transgene) added to its original genetic material. The additional genetic information enables it to acquire new properties such as resistance to insect pests or herbicides or longer fruit conservation.

Until very recently, genes were confined to a particular species: cotton could not possess genes from a variety of corn. With the advent of biotechnology, plants containing genes from different plant species or from animals or bacteria can be produced. Barriers between species have therefore disappeared and the door to "genetic globalization" has opened wide. The role and activities of scientists today give rise increasingly to questions, if not controversy. Discoveries are being made in quick succession, raising questions about the advantages and disadvantages of such research. On one hand, genetic engineering raises hopes because it seems to open up interesting prospects, kindling widespread satisfaction at the achievements and exploits of scientific research; but on the other it creates fears because of the many unknowns that fill us with anxiety and questions.

Biodiversity and biotechnology/GMOs

One of the main concerns relating to the use of GM crops is their impact on biodiversity. One of the reasons for hostility to GMOs is the belief that they will destroy or cause loss of biodiversity. In terms of biodiversity, genetically modified plants raise two main questions: as sources of pollen, what is their impact on surrounding crops and wild plants? More generally, what is their impact on ecosystems?

The impact of GMOs on biodiversity is a complex subject and can be evaluated only on a case-by-case basis. Some plants do not require the transport of pollen for reproduction but are self-pollinating (autogamous plants). However, in plants that reproduce through cross-fertilization (allogamous), reproduction requires pollen to be carried from one plant to the stigma of another.

Pollen from GM plants could cross-fertilize related species and have an impact on the environment through the production of hybrid plants and their descendants. Four basic factors determine the probability and consequences of gene flow in such a case: distance travelled by the pollen from the GM plant, synchronisation of flowering periods of the GM plant and the related plant, compatibility between the GM plant and the related plant and interaction between the two species. The transferred gene must also have a selective advantage. Otherwise it is not be transmitted to descendants.

The real question is not whether or not GMOs affect biodiversity, but rather whether they threaten biodiversity more than conventional crops, both quantitatively and qualitatively. The assessment of the effect of GM crops on biodiversity should therefore include a comparison between the potential benefits and risks of both types of crops. Several scenarios predict irreversible and catastrophic damage to biodiversity as a result of the use of transgenic plants. Others argue quite the opposite. In general, it is thought that modern agriculture, supported by plant improvement and the seed industry, has caused the genetic erosion or loss of several varieties of crops grown by producers. As to modern biotechnology, some think that it will accelerate this trend and lead to even greater genetic erosion. In contrast, others believe that the tools of modern biotechnology, such as cryopreseveration, will contribute to the *ex situ* conservation of biodiversity. However, is the biodiversity lost as a result of the destruction of tropical rainforests not larger than the genetic diversity lost as a result of genetic erosion (Leisinger, 1999)?

Modern biotechnology and GMOs can contribute to the preservation and better use of biodiversity.

1. Biotechnology and biodiversity do not run counter to each other: if used with care, biotechnology can be a major instrument in efforts to conserve biodiversity.

   - Biodiversity is, first and foremost, threatened by the destruction of natural habitats (according to the Convention on Biological Diversity, 1992), the major cause of destruction being, according to the FAO, the increase in the demand for farmland. Agriculture today is typified by large-scale cultivation of a small number of varieties that require repeated human intervention for the achievement of yield potential (labour, use of phytosanitary products, fertilizer, minerals and so on). These large agricultural zones do not strengthen biodiversity. GM plants, which could give higher yields per unit of cultivated land, would contribute to lower the threat of habitat loss and therefore to more sustainable biodiversity.
   - Biotechnology also develops important tools for making inventories of and studying biodiversity and serves as a starting point for sustainable management.

2. Biodiversity can only take on its full value when used in a sustainable fashion. To this end, various biotechnology techniques are used.

   - The use of molecular markers and knowledge of DNA sequences with new traits (e.g. resistance to plant diseases or higher nutritional value of crops) lead to new approaches in order to raise the productivity and nutritional value of plants.
   - The use of genes for the purposes of transgenesis result in genetically modified plants that acquire genes of a higher quality that are advantageous in crops adapted to African agriculture.

3. Enormous biodiversity resources exist on the African continent but they are neither sufficiently known nor used in an advantageous manner.

   - The value and, therefore, the importance of protecting biodiversity depend on our capacity to use it sustainably and our success in doing so.

- It is in this regard that the various areas of biotechnology come fully into play.

4. The use of genetically modified plants does not in itself constitute a threat to biodiversity.

   - Their use must be subjected to rigorous scientific assessment of potential risks, according to principles agreed under the Biosafety Protocol (2003).
   - The scientific analysis of risks provides an effective framework for the production of data required by decision makers.

5. Contrary to what is frequently claimed, African countries do have the necessary capacities to produce data required for decisions on the use of GMOs, provided that:

   - existing capacities are recognised and geared to research and risk assessment projects.
   - national capacities are deployed at a regional level so that the highest levels of expertise are mobilised in the process.

African perspectives

When the impact of agriculture on the environment is considered in a measured fashion, several variables come to the fore. A number of questions should be asked in respect to conventional cultivation, such as the effects of varieties developed through mutagenic irradiation or interspecific breeding. These products may have unforeseeable features. In other words, in view of current and future agricultural production objectives in Africa, all relevant available technologies must be used and promoted in order to reduce the risks to biodiversity.

The major questions being asked by Africans today are set out below.

(1) What can be done to ensure that the use of GMOs does not damage the biodiversity of African agro-ecosystems and does not increase the farmers' dependence on interests outside the continent?

The answer to this question also partly answers the second inasmuch as Africa will not be able to protect its interests until it has the necessary resources in place to produce, use or monitor GMO technology and modern biotechnology products. Biosafety bodies must exist in all countries and be provided with the requisite human, material and financial resources to carry out their work. Today GMOs (seeds and food products) are in circulation in many countries without their knowledge. How will they find out if they do not have a minimum monitoring and detection capability? The preservation of biodiversity concomitantly with the use of GMOs is only possible if user countries build capacities for GMO environmental risk assessment and management.

Independence of external interests is a complex issue inasmuch as our countries do not control their own genetic heritage. Moreover, how many countries have the national expertise that would enable them to protect intellectual property rights? These are areas in which capacity must be built in order to raise hopes of reducing such dependency. Farmers themselves must be made more aware of the need to enhance and protect the heritage and biodiversity against the outside world. One very important area that could be studied by biodiversity managers is property rights, namely rights relating to the land and resources linked to the removal of those resources on the one hand and, on the other hand, rights to technology generated from those resources, whether that be in agriculture, the raising of livestock or medicine.

(2) How can African capacities for research, monitoring, information exchange and stakeholder involvement be improved to prevent the effects caused by uncontrolled spreading of GMOs in a globalised world?

The agencies of the United Nations (WHO, FAO and others) and the African Union (NEPAD, ECOWAS and others) have recognised that biotechnology can play a positive role in the development, in particular the agricultural development, of Africa. Investment in biotechnology can lead to significant improvements in agricultural output, and in the health and welfare of Africans.

Biosafety is the first criterion when deciding whether or not to use the instruments of modern biotechnology and its products, particularly GMOs

(how will GMOs be tested and used with minimum risk to biodiversity, the environment and human and animal health?).

In regard to the question of biotechnology in general and above all, how to make the best use of biotechnology effectively protecting of the environment, Africa has serious shortcomings and must take up many challenges.

(a) Very low use of biotechnological tools, lack of an African biotechnology/biosafety strategy and a crucial lack of funding, qualified human resources and relevant infrastructure.

It is necessary to:

1. draw up an African biotechnology/biosafety strategy;
2. develop priority-setting subregional mechanisms to identify constraints and products that might benefit from biotechnological tools and have an impact on development;
3. develop public-private partnerships for the use of biotechnology;
4. build capacity in terms of funding, qualified human resources and relevant infrastructure;
5. develop international cooperation in the field of biotechnologies with a view to ensuring their effective, practical and sustainable use through North-South and South-South collaboration;
6. create a network of domestic laboratories and biotechnological centres in the subregion and mobilize the network to carry out biotechnological programmes.

(b) Lack of a suitable legislative framework for the use of modern biotechnology, regional harmonisation of existing legislative frameworks and the inability of regional institutional systems to ensure access to biotechnological products and tools.

It is necessary to:

1. put into place national regulatory legislative frameworks and laws and gradually harmonize regional biosafety legislation. Some initiatives are already under way in this area;
2. ensure that legislation is not detrimental to African products and markets while protecting them from potential risks;
3. train African specialists to take part in major international negotiations;
4. improve existing seed systems to include biosafety considerations (WAEMU initiative, the Sahel Institute/CILSS).

(c) Commercial weakness/ international and regional markets

It is necessary to:

1. strengthen regulatory and quality control systems with a view to improving access to markets for African products;
2. work to remove trade barriers and subsidies in developed countries;
3. implement laws on intellectual property to promote product development while recognizing the diversified nature of agriculture.

(d) Lack of public information on biotechnology

Biotechnology is a science of the future for Africans, and they should adopt it on an objective basis. Full and appropriate information on biotechnology is required to enable the public to take informed decisions on the subject. Communication must be improved and stakeholder capacities built to improve public understanding of biotechnology.

Conclusion

Agricultural practices have harmful effects on biodiversity in several ways. Most of these effects can be totally or partly controlled through a judicious use of available technology and crop management strategies. Under an ecologically adapted and rigorously monitored approach, GM crops have shown that they have a beneficial effect on the environmental aspects of modern agriculture (Klaus, 2004). Scientific studies and resulting technological developments have always opened new opportunities for humanity (the wheel, fire, cars, aeroplanes, vaccines, mobile phones and so on). Yet change has never been made without prompting fear and resistance, and emphasis primarily on the likely dangers of the technology.

Ultimately, the question is not whether or not the

new technology should be adopted but rather how the new opportunities afforded can best be used … and how then to institute an appropriate regulatory policy for its use.

OURÈYE SY:
RELATIONSHIP BETWEEN BIODIVERSITY, GMOs AND BIOTECHNOLOGY: PROSPECTS FOR AFRICA

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Introduction

A country's biological – or bio- – diversity consists of the sum total of animal and plant species living on its territory. Species, the basic units of biodiversity, are each characterized by the diversity of their constituent members – intra-species diversity – and by interfertility between individuals belonging to a same species. Collectively, all the individuals of the same species constitute a monospecific population, whereas most natural populations tend to be multi-species. They endow nature, landscapes and ecosystems with their beauty, their richness, and their diversity. The three main aspects of biodiversity, then, are the diversity of species, diversity within species, and the diversity of ecosystems, or functional ecological diversity. These are the cornerstones of the international, conservation-oriented, Convention on Biological Diversity adopted in Rio de Janeiro in 1992 by the United Nations Conference on Environment and Development (UNCED). UNCED marked the culmination of a long process of reflection and awareness-raising within the international community aimed at crystallizing the thinking on sustainable development and environmental protection. The concept of biodiversity first emerged during a preparatory workshop in the lead-up to UNCED (Wilson, 1988), but it is hard to account for the diversity of life by means of a single yardstick in view of the way in which biodiversity is constantly evolving and mutating in line with environmental change. Biodiversity's over-exploitation and massive destruction by human beings have generated clashes of interests and made it an issue at the global level. UNCED was seen as an essential means of setting standards for the use and conservation of biological resources that were vanishing at an alarming rate – resources that the United Nations Food and Agriculture Organization (FAO) regards as humanity's heritage.

At the present time, some 800 million people are suffering from malnutrition and undernourishment because of a host of interdependent factors of a political, economic and social nature. With the world's ever-growing population, set to reach an estimated eight billion by 2020 (FAO, 1999), the developing countries (DCs) will, according to the Global Food Outlook, be responsible for the whole of the growth in food demand by 2015. It would take an annual growth in agriculture of about 6% – one of the goals of the Millennium African Plan and NEPAD (New Economic Partnership for Africa's Development) – to meet that demand. New strategies would need to be deployed and new methods of production devised in order to reconcile more fully the claims of the growth of productivity, the preservation of major ecological balances, economic efficiency and social acceptability (Weil, 2002).

The advent of biotechnology can help to solve some of these problems. As a matter of fact, progress in the knowledge of plant genomes – genetic engineering – is opening up new opportunities for Africa and for the DCs with respect to the introduction and use of transgenic plants in agriculture. GMO use, however, raises many questions of a scientific, economic, social and ethical nature.

Importance of biodiversity

The Rio de Janeiro Convention on Biological Diversity (CBD) highlighted three levels at which biodiversity was at issue: landscapes and the communities that inhabit them (ecosystems); the number and frequency of species (species richness); and genetic variability among individuals within a single species (intra-species diversity). The earth might be home to between 10 and 30 million species, but barely 1.7 million of them have been listed. Just four – wheat, rice, maize and the potato, which have long been domesticated – account for 50% of human calorie intake; and fewer than 40 account for 80%. So-called "genetic resources" are plants, animals and micro-

organisms with actual or potential economic value. Useful genetic resources currently amount to no more than 1% of plant species and 0.1% of animal species – with 90% of global livestock production reliant on just 15 of the 15,000 species of mammals and birds (Moinet, 2005). The pharmaceutical industry, for its part, has explored – and drawn genuine benefits from – the curative properties of just a few thousand species. Usefulness is a highly relative concept that varies from one time and place to another and remains unknown as far as the future is concerned. Unique species and ecosystems are priceless treasures for humanity and must be protected in such a way that they can be passed on to future generations. For genetic diversity is the key to an ability to adapt to ecological disturbances, and a means of securing sustainable development (Barbault, 2002).

The major interest of biodiversity is reflected in its economic and social importance. As far as crop species are concerned, 50% of increased production stems from the use of wild genetic resources. Thus, the introduction of resistant genes of a wild wheat parent from Turkey into commercial varieties has generated an estimated US $50 million a year in profits for the United States of America. According to that country's Department of Agriculture (USDA), the contribution of wild parents from around the world in boosting crop productivity and combating malnutrition could be worth profits of around a billion dollars a year. Furthermore, over 60% of the peoples on earth depend directly on plants for their "natural medicines". An American researcher, speaking about the value of such priceless treasures deriving from the products of biodiversity, has said: "I continue to maintain that no chemist could reinvent the complexity of the bioactive molecules produced by nature, but they can, once those primary natural compounds have been discovered, move on to the synthetic modifications that will make them more active".

At the global level, the unprecedented and accelerating speed at which species are vanishing gives grounds for concern. The average extinction rate is around 5,000 species a year – 1,000 times faster than the ecosystems' natural renewal capacity. Twenty-five percent of all known mammals, 11% of birds and 17% of plants, i.e. some 16,000 species, have been reported as being in danger of disappearing once and for all on account of the loss of their habitat and the fragmentation of their ecosystems as a result of urbanization, industry and intensive agriculture (Moinet, 2005). Some scientists are wondering whether we might not be heading into the sixth great wave of species extinction since life first appeared on earth. So the international community must now agree, as a matter of urgency, on what must be conserved, by what means, and for whose benefit. This role was assigned to the CBD, which recognizes biodiversity as a common concern for humankind, and an integral part of the economic and social development process. Several ground-breaking features deserve mentioning. At an operational level, it needs to promote a spirit of partnership among nations based on scientific and technical cooperation, access to financial and genetic resources, and the transfer of environmentally sound technologies. As a legal instrument, the CBD sets out clearly the rights and duties of the States Parties to the Convention with regard to scientific, technical and technological cooperation (Bâ, 2005).

The situation in Africa

Most countries in sub-Saharan Africa are afflicted by constant environmental degradation combined with an inexorable loss of arable land due to unbridled urbanization, recurring cycles of drought, famine, economic stagnation, rampant poverty and fresh outbreaks of malaria, HIV/AIDS and other diseases. The situation has worsened over the past 20 years, and the food needs of half of the sub-Saharan population are not being met. What is more, global food aid is proving ineffective because it is too short-term for the deprived populations. African agricultural policies are equally ineffective, and the continent remains heavily dependent on food aid, especially for cereals, as much as 50% of which are imported.

The green revolution in Western countries has had adverse effects (Weil, 2002). African countries are characterized by extremely high population growth and ever-declining agricultural production due to a loss of arable land and the ineffective use of pesticides and fertilizers. The strategies that could be developed to increase agricultural production hinge on productivity growth and efforts to secure new land for farming. The techniques used in these countries have proved effective, but would need to be combined with

the discontinuation of some technical itineraries in order to mitigate their drawbacks in the DCs. In short, a "dual green revolution" is required, involving the use of new, high-yield varieties that could help, as a matter of urgency, to bring about a sustainable increase in productivity while minimizing the adverse effects on natural resources and the environment. The fact is that there is a lasting price paid for the depletion of genetic resources: the poorer an ecosystem is in terms of biodiversity, the less able it is to resist the adaptation of invaders. Efforts to make agricultural production compatible with biodiversity conservation must succeed. In other words, agriculture must, according to Guy Riba of the French Institut National de la Recherche Agronomique, reconnect with biodiversity through the introduction of new cultural practices. The use of genetics in order to improve crop adaptability can be a way of achieving sustainable development, which means using modern biotechnologies as a short cut and the key to achieving sustainable productivity growth and to ensuring food security in Africa.

Biodiversity, biotechnology and GMOs

The CBD defines biotechnology as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (CBD, 1992). Biotechnology applications have great potential – both positive and negative – across many areas of agricultural development. "Green biotechnology" involves using organ and tissue cultures for large-scale plant multiplication. These techniques include micropropagation, embryo rescue, the regeneration of somatic embryos, and large-scale production by cell suspension (coffee tree, banana, oil palm, and so on). This is a major technology for the production in the developing countries of disease-free, high-quality planting material, and has commercial applications, in such areas as market gardening, horticulture and floriculture, that can generate employment. Through "red biotechnology" – using genetic engineering and recombinant DNA technology – it has become possible to obtain genetically modified organisms; to use markers and probes in gene mapping and in functional and structural genomics; and to identify genotypes through DNA fingerprinting. It is applied in the areas of agricultural production, medicine and agro-industry. Transgenesis has been defined as a process involving the transfer of one or more genes from one living organism to another by means of genetic engineering, i.e. not through sexual reproduction. The new transgene or transgenes is/are integrated into the genome, and will be passed on to the progeny. Transgenesis transcends species barriers. This revolutionary technique nonetheless has its limits, arising from a lack of knowledge as to where the gene has been implanted – due to its random introduction – and the number of copies inserted, and as to whether the vector will be accepted by the host organism. The most typical example is that of transgenic plants. These are plants whose genome has been modified through the insertion of genes. The gene in question is either a foreign gene – as in the case of insecticide plants producing the Bt protein or a native gene of the plant previously modified to give it new properties such as glyphosate herbicide tolerance. Several transgenic cultivars of major food crops have been created through the introduction of genes for resistance to herbicides and/or insects (Bt cotton, Bt corn and transgenic soya, for instance). By 2004, the area planted with transgenic crops had increased from 2.8 million ha in 1996 to 81 million ha, i.e. 5% of the world's surface. In the DCs, which accounted for just over a third of that area – 27.6 million ha – the figures are still rising sharply. Throughout the decade of rapid, worldwide growth in transgenic crop production, herbicide tolerance was the major feature, followed by resistance to insects. An area of 15.6 million ha (19%) was planted with Bt varieties. The five DCs involved in the large-scale cultivation of transgenic plants are Argentina, Brazil, China, India and South Africa (Clive, 2004).

Micro-organisms represent another area for transgenic applications. "White biotechnology" involves the use of depolluting micro-organisms for bioremediation. Bacteria have been used to treat arsenic soil contamination in Bangladesh, while "Oilzapper" micro-organisms – Pseudomonas and Bacillus – have been employed to decontaminate hydrocarbon-polluted soil in the Persian Gulf. Organisms have also been modified for use in biological pest control and biofertilizers as a means of improving the edaphic environment.

The marketing of GMOs over the past decade has been a matter of concern for the countries of the South which need to avail themselves of the technology,

while at the same time defending themselves against having GMOs forced upon them, unchecked, as a result of pressure from multinational corporations. Such has been the case of Bt cotton – a major issue in the West African subregion – which has completed its third year of trials in Burkina Faso without there being any effective legislation in the West African Economic and Monetary Union (UEMOA). Leaving aside the research and development matters, questions arise over the circulation of GMOs entering the subregion not only via imports and food aid, but also through informal trade among farmers. The lack of regulatory controls makes it hard to detect and trace the presence of GMOs in agricultural raw materials and in food products. The introduction of border controls is absolutely essential.

Risks associated with the use of GMOs

1. Concept of risk

"Biosafety means the safe and environmentally sustainable use of all biological products and applications for human health […] in support of improved global food security" (FAO, 1999). The Codex Alimentarius – a joint instrument of FAO and the World Health Organization (WHO) for setting food standards – defines risk as a "function of the probability of an adverse [health] effect, consequential to a hazard(s) [in food]" (FAO, 2004). Risk assessment involves hazard characterization, estimation of the probability of danger, and assessment of the seriousness of hazards.

2. Environmental risks

Once transgenic plants are released into the environment, they can no longer be contained. The main form of gene transmission in the environment is pollen transfer. A worrying feature here lies in the likelihood of self-propagating plant varieties acquiring transgenes and becoming resistant to herbicides, insects and disease – characteristics capable of conferring a selective advantage (Bergelson et al., 1998; Bachand, 2001). Uncontrolled dissemination of genes is all the more likely in crop diversification centres – the native habitat of cultivars – because those areas contain wild species that are genetically compatible with, and competitors of, the transgenic plant (Van Aken, 1999). Potential gene flows such as these could be most harmful to biodiversity, resulting in the selection of resistant pathogens that turn into "superpredators". An invasion would amount to an environmental disaster because those GMOs have no natural predators.

3. Risks to agriculture

FAO estimates that 75% of the genetic diversity of agricultural crops has been lost (Wildfong, 1999). One of the major drawbacks of intensive agriculture is that it favours monoculture at the expense of diversified farming; and the same goes for transgenic plants (Rifkin, 1998). The fact is that diversity would appear, according to the dominant model of production, to stand in the way of productivity and make monoculture and uniformity an absolute necessity. Ironically, however, plant selection techniques destroy the very components upon which they rely (Shiva et al., 1994). Planting GMOs would therefore lead to local food crops being abandoned in favour of high added-value transgenic crops, and this would mean the disappearance of those local varieties selected by means of farmers' know-how over thousands of years.

4. Socio-economic risks

The marketing of transgenic plants gives rise to intense debate over the scientific and ethical implications of manipulating the plant genome. However, such questions tend to obscure the underlying economic issues. The fact is that biotechnology is generating increasing economic interest on the part of both companies and states. Plant biotechnology is regarded as a field of the future, as a source of economic growth and employment. Yet the new activities are increasingly dominated by the large agrochemical corporations. While small firms may seem to be playing a key role in this economic revolution, biotechnology leads to a reconfiguration of the industrial landscape to the advantage of the large corporations – reshaping everything while adding to the strength of that highly concentrated global oligopoly (Bellais, 1999). The agrochemical multinationals that have invested billions of dollars are likely to make rural communities dependent upon them and to confiscate de facto their resources, thus endangering their food autonomy. This strategy is enlightening as far as transgenic seed is concerned: not only would the farmers be compelled to give up cultivating traditional varieties in favour of

economically more competitive transgenic crops, but the patents registered for genetically modified varieties would "subjugate" them to the multinationals which assert their monopolistic power. Moreover, the various local varieties selected by small-scale farmers would, in the long run, disappear in favour of biotechnological and industrial crops, leading to the decline and erosion of genetic diversity too.

The issue of biotechnological agriculture is crucial in that its implications are global and set to change completely the commercial terms of trade, already distorted by the dictates of the World Trade Organization (1995) under the TRIPS and GATT agreements authorizing the patentability of life forms. Besides, if raw materials that can only be grown in the tropics – vanilla, cocoa or sugar cane – could be produced at low cost in laboratories in the industrialized countries, what would become of the economies of the developing countries where they are grown?

The unprecedented consolidation of agrochemical firms into a powerful consortium is most worrying: a dozen giant-sized firms exercise near-exclusive control over the seed and chemicals markets, forcing farmers to use their transgenic seed and related phytosanitary products. Such domination of farming communities directly undermines a people's right to ensure its own food independence. Seed containing "terminator" and "traitor" genes demonstrates unequivocally the global control of the multinationals over farming communities in the Third World. These patented transgenic seeds produce plants whose seed is sterile and unable to germinate. The "traitor" gene prevents such seeds from germinating or defending themselves against pathogen attacks without the aid of chemicals manufactured by the company that patented the seed. Thus, transgenic agriculture increases the farmers' dependence on those costly chemical inputs. Such a stranglehold on agriculture causes the erosion or disintegration of the social fabric – not to mention changing dietary habits – in farming communities. The most disadvantaged are forced to leave the land for the city in an effort to survive, with the additional consequence of the loss of local expertise.

Even though the CBD is described as a step forward, since it essentially advocates the equitable sharing of genetic resources, and compels the multinationals to make a few financial concessions, it does not prevent these consortiums from continuing to promote and support propaganda extolling the pre-eminence of the economy market. Life itself has become a commodity. Humanity is reduced to "bits of genes that can be exchanged for cash". In other words, biotechnology has enabled the companies to engage in industrial restructuring and to extend their grip over the entire global agribusiness sector. Yet the contracts protecting the exclusive rights of multinationals over plants or animals are open to question insofar as these species form part of the world heritage, and that action of this kind is likely to give rise to a kind of economic neocolonialism.

International regulatory controls

GMOs generate intense debate on account of their environmental, health and ethical implications. So much is at stake that the international community has adopted the Cartagena Protocol on Biosafety – concluded in 2000, after negotiations that began under the auspices of the CBD in 1993, and ratified by the majority of States in Africa.

Most African countries, with the exception of South Africa, lack the appropriate biosafety infrastructure, facilities and expertise for carrying out risk assessment, risk management, detection, identification and so on. But debate on GMOs and biosafety has begun to emerge within such subregional organizations as the Economic Community of West African States (ECOWAS) and the West African Economic and Monetary Union (UEMOA). Initiatives launched by the Conférence de Responsables de Recherche Agronomique Africains (CORAF), the Comité Permanent Inter-Etats de Lutte contre la Secheresse au Sahel (CILSS) and other research-oriented bodies have done much to raise awareness among those subregional organizations. CORAF has developed a biotechnology and biosafety programme with the support of USAID. The Sahel Institute (INSAH) has become even more deeply involved in regulatory issues (Chetaille, 2006).

The launch of Bt cotton trials in Burkina Faso triggered wide-ranging debate within UEMOA, giving rise in turn to the OAU's African Model Law for the Protection of the Rights of Local Communities,

Farmers and Breeders, and for the Regulation of Access to Biological Resources. Conventions on intellectual property rights have been adopted – the revised Bangui Agreement Relating to the Creation of an African Intellectual Property Organization (AIPO), the International Convention for the Protection of New Varieties of Plants and so on – and two model laws on biosafety have been passed by the African Union (CILSS-IS, 2004). In 2001, thanks to joint support from the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF) 39 African countries, including the Member States of UEMOA, received funding that has enabled them to develop national biosafety frameworks involving (i) an administrative system to handle requests for permission to import, distribute or market GMOs; (ii) a regulatory regime; (iii) risk assessment and risk management mechanisms for decision-making; and (iv) mechanisms for public participation and awareness-raising. Once finalized, these projects will need to be validated by means of public workshops in each country. This marks the first step in meeting the Cartagena Protocol (2000) commitments. For the time being, however, Burkina Faso remains the only country in Africa with working laws on biosafety.

Controversy and debate

Even though the use of biotechnologies has been the subject of much controversy and debate, one must avoid the wholesale demonizing of GMO technology – as has been the case in Europe – or overestimating the risks incurred *a posteriori*. It may be hard to understand and take account of all the underlying issues regarding the biotechnologies, but this must not obscure the benefits that Africa stands to gain from this new technology.

The ethical and scientific implications of biotechnology are, of course, one aspect of this debate; but there is more to it than that. The use of GMOs gives rise to a feeling of desecration insofar as human beings, in crossing the species boundaries, are bringing about changes whose effects they are not necessarily going to be able to control. Some people are, unsurprisingly, affected by the "Prometheus complex": the fear of there being a heavy debt to pay for having flouted the inherent laws of nature – all the more so given that "biodiversity and species integrity are inextricably linked" (Ho and Tappeser, 1996; Bellais, 1999). The assertion by multinational companies that transgenic plants are entirely safe is not convincing. However, the use of this technology, while applying the precautionary principle, could be beneficial to Africa, by helping to increase its agricultural productivity and guarantee its food security.

Prospects for Africa

The opportunities opened up by biotechnology in regard to effective plant selection and improvement definitely make it possible to save time as compared with traditional selection techniques. The mapping of coffee, rice and other plant genomes, for instance, will help select the best varieties and – through the use of molecular markers – improve the selection and management of collections of genetic resources. Thus, genetic engineering technology will only offer a real break with the past if combined with the appropriate technical itineraries to enable DCs to bring about a sustainable increase in their agricultural production. Furthermore, isolating the genes responsible for resistance to drought and salinity and introducing them into the food crops consumed by Third World populations would mean using transgenesis as a way of resolving problems specific to the DCs, and steering a course towards food security.

For most DCs, it is no longer a matter of debating the pros and cons of using modern biotechnologies, but rather of trying to capitalize on this technological breakthrough. Some see the biotechnological solution as a means of achieving a paradigm shift – and reducing the inequalities – in the relations between North and South. The DCs could use their biological reserves as a bargaining chip or as a quid pro quo for access to their genetic resources. It is therefore essential to develop appropriate biosafety regulations; to assess the risks associated with biotechnological products; and to introduce mechanisms for controlling their use. Securing qualified staff would be crucial for the application of biotechnological tools and for efforts to make the right research and development choices. The DCs need to invest in knowledge and to build up their expertise with regard to GMOs, because most of the benefits in agriculture and other areas are of little interest to the multinationals.

Conclusion

Biotechnology is more than just a scientific issue. It generates friction, controversy and moral and ethical concerns. While there is no doubt as to benefits of using GMOs in medical and therapeutic fields, respect for the ethical aspects must be maintained in the face of the attractive prospects of financial gain. However, one must not dismiss the actual and potential opportunities afforded by transgenic plants for increasing food supplies. Ethical issues are closely related to the cultural context and to levels of public perception and awareness. Socio-economic realities must be taken into account in decisions on the use of GMOs. Constant efforts should be made to foster dialogue and communication between decision-makers, users, consumers and farmers, and to enable the developing countries to remain masters of their own destinies.

SOULEYMANE NIANG: CLOSING ADDRESS

President, Academy of Science and Technology of Senegal

The Academy is honoured to have been associated with the work of the Fifth Ordinary Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), since ethics is one of our concerns, as we pointed out at the beginning of this meeting. Having participated in its preparation, we are pleased to observe that the objectives established have been amply met. We should like to thank everyone who has contributed to this success.

We were particularly pleased to note that, even before the official opening of the session, the Forum of Young African Researchers afforded an opportunity to raise a number of issues of concern to those in the scientific world who, in the international context of globalization, are increasingly asking questions about their position, role and responsibilities, especially in terms of ethics. The reception of and response to their apposite declaration will most probably provide an answer to the question of how we can make sure that the scientist maintains high standards of scientific integrity and quality control when the relationship between the researcher and other actors such as universities, the State, business and international trade organizations is changing. The Academy, for its part, will participate fully in any work planned in this area.

The conclusions on ethics and science, responsibilities of scientists and codes of conduct will be the subject of further in-depth discussion by our Academy in order to expand our contribution to the regional consultation for Africa on these issues.

The Academy is already engaged in reflection and has exchanged ethical ideas with sister academies on the problems of toxic waste, biotechnology and genetically modified organisms. We therefore note with interest and endorse the conclusions that have emerged on these issues during the meeting. This convergence of opinion provides a basis for fruitful cooperation in the future.

Lastly, returning to the general theme of this session of COMEST, attention should be drawn to the importance of the ethics of the production of scientific and technological knowledge. The continent of Africa is currently in a paradoxical situation characterized by poverty, hunger, malnutrition and endemic diseases. Yet solutions to all these scourges exist in a world that unfortunately does not share its resources but has established the World Trade Organization as a stronghold to organize and perpetuate unequal trade and the law of the economically strongest.

In such circumstances we are tempted to give in to the constant clamour and accept technology transfer. But which technologies? To solve which problems? In what sociological context? On what terms and at what price? To answer these questions, we shall refer in particular to the conclusions of the World Conference on Science, jointly organized by UNESCO and the International Council for Science (ICSU) on science and the use of scientific knowledge, which adopted a declaration stating that:

"All scientists should commit themselves to high ethical standards, and a code of ethics based on relevant norms enshrined in international human rights instruments should be established for scientific professions."

In addition, "science curricula should include science ethics, as well as training in the history and philosophy of science and its cultural impact". Thus, "the ethics and responsibility of science should be an integral part of the education and training of all scientists". It is therefore important to instil in students a positive attitude towards reflection, alertness and awareness of the ethical dilemmas they may encounter in their professional lives.

Finally, ladies and gentlemen, for our Academy the ethics of science is neither a short-lived fashion nor a passing intellectual fad. For that reason, our Academy's programmes will always be based on the ethics of science.

Thank you.

PIERRE SANÉ: CLOSING ADDRESS

Assistant Director-General of the Social and Human Sciences Sector of the United Nations Educational, Scientific and Cultural Organization (UNESCO)

Mr Minister of Education,
Madam President of COMEST,
Mr President of the Academy of Science and Technology of Senegal,
Ladies and Gentlemen,

I am delighted that we have been able to hold the Fifth Session of COMEST in Dakar, to be followed in six months' time by the Fourteenth Session of UNESCO's International Bioethics Committee in Nairobi. I am now convinced that work on ethics will remain one of the highest priorities of the Social and Human Sciences Sector of UNESCO, especially in Africa.

A particularly important and critical task must be undertaken on the continent, given that our discussions in the last three days have focussed more on science and technology proper than on the ethics of science and technology. Indeed, we have addressed governance and science policy issues at greater length than the ethical principles that should be guiding and supporting scientific research and the use of research findings. Ethical discussion, with a few exceptions, has been quickly dispatched, despite a carefully structured agenda expressly covering some of the most important issues of the ethics of science and technology, such as ethics education, science ethics and environmental ethics.

Why did the discussion not bear more specifically on the ethics and values which, in Africa, must provide a framework not only for science and technology but also for politics, business and education and environmental management? I have no conclusive answer at this stage.

Mr Minister,
Ladies and gentlemen,

In the course of their differing historical trajectories, societies produce and are dialectically influenced by various values. Thus a society that is defined by intense individualism does not produce the same scale of values as a society defined by a strong sense of community. A society dominated by secularism does not produce the same scale of values as a profoundly religious society. A society in which the law determines social relations, and even values, does not produce the same scale of values as a society in which it is primarily tradition that determines social relations and values, including, for example, the role of women in that society. A profoundly capitalist society does not produce the same scale of values as a pre-capitalist society. The former case is an allusion to the West, and the latter, to Africa.

The discussion did not, however, bear on these values and the African strands of opinion that should have enriched the international debate on the ethics of science and technology and improved mutual understanding.

On the other hand, the African continent is geographically huge and its cultural diversity is equally vast. Is the scale of values among Fulani pastoralists the same as among Jola farmers? Among Muslims as among Christians? Among peasants as among city dwellers? Among Arabs as among Bantus? Especially as these values are not set in stone but are constantly evolving through contact and interaction with other cultures and world views.

A number of questions remain concerning these multifarious African values. Are they mutually compatible? Do they conflict with each other? How are they linked to each other? We should have liked the public discussion of these crucial questions to have been conducted in greater depth in order to clarify matters and exchange ideas and opinions with African researchers in the natural sciences and in the social and human sciences.

Mr Minister,
Ladies and gentlemen,

For us as Africans, the ethics of science and technology is a matter of particular urgency. There is a real need for debate on ethics in fast-changing societies such as ours. In this context, therefore, it is not the debate on science that is the most urgent. It is the debate on ethics, that is on society's choices and the principles of governance, that must inform laws, policies – including science policies – and social and government practices. The reply to those who say that the ethics of science and technology cannot be a priority in a continent where there is so little science and technology is, therefore, that ethical debate constitutes the priority and vital need, as science and technology are merely vehicles that bring this crucial debate into the public arena.

This meeting has been a first step in that direction, especially for young people. This work must be continued in order to meet the need for a broad interdisciplinary public debate on ethical issues and thus strengthen social cohesion which is threatened throughout Africa today by "misdevelopment", bad governance and North/South inequalities.

The Member States have given UNESCO an ethical mandate based on the values contained in its Constitution – justice, human dignity and human rights – which underlie the universal approach that has been developing since the end of the Second World War. Armed with its mandate, UNESCO has been fostering pluralistic dialogue on the ethics of science and technology, bioethics, information ethics, management ethics for social transformations, educational ethics, and has aimed to support the strengthening of informed, inclusive and responsible societies and to build social and international relations founded on the values of peace and solidarity. We undertake to promote this debate in Africa, and the holding of the Fifth Session of COMEST is an important step to that end.

Allow me to express my sincere thanks to those bodies that have made this session possible, namely the Ministry of Scientific Research of Senegal, the Academy of Science and Technology of Senegal and the IDRC, which have joined forces with UNESCO to enable COMEST to initiate a debate with the African scientific community.

In conclusion, I should like to thank the interpreters for their quality work, which has permitted a very rich and constructive debate, which it is now our collective duty to nourish and continue.

Thank you for your attention.

MOUSTAPHA SOURANG: CLOSING ADDRESS

Minister of Education, Senegal

Distinguished Ministers,
Mr Assistant Director-General of the Social and Human Sciences Sector of UNESCO,
Madam Head of the UNESCO Office in Dakar,
Madam President of COMEST,
Mr Regional Director of the IRDC,
Distinguished Members of COMEST,
Mr President of the Academy of Science and Technology of Senegal,
Distinguished Young Researchers,
Distinguished Participants,
Ladies and Gentlemen,

It is a great pleasure to be here before this group of experts in practically every field and to chair the closing proceedings of the Fifth Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) on the ethics of science in Africa, especially as I have had the privilege of chairing the Programme Commission of UNESCO's Executive Board and am currently President of the National Commission for UNESCO in my capacity as Minister of Education.

The World Commission on the Ethics of Scientific Knowledge and Technology, whose tasks include imbuing technological innovation and the production of scientific knowledge with the basic ethical values that underlie any society, no longer needs to prove that it is relevant and needed.

How could this be otherwise in view of the notable figures united within it in perfect symbiosis among different cultures?

The Commission, aware that the standard of ethical values cannot be borne higher than by a younger generation that has espoused them, offered young African researchers the opportunity at the opening of the session to review the role of science and technology in shaping our societies and also, more importantly, to examine prospectively their responsibilities in building future societies in which the guiding principles will be dignity, equity and justice.

Ladies and gentlemen,

The Forum of Young African Researchers has provided the framework for an exchange of ideas on the social responsibilities of scientists in Africa, challenging African researchers to reflect on their position and their perforce vanguard role in society. The Forum has thus allowed emphasis to be placed on the need to harmonize concepts in order to integrate ethics more effectively into the whole process of producing knowledge and using the results of research and technological innovation.

This was all the more essential because we are fully aware that the scientific and technological divide can only be closed through extensive involvement of young people, which will subsequently make it possible for us to contribute to the world intellectual market and, undoubtedly, to have the capacity to take up the challenges facing us.

As Minister of Education with responsibility for higher education, I am very heedful of the outcome of the work in the Forum of Young African Researchers, as are all my colleagues moreover, and I shall attach special importance to the conclusions of these young people, who are the standard bearers of the future.

Ladies and gentlemen,

Your reflections on ethics and responsibility have drawn to a close. These reflections, which aim to encourage a social and responsible use of science, focused mainly on burning issues facing our societies in Africa, such as (i) the consequences of toxic waste pollution, (ii) the controversy over genetically modified organisms (GMOs) and their impact on public health, and (iii) threats to biodiversity and the implications for the herbal medicine used by more than 70% of the African population. We shall undoubtedly find your recommendations on ethics education to be very useful.

You will appreciate that your apposite conclusions will contribute substantially to the adoption of enlightened policy choices and strategic options since they will be based on established knowledge.

Ladies and gentlemen,

The fifth COMEST session has also been marked by formal consultations between ECOWAS science and technology ministers. In an open and honest discussion, they have contributed to the debate on the social and ethical problems associated with science and technology, placing particular emphasis on the themes of this session.

In the Dakar Declaration, which noted plainly that African countries accorded little attention to the ethical implications of science and technology and that the sociocultural dimension of scientific progress and technological innovation must be taken into account to ensure that human rights are respected in the free pursuit of knowledge and skill, the ministers have firmly undertaken to incorporate science ethics into African social and economic development policies.

The declaration will not only be brought to the attention of the Heads of State and Government at the African Union summit in January 2007, but will also be submitted to UNESCO and ECOWAS by the Government of Senegal.

UNESCO, in collaboration with ECOWAS, is required to develop a regional programme to support ECOWAS ministers in implementing the undertakings contained in the Dakar Declaration.

I cannot conclude without once again paying tribute to UNESCO for providing the opportunity for eminent persons to analyse subjects of major importance on the hospitable soil of Senegal.

On behalf of the President of Senegal, His Excellency Maître Abdoulaye Wade, as well as the Government and the people of Senegal, I also wish to thank the Academy of Science and Technology of Senegal, the International Research and Development Centre and all partners who have worked hard to make this session a success.

I wish our guests a pleasant journey home to their respective countries and I declare the Fifth Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) on the ethics of science in Africa closed.

Thank you for your attention.

APPENDICES

LIST OF ACRONYMS

AACHRD	African Advisory Committee for Health Research and Development
AAU	Association of African Universities
AUF	Agence universitaire de la Francophonie
CAMES	African and Malagasy Council on Higher Education
CBD	Convention of Biodiversity
CCD	Convention to Combat Desertification
DCs	Developing Countries
ECOWAS	Economic Community of West African States
EIS	Environmental Impact Statement
GARNET	Ghana Academic Research Network
GM food	Genetically Modified food
GMO	Genetically Modified Organism
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IDRC	International Development Research Centre
IUCN	International Union for Conservation of Nature
LDCs	Least Developed Countries
MARPOL	Convention for the Prevention of Pollution from Ships
NEPAD	New Partnership for Africa's Development
PABIN	Pan-African Bioethics Initiative
PERSGA	Regional Organisation for the Conservation of the Environment of the Red Sea and the Gulf of Aden
RENs	Research and Education Networks
SCFCS	Standing Committee on the Freedom in the Conduct of Science
SCRES	Standing Committee on Responsibility and Ethics of Science
TWAS	Academy of Sciences for the Developing World
UNCCD	United Nations Convention to Combat Drought and Desertification
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Commission for Human Settlements
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNU-INRA	United Nations University Institute for Natural Resources in Africa
WHO	World Health Organisation
WMA	World Medical Association
WWF	World Wide Fund For Nature

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The following Declaration is an outcome of the Ministerial Meeting of Ministers and Higher Authorities of the Ministries for Research from Benin, Ivory Coast, Guinea, Kenya, Mali, Niger, Nigeria, Senegal, and Togo. It was approved on December 9, 2006 and transmitted to UNESCO.

DAKAR DECLARATION ON THE ETHICS OF SCIENCE IN AFRICA

PREAMBLE,

WE, Ministers of Scientific Research and Technology of the Economic Community of West African States (ECOWAS), meeting at the Fifth Ordinary Session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) from 6 to 9 December 2006 in Dakar, Senegal;

Guided by the Constitution of UNESCO which mandates the organization to promote "the intellectual and moral solidarity of mankind" and to play a leading role in the area of ethics of science and technology;

Guided by the vision of African Heads of State who have adopted science and technology as fundamental paths for sustainable development;

Aware that, to translate this vision into reality, we need to bridge the scientific and technological divide between the developed countries and Africa;

Considering that Africa lags behind in the fundamental area of science and technology, as well as the risk this entails of its marginalization in decision-making at the global level;

Considering the complexity of issues related to science and technology and their applications, which requires a multidisciplinary and pluralistic approach;

Noting the acceleration of the process of globalization and considering that African societies are increasingly influenced by scientific progress and technological innovations;

Realising that African countries accord little attention to the ethical implications of science and technology and that ethical frameworks for scientific and technological research practices remain inadequate on the continent;

Considering the importance that UNESCO and the scientific community attribute to international instruments, in particular the Universal Declaration on the Human Genome and Human Rights adopted in 1997 and the Universal Declaration on Bioethics and Human Rights adopted in 2005;

Taking note of the Declaration on Science and the Use of Scientific Knowledge resulting from the World Conference on Science, co-organised by UNESCO and the International Council of Scientific Unions at the University of Budapest in June 1999, which requested that particular attention be given to codes and regulations of scientific professions;

Considering the importance of training and awareness building on issues of science and technology;

Considering the recommendations of COMEST related to ethics of environment, the development and use of new technologies and the teaching of ethics;

Taking note of the results of discussions during the Fifth Session of COMEST on the social responsibility of young African researchers, ethics of science, codes of conduct, teaching of ethics of science and technology, ethics of environment including the issue of toxic waste, relations between biosecurity, biodiversity and genetically modified organisms;

Aware of the need for effective, responsible and transparent interaction between scientists, policy-makers and civil society to address numerous challenges, in particular the management of toxic waste, biosecurity problems and non-compliance with norms for clinical tests,

BY THIS DECLARATION, WE UNDERTAKE:

1. to reinforce our commitment to scientific and technological research for our societies by increased support to institutions, research programmes, and researchers;

2. to encourage exchanges, cooperation and building of synergies among our countries in the field

of scientific research and technology both in the public and private sectors;

3. to support and encourage young researchers by providing them opportunities for high level training and for professional integration into the scientific community:

4. to pursue vigorous efforts to assure women a place in the scientific community;

5. to promote South-South and joint North-South cooperation by facilitating the mobility of scientists, the pursuit of common programmes, the networking among centres of excellence, and the mobilization of necessary funds;

6. to progressively put into place programmes for training and teaching of ethics in all academic curricula and professional training programmes, and also for researchers and networks of governmental and non-governmental institutions;

7. to create, support, and provide encouragement to committees on ethics of science and bioethics in our countries;

8. to set up a regional body responsible for:

a. ensuring the application of national and international texts aimed at the protection of human beings, societies, and the environment
b. seeing to it that codes of conduct are elaborated and enforced
c. encouraging the responsible involvement of women and young people in scientific and technological research
d. analysing the risks and benefits of research in order to ensure more sharing of research results
e. considering the possibility of preparing normative texts following international consultative processes (eg model laws like the one on biosafety)

9. to encourage cooperation between Ministries concerned by questions of ethics of science and technology;

10. to encourage and support meetings and forums held at the regional and sub-regional levels to promote exchanges on questions of ethics;

11. to work for strengthened collaboration in the field of ethics, bioethics and life sciences between universities, professional associations, research institutes and African ethics committees, and with regional and international partner institutions;

In the light of these commitments,

We, Ministers of Scientific Research and Technology:

Recommend that our States and Governments recognize the growing importance of the social and ethical implications of scientific and technological research, and translate this into our economic and social development policies.

Call on the Government of the Republic of Senegal to submit this Declaration to:

- The Executive Secretary of ECOWAS;
- The Authorities concerned in the African Union for review during the Eighth Summit of Heads of State and Government of the African Union in January 2007 on the theme "Science, Technology and Research for Development in Africa";
- The Director General of UNESCO.

Thank UNESCO for organizing the Fifth Ordinary Session of COMEST in Africa,

Call on UNESCO to develop a Regional Programme in collaboration with the ECOWAS Executive Secretary in order to support ECOWAS Ministers in implementing this Declaration.

WE express our deep gratitude to His Excellency Abdoulaye Wade, President of the Republic of Senegal as well as the people of Senegal for their warm, convivial, and friendly welcome and for the excellent organisation of this first meeting of COMEST on African soil, in Dakar.

Adopted on 9 December 2006 in Dakar, Republic of Senegal.

DAKAR DECLARATION ON THE SOCIAL RESPONSIBILITY OF RESEARCHERS IN AFRICA

The following Declaration is the result of the Forum of Young African Researchers.

It was adopted on December 9, 2006.

DAKAR DECLARATION ON THE SOCIAL RESPONSIBILITY OF RESEARCHERS IN AFRICA ADOPTED BY THE FORUM OF YOUNG AFRICAN RESEARCHERS

We, the participants of the Forum of Young Researchers – representing associations of young African researchers, universities and African research institutes, government institutions and African-based NGOs – came together on the 6th of December 2006 in Dakar, during the Fifth Ordinary Session of UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), to debate the "Social Responsibility of Researchers in Africa",

Guided by the UNESCO Constitution, which requires UNESCO to promote "the intellectual and moral solidarity of mankind" and to play a guiding role on the ethics of Science and Technologies,

Witness to the fact that scientific and technological research is fundamental to development,

Certain that scientific and technological research has a crucial role to play in bringing Africa out of poverty and enabling it to achieve the Millennium Development Goals,

Aware that Africa has specific needs and expectations from scientific research, including the eradication of recurrent diseases, hunger and conflicts, as well as the preservation of environmental and natural resources,

Acknowledging the limited contribution of the African continent to the production of international scientific knowledge and to the ethics of science and technology,

Observing that scientific research is relegated to the lowest rank of priorities in African Member States, despite the large number of opportunities available,

Noting the numerous challenges that face African researchers in general, and young researchers in particular,

Convinced that young researchers have a vital role to play in the development of the continent,

Acknowledging the need to make research more visible and accessible to development professionals and the wider community,

Aware of the communication gap between researchers and their African and international peers, between researchers and leaders, and between researchers and the community,

Noting the lack of synergy in research at the national, sub-regional and continental levels,

We undertake to:

Respect and promote ethical values in the field of research,

Use the knowledge we have acquired to serve the continent and promote its development,

Assume our very high level of responsibility towards all of humanity, and in particular towards the African people,

Work first and foremost on research topics that respond directly to the needs of African communities,

Operate in multidisciplinary and cross-disciplinary teams to enhance the efficiency and effectiveness of research,

Establish and develop networks at the national, African and international levels, in particular with the African diaspora, to share our experience, knowledge and skills,

Contribute to the mobilisation of financial and material resources, both at national and international levels, for the development of research,

Make our work more visible and accessible, notably through scientific papers, exhibitions and public conferences,

Meanwhile, we ask that:

African Member States,

Give greater recognition to the existence and competence of African expertise,

Take the results of endogenous research into account in the decision-making process and when devising development policies,

Put into place effective policies on research and allocate part of their GDP in proportions close to international standards in order to create acceptable working conditions,

Create monitoring systems to ensure respect for ethical standards in the field of science and technology,

Make good use of African human resources in the sciences by creating conditions that will allow large numbers of young African scientists to enter into the African research field in order to prevent the "brain drain",

Encourage the mobility of young African researchers on the continent in order to share experiences on issues specific to Africa in the context of globalization,

Encourage the participation of young researchers in international meetings;

The African Union and organisations for African integration,

Create "centres of excellence" at the regional and continental levels to facilitate coordination of African scientific resources and encourage young researchers to stay in Africa,

Create an exchange forum for African researchers to identify priority orientations and research themes which comply with the needs and expectations of African communities,

Create an enabling environment for discussion between young African researchers and those in the rest of the world on scientific issues that are of interest to all of humanity.

International institutions and development partners

Contribute to the creation of "centres of excellence" for scientific and technological research in Africa,

Increase their technical and financial support for research activities in Africa,

Help the process of popularisation and wider use of the results of research in Africa,

Assist in the process of ethics training for young researchers so that they can fully assume their social responsibility,

Encourage regular scientific meetings of young African researchers.

As young African researchers, we firmly believe that Africa has very rich potentials that must be used to its advantage. We therefore undertake to tackle the many challenges the continent is facing, particularly the scientific divide, in order to give the African continent an honourable status in the world. For this reason, we are committed to working together through innovative action, activities in the field and diverse initiatives in our own countries, as well as through our commitment to Pan-Africanism, our motivation, energy, skills and our firm commitment to bringing Africa out of its current situation.

We, therefore, invite African Member States, policy-makers, international agencies and NGOs to work together and support these efforts in order to achieve these goals of sustainable development.

Adopted on 9 December 2006 in Dakar, Republic of Senegal.