PROCEEDINGS

First Session

Oslo, Norway, 28-30 April 1999

WORLD COMMISSION ON THE ETHICS OF
SCIENTIFIC KNOWLEDGE AND TECHNOLOGY

Division of the Ethics
of Science and Technology of UNESCO

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INTRODUCTION

At the kind invitation of the Government of the Kingdom of Norway, the first session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) was held in Oslo, Norway, from 28 to 30 April 1999. The opening ceremony was honoured with the presence of His Majesty the King of Norway, H. E. Mrs Vigdís Finnbogadóttir, former President of Iceland, 1980-1996, and President of the World Commission, H. E. Mr Jon Lilletun, Minister of Education, Research and Church Affairs of Norway, who delivered the opening address and Professor Mambillikalathil G.K. Menon, former Minister of Science of India.

Activities undertaken by Norway in the field of ethics of science and technology were presented by representatives from a number of Norwegian institutions, in particular the Norwegian Values Commission. The first session then devoted its work to an analysis of the ethical issues at stake in the fields of energy, the use of fresh water resources, on the basis of a report drawn up by a working group on the ethics of energy and on the initial work of the working group on the management of fresh water resources. The meeting also dealt with ethics and the information society. A brief presentation of the ethical issues concerning outer space was also made.

Finally, three round tables on the ethics of energy, the ethics of fresh water resources and the protection of the rights and freedoms of scientists, provided the opportunity for the general public to be associated in this gathering. The discussions which took place during these round tables confirmed the belief that the evaluation of technology has become indispensable for democratic governance of society and at the same time showed that the setting up of *'good practices'* in the utilisation of scientific knowledge and technology requires close collaboration between both public and private decision-makers.

The present Proceedings include the report of the first session of the COMEST, the speeches delivered and all contributions presented during the meeting itself and the round tables.

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Chapter 1

REPORT OF THE PLENARY SITTINGS

I. Introduction

The first session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) was held in Oslo from 28 to 30 April 1999 at the generous invitation of the Government of Norway. It was attended by over 160 experts from 50 countries of the different world regions, including members and *ex officio* members of THE COMEST and representatives of Member States, intergovernmental and non-governmental organizations, scientific academies and universities.

At a closed sitting in accordance with its Statutes adopted by the UNESCO Executive Board at its 154th session, the World Commission on the Ethics of Scientific Knowledge and Technology adopted its rules of procedure together with an amendment to Article 9.1 suggested by the Director-General of UNESCO. The Commission went on to elect the following officers:

Chairperson:	H. E. Mrs Vigdís Finnbogadóttir (Iceland)
Vice-Chairpersons:	Mrs Attiya Inayatullah (Dr) (Pakistan)
	Mr Benediktas Juodka (Lithuania)
	Mrs Suzanne Mubarak (Egypt)
	Mr Thomas R. Odhiambo (Kenya)
Rapporteur:	Mr José Sarukhan (Mexico)

This first session was devoted to an analysis of the ethical challenges posed by the use of energy sources and fresh-water resources and by the information society. One working meeting examined the contribution which COMEST could make to the World Conference on Science (Budapest, Hungary, June 1999) and another its work programme over

the next few years. During the latter meeting an outline was given of the initial elements identified by the COMEST working group on the ethics of outer space.

This session included three round tables open to the public on the following themes: 'Ethics and energy', 'Ethics and fresh-water resources' and 'Protection of the rights and freedoms of scientists'. These round tables were led respectively by Mr Nicholas Ashford (United States of America), Professor of Technology and Policy, Massachusetts Institute of Technology, Mr Ismail Serageldin (Egypt), Vice-President of the World Bank, Chairperson of the Global Water Partnership, Chairperson of the World Commission on Water for the 21st Century, and Mrs Ágnes Heller (Hungary), Member of COMEST.

II. Opening of the Session

The opening ceremony of the first session of the COMEST was honoured by the presence of His Majesty the King of Norway.

The opening speech was delivered by H. E. Mr Jon Lilletun, Minister of Education, Research and Church Affairs of Norway, who welcomed those present to the first session of the World Commission on the Ethics of Scientific Knowledge and Technology. He said that COMEST brought together specialists from a wide variety of fields ranging from science to politics. A concern for ethics was looming increasingly large in contemporary society. Never before had technical progress wielded such great influence over lifestyles and human relationships. Humankind had never been so aware of the advances of science as at present. That was why the initiative taken by UNESCO was so important.

Mr Lilletun referred to the serious problems facing modern society and mentioned science and technology as key assets in tackling them. Scientists bore a heavy responsibility because their work often formed the basis for the political decisions governing society. He hoped that this meeting would enable answers to be found to important questions like the ethics of energy, the use of fresh-water resources and the environment. He was particularly pleased that UNESCO had chosen to treat these questions in a novel way. The innovation generated by the new technologies meant that these were often favourably received by society, which might turn out to be a matter for regret. Everything new must be appraised according to what individuals could accept and the environment support. He hoped that COMEST would help the best possible balance to be found by initiating a public debate at international level as certain countries had already done at national level.

The scientific research initiated by numerous countries, praiseworthy in itself, must not go beyond certain ethical barriers. The curiosity of scientists must not be satisfied at the expense of humanity. To ensure that these principles were respected it was not necessary to institute a supreme court of scientific justice; the aim was not to punish but rather to make scientists assume their responsibilities and persuade them to view their work in the light of the ethical implications of their researches. This could be done through an international body like COMEST whose terms of reference included promoting a dialogue between scientists, political decision-makers and the general public and helping to draw up a new contract between science and society. Mr Lilletun expressed the hope that science and society would one day be able to coexist and thereby conduct an open and fruitful dialogue.

Professor Mambillikalathil G. K. Menon, former Indian Minister of Science and Technology, Meghnad Saha Distinguished Fellow of the Indian National Academy of Sciences, spoke about the role of science. Science and technology represented one of the most impressive human activities of the current era. In the past, scientific progress had been born of need and had expressed itself in a highly concrete way. Scientists had simultaneously endeavoured to obtain a better knowledge and understanding of nature. This need to know had sometimes brought about conflicts with the traditional world. On this point he referred to the cases of Galileo and Copernicus and to the still hotly debated theory of Darwin. These examples demonstrated a fundamental truth, namely that science must be able to develop freely without being impeded by established theology, politics or doctrines. That was the only way to preserve the imagination and curiosity of scientists.

Mr Menon referred to Louis Pasteur's words in his last public address. After advising students to live 'in the serene peace of laboratories and libraries', he had told foreign delegates: 'I am firmly convinced that science and peace will triumph over ignorance and war, that nations will unite not to destroy but to build, that the future belongs to those who act to relieve the sufferings of humanity.' Humanity was still suffering even now and was demanding that science make its contribution.

He pointed out that the history of science, although marked by a number of exceptional events, had for many years shown very slow progress. Only over the past 200 years had society witnessed a rapid growth in scientific knowledge. The place occupied by science today was proved by the number of active scientists, the number of works published and the magnitude of the resources devoted to research.

He stressed that science was no longer isolated and was now inextricably linked with industry, agriculture, weapons and politics. Knowledge was being converted into concrete applications at an unprecedented pace, thus emphasising the synergic and symbiotic relationship between science and technology. Progress sometimes took the form of gigantic projects between several countries and thus required an organization and management more akin to the world of industry than to that of research. Current discoveries were often the outcome of commercial or political initiatives and were sustained by substantial funds. The resulting knowledge and power imposed fresh responsibilities on scientists, political decision-makers, industry and society in general. The fruits of science had considerably improved the human condition and understanding. However, science today represented a paradox for society and awakened both admiration and distrust. It proposed new solutions but imposed difficult choices.

Turning to the relations between science and the weapons industry - an association which, in fact, went back some time -, Mr Menon mentioned the case of Leonardo da Vinci, an artist of genius who had also been a great scientist whose talents had helped among other things to develop the arms industry of the time. The most important weapon of destruction, the nuclear bomb, had resulted from research whose ultimate use would have been unimaginable to its originators.

Referring to the life sciences, Mr Menon said that biology too was the arena for conflicts of interest. Genetic modification was already being applied in everyday life by helping to improve plant resistance and quality. Here the question of intellectual property bulked large in that while the process of genetic modification was the outcome of long scientific research all the benefits would be reaped by industry and the multinationals. The developing countries would be unable to participate. For the techniques concerned to contribute to the well-being of society the systems established to supervise, monitor and analyse them must remain independent. Looming already on the horizon were projects which could transform the human species, among them the project to study the human genome. Current research held out glittering prospects to medical science but also raised disturbing questions. Would humanity attempt to master all aspects of life on earth or would it leave a suitable place for nature?

Mr Menon welcomed UNESCO’s initiative in creating the International Bioethics Committee (IBC) in November 1993. This committee was the author of the Universal Declaration on the Human Genome and Human

Rights and followed logically from the UNESCO Constitution, which stressed the importance of human dignity and equality and of respect for human rights that constituted the basis of ethics.

Science and technology played a crucial role in numerous fields. Besides water and energy, which formed the main subjects of the current session, Mr Menon mentioned the fundamental needs of humanity (food, health, housing), bioethics and the ethics of medicine, sustainable development, informatics and the development of the market society. He hailed the work of the Director-General of UNESCO, Mr Federico Mayor, through whose efforts ethics had been made a part of all the Organization's activities.

In conclusion, Mr Menon pointed to three tendencies in ethics: the importance of public opinion; progressive awareness on the part of businesses and their resolve to act; the importance of educating the public. Only scientists were in a position to identify the problems, dangers and consequences of technical advances in the early stages of their researches and bring them to the attention of governments and peoples. If science were used rationally under peaceful conditions, its possibilities would be endless.

The last speaker at this opening sitting, H. E. Mrs Vigdís Finnbogadóttir, former President of the Republic of Iceland, Chairperson of the COMEST, thanked the Norwegian Government for its generous invitation and warm welcome and noted with regret that in the West humankind no longer recognized the value of nature, which nowadays it perceived as an economic tool that existed to serve it. The same applied to science. Mrs Vigdís Finnbogadóttir hoped that this session would mark a turning point in the way the planet and human development were perceived.

The Chairperson of the COMEST stressed how greatly Norway was respected throughout the world for its democratic society and its perennial desire to see conflicts resolved by peaceful means. The integrity of Norway and its vision of a harmonious world made it a perfect venue for the first session of COMEST. She reminded participants that it was the Director-General of UNESCO, Mr Federico Mayor, who had been responsible for setting up the World Commission on the Ethics of Scientific Knowledge and Technology, whose members, following their nomination in September 1998, had all reacted with enthusiasm and interest to the invitation to a seat on COMEST. To very many people in the world, science and technology appeared to be uncontrollable monsters driven by obscure motivations and it was therefore important for people to know that the ethics of science was being discussed on a world scale.

She reminded her listeners that COMEST's function was to act as an intellectual forum for the exchange of ideas and experience, identify the first signs of risky situations, give advice to policy-makers and, in short, promote dialogue between the scientific community, politicians and the general public. COMEST must also encourage international co-operation among scientists, particularly between developed and developing countries, in order to arrive at a set of ethical principles leading to the development of a culture of responsibility and solidarity.

Referring to the fields to be studied by COMEST, Mrs Vigdís Finnbogadóttir expressed the view that ethics was a tool enabling situations to be assessed according to human values. Nowadays electricity formed one of life's basic necessities for a large number of people. It nonetheless created difficult ethical dilemmas. It affected both those who used it and those who had to do without it. A choice, moreover, had to be made between different types of energy, among them fossil fuels, which were inexpensive but environmentally dangerous, nuclear energy with its serious risks to the planet as a whole and hydroelectric energy, which also had considerable drawbacks.

With regard to fresh water, the major ethical questions to be studied were appropriation, pollution prevention and access. This last factor would be one of the greatest threats to peace in the next century. The problem was not so much the quantity of water but rather its quality and management and the role of industrialization in that management. More recently humanity had acquired a new parameter, cyberspace. The latter was omnipresent but invisible and required a new code of ethics covering questions such as the training of individuals in this new culture, the gap between rich and poor populations and access to information.

She made it clear that the discussions of COMEST and its working groups, far advanced as they were, would probably have no immediate tangible effects. The initial task was to develop new ways of thinking, draw up the guidelines for a new code of ethics and assist policy-makers and members of society to take enlightened decisions. Needless to say, rules must not be an obstacle to progress; their function must simply be to channel scientific knowledge so as to serve the best interests of society as a whole. COMEST must first and foremost make people realise that the worse possible choice was pessimistic indolence. The current generation must leave its mark on history by adopting a proactive approach to life and to the future for the good of all humanity.

III. Presentation by the Representatives of Norwegian Institutions of Their Activities in the Field of Ethics of Science and Technology

As an introduction to the sitting devoted to the presentation by the representatives of Norwegian institutions of their activities in the field of the ethics of science and technology, Mr Jens Erik Fenstad, Chairperson of the Standing Committee for the Physical and Engineering Sciences of the European Science Foundation and a member of COMEST, said that the future of science was not as it had been imagined in the past. Nowadays the scientific 'advances' represented by atomic energy, new chemical compounds and genetically modified food were causing undeniable fear for the future of humanity and nature.

The period following the second world war had been prosperous and had favoured the development of modern science and technology. These had been exploited with the object of improving the human condition, benefiting public health and providing the individual with greater security. In accordance with the ideology of industrial society, humankind had used nature for its own ends. Today society recognized that a limit must be set on such exploitation and was beginning to doubt man's omnipotence. Many countries had accordingly initiated a process of reflection about the role of science in modern society and had taken various courses of action as a result. Part of the work of COMEST would be to examine those initiatives and transform them into overall proposals. He said Norway was honoured to be the first country to present its activities in this area.

Mr Matthias Kaiser, Director of the Norwegian National Committee for Research Ethics in Science and Technology, surveyed the work of the national ethics committees in Norway. The existence of those committees, which actively supported the work of COMEST, proved the growing importance of ethics in contemporary societies. They also heralded the birth of a new social discourse in which science and technology would henceforth incorporate ethical concerns as an essential dimension of their development. They furthermore constituted a valuable link between the State and the general public.

Three committees had existed side by side since 1990 and covered three different sectors, namely medicine, scientific research and the technologies, and the social and human sciences. As their tenth anniversary approached it was appropriate to take stock of these committees' achievements. It must first be pointed out that their path had not been altogether smooth. There had been numerous conflicts both

within the committees and between the latter and the publics which they addressed. Nevertheless, those differences of view, which persisted today, were inevitable in dealing with such varied and sensitive subjects. It was, in fact, through those conflicts that the committees had succeeded in making their greatest progress.

He said that the Norwegian ethics committees followed the principle of consensus. Any recommendation made by one of them must have been agreed to by all members. This unanimity requirement ensured that recommendations were implemented smoothly. The committees also aimed at relevance, with every recommendation they made being based on a specific case. The fact was that principles laid down by many national and international bodies were frequently very far from reality.

Unfortunately the committees' influence was not as great as they would wish. It was currently difficult to foresee the long-term effects of their activity. The committees were likewise unable to tell which sections of the population would take up their work in the future. Young people and the general public were reluctant at the moment to take part in the social dialogue on ethics. However, the committees had found that nothing was impossible in practice. This was well illustrated by their actions in the field of genetic manipulation. Since the introduction of genetically modified food some years before, States had endeavoured to frame legislation controlling its production and distribution. Norway, which had long paid no heed to the matter, had passed no laws along these lines. The national committees had therefore decided to sound out public opinion on the matter in order to develop a national policy. The determination to involve the public in the State's decisions had been such that the committees had set up a citizen group composed of persons drawn from the public at large. Despite the scepticism of the scientists, who had felt that the subject was too technical to be grasped by ordinary citizens, a committee of 16 persons representative of the population had been set up. After receiving some initial training, this group had chosen the experts who would carry out the survey and discussed the results submitted by them. This initiative had culminated in a three-day conference during which those citizens questioned the experts and prepared a joint report. The media had been won over by this initiative, which had transformed citizens into decision-makers overnight. As regards the report itself, its quality had been unanimously acclaimed. This project represented a concrete application of the principles of democracy at society level.

Regarding the Norwegian Scientific Research Council, Mr Dagfinn Føllesdal, Professor of Philosophy at the University of Oslo and at Stanford University (United States of America), referred first of all to the origin of the ethics programmes in Norway. A year after the setting up of the national committees the Norwegian Research Council had been established with a national grant amounting to 7 million dollars.

Science had ceased to be the benefactor of humanity since the second world war. It had revealed dangerous capabilities and was now awakening increasing distrust. This sentiment was accentuated by the fact that science could now go from theory to application in only a few months. It was therefore essential for States to establish research bodies which would identify and study those aspects of science that might prove harmful to society. The scope of the ethical dialogue must simultaneously be extended to include the younger generation and the general public. To deal with the specific problems posed by science and technology in the field of ethics, the Norwegian Research Council had set up a dual-skill programme for the young experts of today. This was aimed particularly at researchers who had recently obtained their doctorates and who stood on the threshold of a successful career.

A four-year course leading to a doctorate in ethics had now been established. The 40 persons currently taking that course came from a wide range of backgrounds ranging from genetic engineering to nuclear energy and including international taxation, the human sciences and education. Their studies were financed either by public authorities or by outside bodies. For such an initiative to succeed, it was obviously necessary to have high-calibre candidates who were preferably already well-regarded in their fields. The first year of the programme was devoted to the strict teaching of ethics. The 40 courses prepared to date had already been attended by over 500 people and were given by value trainers. These had to be well-known persons with teaching ability and a desire to work in depth with young people. At the end of that first year, students who were judged capable started to prepare their thesis over a three-year period and had six months in which to have their results published in professional journals.

He laid stress on the fundamental idea of dual skills. It was impossible to recognize the ethical problems in a situation if that situation were not perfectly understood. Conversely, it was impossible to distinguish between a good and a bad decision without a thorough knowledge of ethics. In conclusion, Mr Føllesdal also stressed the importance of this dual view for future policy-makers as well as for members of committees and commissions similar to the COMEST.

Mr Inge Eidsvåg, Vice-Chairperson of the Norwegian Values Commission, gave details of the latter body. Set up on 30 January 1998, the commission was composed of a twelve-person steering committee, an advisory committee with 37 members and a four-person secretariat. The commission members were representative of Norwegian society. The purpose of the commission was to contribute to the development of humanity and to strengthen the moral values specific to humankind for the good of the environment and the community. All citizens had to be encouraged to play an active part. As the new millennium came closer, changes were occurring one after another, life was speeding up and insecurity was increasing. By adopting an ethical approach, society would recover its equilibrium.

Mr Eidsvåg described certain aspects of Norway's worldwide action as exemplified by the activities of the Norwegian Values Commission. The commission had recently studied the question of oil deposits in the North Sea with the aim of defining the respective responsibilities of policy-makers, industry and the State in managing oil resources with respect to the less well-off populations of other countries and young people, particularly as regards the role to be played by democracy, human rights and the environment in Norway's investment strategy. All these matters had to be kept under permanent study.

At national level the Values Commission was endeavouring to draw up a definition of what constituted an effective local community. One hundred and thirty municipalities had taken part in a survey and some three hundred meetings organized throughout the country had been attended by several thousand people. The data obtained would help the Values Commission to make a better forecast of local life in Norway in the future. The commission was also interested in death and old age, which society seemed to want to ignore.

He referred to a body known as the '2050 Group' which concerned itself with another section of the population, young people who would still be alive in 2050. Its aim was to form an accurate idea of what their lives would be like and how they would view society. The project would culminate in a meeting of the Youth Parliament at which laws addressing future problems would be passed in symbolic form. This initiative took as its slogan the famous remark by George Bernard Shaw, 'You see the world as it is and ask 'Why?'. I see the world as it could be and say 'Why not?'.

The Norwegian Values Commission proposed to carry out several surveys in order to get a better view of Norwegian society. The surveys would particularly cover quality of life, consumption, the man-nature relationship, family life, exclusion and Norway's place in the world. The commission would simultaneously encourage dialogue between people of different religions with a view to better mutual understanding and collaboration on solving future problems. Such dialogue must also be encouraged at the grass roots of society and in schools and associations.

Mr Eidsvåg concluded that difference should not be distrusted but used for mutual enrichment. Violence arose when dialogue was absent. The projects described represented only a part of Norway's current efforts to create a more humane society.

IV. Ethics and Fresh Water Resources

This sitting was chaired by the Earl of Selborne, a member of the COMEST. Lord Selborne stressed the importance of understanding water problems and initiating a genuine dialogue on the matter.

After giving details of the creation and multicultural and multidisciplinary composition of the working group on the ethics of fresh-water resources, Mr Ramon Llamas, Professor of Hydrogeology at the Complutense University, Madrid, and co-ordinator of the group's work, presented the plan of the progress report being prepared on this subject. He told COMEST that all suggestions made during the session would be taken into account at future meetings of the working group.

He mentioned that the working group was convinced that it was necessary to adopt new behaviour patterns and even to develop a 'new water ethic' if the problem was to be attacked at its source.

Mr Llamas said that the final report presenting the working group's conclusions and suggestions for the future should be ready by the end of the year and would contain an exhaustive study of the problem and a synthesis. He then talked about the complexity of questions relating to the use and distribution of water resources. 25% of the world's population had no access to drinking water. The United Nations considered that between 23 and 25 billion dollars a year would have to be spent over eight to ten years in order to provide all those who needed it with drinking water. States currently allocated some 8 billion dollars a year to water.

Mr Llamas set out the guidelines for a code of water ethics based on three main themes.

(i) Protection of human life and nature

Water was indispensable for human life whether for nutritional, agricultural or industrial purposes. Access to drinking water played an essential part in the war on want, the maintenance of peace and sustainable development. As one of the group members said, water had a twofold function, being essential for human well-being and for the economic development of society. The two functions could not be separated. Conflicts would inevitably arise if no steps were taken to distribute water more fairly. Protection of the environment must also be one of the chief concerns in connection with the use of water and society must strain every nerve to ensure that this resource was not polluted.

(ii) Development of new technologies

In agriculture, new recycling, cultivation, harvesting and transport techniques must be developed for the improved use of water. Mr Llamas said that Spain had multiplied its farm production twentyfold between 1960 and 1995 through new agricultural techniques. During the same period, however, the number of farmers as a percentage of the whole working population had fallen from 30% to 6%. This trend towards increased productivity was found in all industrialized countries and would soon be normal to the developing countries. Traditional management methods must be used in addition to new technology, the purpose of which was to enable the ever-increasing population of the planet to have access to drinking water.

(iii) Respect for cultural characteristics

The water question could not be dealt with without the participation of local, regional and national authorities. Non-governmental and international organizations must also take part in the debate. The inequitable distribution of water was the result mainly of political malfunctioning and not of geophysical factors. Despite the severe drought in Spain between 1991 and 1995, the price of foodstuffs had not increased. The stability of the government and the country's participation in the international market had offset the rigours of the weather, with the help of irrigation and groundwater reserves. Any redistribution measure must allow for the local social and economic context, water being a common resource which must be managed for the good of all.

Concluding his statement, Mr Llamas proposed the following topics for discussion: water as an economic good; water appropriation; the role of the public and private sectors.

Lord Selborne, who was Chairing the sitting, referred to the main ideas expounded by Mr Llamas and stressed the importance of participation by the public at large in developing a water policy; the harmonization of such a policy between the various countries; the need to grade the different water-related problems in order of importance; the importance of sustainable development; the role of water price and of the resources allocated by States. Regarding the ethics of science and technology in general, Lord Selborne referred to the potential role of new technology and the importance of transparency in decision-making.

Debate

The ensuing debate concentrated on several ideas.

(i) Necessity for a new code of water ethics

It was stressed that it was the job of the current session to determine the ethical dimension of the problem of fresh-water resources for the purposes of decision making at national and international level. While no ethical system commanded universal acceptance, one truth had to be recognized, namely the absolute necessity of water because of the impossibility of replacing it by any other natural element. No one could object to poor countries having access to water, to the participation of all parties in the water debate or to the harmonization of goals among users. The task now was to identify more precise targets, among them particularly the definition of what was described as waste. Ethics implied a conflict between different moral values. A hierarchy of such values must therefore be drawn up, although it was certainly more difficult to agree on the means of achieving them. Would it be preferable to develop genetically modified organisms in order to control famine effectively, or to reject them because of the water requirements they generated? Progress would involve setting out and comparing the different logics which had led to the existing situation.

The necessity for a new water ethic highlighted the link between water and health. The quantity of water required by one person to stay healthy was estimated at 50 litres per day, allowing for the various needs of domestic consumption. In contrast, average consumption in California per person per day was 500 litres. In COMEST's view, the aim should not be to reduce consumption by the whole population to 50 litres but to make sure that everyone realised the need to save water.

(ii) Impact of population growth

Although adequate in quantity, fresh-water resources were not evenly distributed. Since the world population was expected to increase by 3 billion persons before stabilizing, this distribution problem could only worsen, especially as the vast majority of that population would live in developing countries. Even on the most conservative estimates (stable food consumption per person, 40% share of irrigation in agriculture, 70% efficiency of water use), irrigation-water requirements would rise by 17%. It would therefore be necessary either to rely on rainwater or to build new dams, which would raise formidable ecological, ethical and social problems. A COMEST member stressed the importance of the question of population increase, which was around 80 million persons per year, at a time when 200 million married and unmarried women currently wished to have the benefits of family planning. In helping them, the international agencies would reduce population increase by a third, which would help alleviate water scarcity. Regarding this question of population growth, the importance of the question of water appropriation was also stressed. How could water sharing between sovereign countries be defined when populations upstream and downstream were increasing considerably and 282 rivers and water-courses were currently shared by 42% of the population?

(iii) Tariff systems and the international market

As regards international trade it was pointed out that the reason that certain countries had not felt the effects of prevailing droughts was that they possessed sufficient money to buy the products they needed on the international market. The largest population growth occurred in developing countries, particularly those in sub-Saharan Africa and South Asia. For those countries, foodstuffs trading on the international market amounted to an exchange of virtual water. For example, a ton of rice required 2,000 tons of water, while a ton of wheat required 1,200 tons of water. Water price therefore had a strong impact on access to food. Must certain populations be condemned to suffer poverty and malnutrition through an accident of nature?

Some participants considered that as water was a symbol of life it should be free. The trouble was that, like any free resource, it was subject to an infinite demand. A fair price would be a way of ensuring that water was used sensibly. While water could not be free of charge it must at least be offered at a price which did not lead to social unrest. Middle Eastern countries devoted 75% of their water resources to irrigation. To conserve

water, new facilities would be needed and this would lead to higher prices. Regarding the cost of water, a number of speakers said they favoured the 'polluter pays' principle.

A basic contradiction as regards the question of the ethical use of fresh-water resources was emphasized, namely that the policy of the market currently seemed to be prevailing over ethical considerations. This was not necessarily harmful because certain economic principles could usefully be applied to water problems. While the poor in numerous cities of Africa and Asia paid more for their water, the wealthiest groups, for example Californian farmers, received subsidies. It was felt that judicious use should be made of economic laws, with the adoption of an economic and not an economist's approach. Pricing policy must be only one management method among others.

According to one participant, the world market was simply what individuals made it. Its functioning depended on a desire to this effect by individuals. This market should therefore be shaped according to more humane principles. Despite a large growth in population, the United States of America had radically reduced its water consumption per person since 1985. Since the Clean Water Act, industry had been required to pay for treating the water which it polluted. In order to keep costs down, it had therefore adopted better water-saving methods and had tried to limit pollution. If society came up with a firm policy, industry would be compelled to adapt. The market could therefore be a tool that served humanity. Someone had suggested that, in some regions, a policy of high prices was the only means of ensuring that water was not wasted. However, if this became common, society would find itself in an untenable situation. The example of the Business Council for Sustainable Development composed of company managers was mentioned. The report submitted by that council at the Rio Conference bore a highly significant title: Changing Course. It made the point that the market often proved highly effective when a precise objective had to be attained.

(iv) Cultural context

Speaking on this topic, a member of COMEST said that the distribution of water resources was a matter of justice and equity. Such justice must be defined by all the parties involved. What method should be used for water redistribution? What was waste? The latter notion was obviously relative and varied with the context. Forcing a certain view of the world on others was not ethical. The moral, cultural and religious context of all parties must be respected. Chemically pure water was not

necessarily accepted as healthy by the target population. All these questions should be dealt with in the report by the working group. While it might be generally accepted that humankind was technically capable of solving all problems connected with water, close attention must still be given in the report to political, social and cultural considerations.

Another member of COMEST said that scientists must take account of traditional local methods when they developed new technology. The relationship of every population to water must be allowed for when new techniques were adopted.

One speaker wanted the principles arrived at by the working group regarding the ethics of using fresh-water resources to be capable of incorporation in a code of moral conduct that could be applied in specific cases. However, unlike the other participants, he felt that the diversity of situations did not call for a whole range of rules and suggestions. The working group's proposals must be valid for all times and places, with ethics being the yardstick for human actions, which could be modified.

An *ex officio* member of COMEST added that the working group fully recognized that the use of new technology could in some cases imperil the identity of the region concerned. The principles accepted by countries in the northern hemisphere could not be applied to those of the south. It was important that the working group should ensure that allowance was made for the characteristics of each population, for while economic deficits could be made good a loss of cultural identity caused irreparable damage to a society. This principle must therefore be embodied in actual policy.

(v) Water as an ecological element

A COMEST member mentioned as an example the right of access to water, which humanists regarded as fundamental. Access to water could not be divorced from population growth nor from a population's geographical position. It was frequently observed that well-off families chose to live in arid regions whose climate pleased them. The question arose whether they were entitled to demand to be supplied with fresh water.

A participant regretted that the working group's preliminary report made no reference to the link between fresh water and forests, as water often originated in forest regions. Trees had an enormous impact on the quality of water, its abundance, speed of soil erosion etc. While recognizing the qualities of 'green' water, Mr Llamas pointed out that this

was the result of long years of interaction between the ground, trees and precipitation. A period of twenty years was needed on average for a forest to reach maturity and developing countries could not wait. Other crucial aspects of the problem were mentioned such as reforestation, the relationship between water and global warming, water and population migration and water and agriculture, all of which were aspects which should be examined closely by the working group. It was also stressed that water was one of the many 'services' provided by the ecosystem to society. Reference should be made to the methods employed by indigenous peoples, which were frequently effective and environmentally friendly.

(vi) Human health

Participants recognized that this question was a pressing one. According to United Nations reports, 2.3 billion persons suffered from water-related diseases. In Pakistan particularly, a quarter of hospital patients was affected by this type of disease. Water could, in fact, be the carrier of harmful or pathogenic substances. One of the most acute problems was due to waste chemicals from factories. Minamata disease in Japan was mentioned as an illustration. Organic waste from a neighbouring factory had contaminated aquatic life in Minamata Bay. People and animals who had afterwards eaten fish and other contaminated organisms fell ill in their turn and were now either dead or afflicted with serious nervous problems. Following a period of investigation into the possible causes of that disaster, scientists had confirmed the origin of the disease, and this had enabled Japan to adopt strict rules on water pollution. It was quite clear, however, that legislation was not the answer unless accompanied by public information and education about the effects of pollution. Regarding water quality, action must be taken to ensure that water ceased to convey harmful bacterial or chemical agents. There were known methods of dealing with bacteria but these required heavy investment. Regarding chemical agents, current know-how was unable to offer adequate treatment techniques, which meant that sources of supply must be protected.

In developing countries, the privileged classes had access to drinking water and to suitably hygienic installations. It was frequently found that disadvantaged sections of the population had to pay more per cubic metre of water than the better-off sections. This source of injustice confronted society with a fundamental ethical choice.

(vii) Historical perspective and the safety of individuals

It was suggested that COMEST should examine the different water-conservation projects worked out to date. At all times and in all places, warring factions had demonstrated the fundamental value of water by trying to deprive the enemy population of access to water. A failure to guarantee universal access to water amounted to declaring war on the disadvantaged. One participant said that history was filled with critical moments. As an example he chose the natural disaster which had struck the planet 10,000 years before when the population was only 10 million. Nomadic tribes consisting of 15 to 50 individuals had been severely affected by drought. To cope with it, they chose a more settled way of life, invented agriculture and grouped together to form villages. When rainfall and river levels started to vary, a second crisis had occurred to which humankind had found two solutions. The first, a technological one, had been to build dams and drains to divert the water. The second solution had been a moral one which involved learning about co-operation, compassion and equity. As early as 500 BC, many religions had embodied these principles in their beliefs and in the year 500 they had become moral axioms for the whole of humanity. Society nowadays followed commercial principles the keyword of which was profitability. With the coming of globalization, the multinational companies were acquiring ever-increasing power, whereas States were taking a back seat. It was not impossible to ensure that the whole planet had access to water; all that was needed was resources and know-how at local level. Waters marking frontiers required efficient management and unwavering co-operation between the countries concerned.

(viii) Questions to be examined further in the working group's report on the ethics of the use of fresh-water resources

The importance of terminology was emphasised. The term 'distribution' of water could be taken as referring either to statistical distribution or to distribution 'channels'. Any ambiguous wording must therefore be avoided. It was also necessary to refine the notion of 'water resources', a term which at the moment reduced the aquatic environment to a source of throughput, a block of cubic metres. Other topics which could be studied by the working group were mentioned such as the different possible causes of water scarcity (lack of natural resources, human resources, technical facilities); the disparity between town and countryside; disputes between ecologists and engineers; the appropriation or marketing of water; sustainable development and fossil water; the role of water in energy production. Moreover, as water had

become a strategic stake in all the world's regions, it was requested that questions of security and conflict resolution should be enlarged on in the working group's report.

V. Ethics of Energy

This sitting was chaired by Mrs Dagmar Schipanski, President of the Federal Scientific Council (Germany), member of COMEST. Introducing the topic, Mrs Schipanski said that the ethics of energy was of fundamental importance for the life of individuals and nations, whether the latter were industrialized or developing. Once upon a time fire had been the symbol of life, a role which now fell to energy. It was for the international institutions to study the social and technological problems associated with energy. Mrs Schipanski cited the following important research fields: natural resources, energy distribution, the link between energy consumption and destruction of the environment, the search for new energy sources, the gap between increasing consumption by the industrialized countries and energy shortages in poor countries. The preliminary report of the working group which had examined the ethics of energy must lead to the enunciation of essential principles. The report must be able to serve as a basis for future discussions between the authorities and the scientific community as well as between energy suppliers and users.

Introducing his presentation of the report prepared by the working group on the ethics of energy, Mr Jean Audouze, Professor of Astrophysics, Director of the *Palais de la Découverte,* and co-ordinator of that group's proceedings, said that it was in Norway, the country hosting the first session of COMEST, that the idea of sustainable development essential for energy management had seen the light of day. The credit for the work *Our Common Future*, which the group had used as a groundwork for its discussions, was in fact due to Mrs Gro H. Brundtland, the former Prime Minister of Norway and currently the Director-General of the World Health Organization (WHO).

Mr Audouze said that the scientific, philosophical and conceptual considerations underlying the ethics of energy could be encompassed in three myths. These were the myth of Prometheus, who had stolen fire from the gods to give it to humankind, the myth of Faust, who had entered into a pact with the Devil to master nature, and the myth of Frankenstein, whose fault had been not so much to have created an artificial being, as was often believed, but to have abandoned it.

Placing the subject in its historical context, he saluted the memory of several famous scientists who had marked the history of energy over the centuries. He mentioned Marriott and Boyle who had independently discovered the principle of the conversion of heat into mechanical energy, and Volta, the inventor of the battery whereby energy had for the first time been transported for use in another place. In the 19th century, the era of industrialization, the world had witnessed the birth of thermodynamics; Clausius had shown that energy was transformed but conserved, while Carnot had stated that the mechanical efficiency of a machine was always less than unity. One of the ethical considerations in the energy field was the quest for machines with an efficiency as close as possible to unity. In the 20th century, Rungen had invented X-rays, anticipating the discovery of natural fission by Becquerel and the initial researches of Pierre and Marie Curie and of Joliot-Curie based on the transformation of matter into energy.

Mr Audouze gave the meeting certain details about the membership of the working group on the ethics of energy, which brought together well-known persons from a variety of fields ranging from nuclear matters to automotive transport, including electricity and solar energy. He stressed that the report submitted to the current session of COMEST was preliminary in nature as it had not been possible to call on experts from the United States of America, China, India and the Russian Federation. The report should therefore be regarded as needing appropriate adjustment.

Looking at the matter from a geopolitical point of view, Mr Audouze stressed the importance of human population trends. In ancient times the earth's population had been between 5 and 10 million. It did not reach one billion until the beginning of the industrial era. Since then the population had grown exponentially. It had reached 3 billion in 1960 and was now 6 billion. According to projections, the earth would have a population of between 8 and 15 billion in 2025. This increase varied according to country. The population of countries belonging to the Organization for Economic Co-operation and Development (OECD) would increase from 1.1 billion to 1.4 billion, while that of the developing countries would increase from 3.3 billion to 7.2 billion. The population of Africa would treble while that of Latin America, India and South Asia would double. The countries whose energy consumption would increase most strongly would thus be those with the strongest population growth.

Population migration towards urban centres must also be taken into account. In 1900, 86% of humanity had lived in the country, while the figure in 2020 would be only 35%, the remaining 65% being distributed between medium-sized towns and the megalopolises. The latter would appear particularly in the emerging countries such as India, Mexico and Brazil and their energy needs would differ from those in the countryside.

Regarding the inequitable distribution of energy resources, over 2 billion persons worldwide currently earned less than 1 dollar per day. The same number of persons had only firewood to use. The manifest inequality indicated by these figures emerged even more clearly when the number of oil-equivalent tonnes available per capita per year in certain countries was examined. This figure was 8 in North America, 3 in Europe and 0.4 in Africa. This seemed all the more absurd because the bulk of the world's oil resources lay in the Middle Eastern countries.

The industrialized countries accounted for 18% of the world population but consumed 65% of the available energy in 1970. By 1995 this figure had become 55% and would be around 46% by 2025. There was nothing to suggest that this disproportion would go on diminishing since technological advances were rarely applied immediately. Even if new insulation or energy-production techniques were developed, it was probable that people would continue to use the same air-conditioning and heating methods for the next 100 years. This was noticed in the case of new roads, major infrastructure and buildings.

Turning to the question of energy intensity, Mr Audouze said that, although the inhabitants of the North American continent consumed 2.5 times more energy than Europeans, they were not necessarily 2.5 times happier. Energy consumption was not a direct measurement of a region's economic health. Energy intensity was the ratio of one unit of GNP to the quantity of energy it could produce. Before the first oil shock there had been an undeniable link between these two factors. Nowadays they were divorced from each other, particularly in the industrialized countries. In the matter of ethics, therefore, consumption was less important than the service rendered by such consumption, which would double by the year 2020. If the share taken by the developing countries were to be equivalent to that of the industrialized countries after that date, their inhabitants would still be disadvantaged. The developing countries must therefore be able to rely on the strength of the developed countries in order to enjoy the same quality of energy services whilst maintaining a lower consumption level.

Mr Audouze then gave a comparison of energy sources.

(i) Fossil energy

Fossil fuels (oil, natural gas, coal) would remain the most widely used form of energy throughout the world for the next 100 years. They offered considerable advantages, the most obvious of which was ease of use.

These fuels were easy to process. This was particularly the case with coal, which the developing countries would find it easy to exploit. However, its emissions could cause serious environmental problems. Oil was also easy to use and was offered at a relatively low price. As regards natural gas, which was destined to develop, large fields had been discovered in the Russian Federation, Iran, the Middle East, Algeria and Norway. Its main advantage was that it released less CO_2 per unit of energy than oil.

However, the main drawback of fossil fuels was their finite nature. Produced a billion years ago, they would inevitably run out. Even if the earth continued to produce certain types of energy, it would be unable to satisfy humanity's needs. The period of grace available to humanity before fossil fuels were exhausted was estimated at 1000 years. This period appeared very long compared with a human life time but was extremely short in astrophysical terms. As regards oil, operators foresaw no problems for the next 50 years. After that date, it was to be feared that the only remaining deposits would be those in the Caspian Sea or the Middle East. The risks of conflicts resulting from such a concentration were clear. Furthermore, fossil fuels released CO_2, a gas which seemed to contribute to the greenhouse effect. On the basis of the precautionary principle, humanity as a whole had decided to endeavour to control the spread of gases of that type, and in accordance with that principle the Kyoto International Conference had set limits for all countries.

Since there could be no question of giving up fossil fuels, they must be used in the best possible way. The first method recommended was to prospect for as yet undiscovered deposits of oil and natural gas. Existing mining techniques could tap only about 15% of the available oil. A figure of 30% must be reached by using methods such as carbon-dioxide injection, seismic-wave analysis and horizontal sampling. Prospecting should also be conducted for methane gas, which appeared to be plentiful on the Atlantic coast of the United States of America. In order to improve fuel efficiency, it would be necessary to develop fuel cells, hybrid engines, co-generation and the harnessing of carbonic gas.

(ii) Nuclear energy

Regarding nuclear energy, Mr Audouze said that the use of such energy usually involved uranium 235 fission. A second technology,. which had still to be perfected, used four hydrogen cores. Despite the very high cost of nuclear installations, the price of 1 kilowatt-hour of electricity was comparable to, or even slightly lower than, that of thermal energy. Nuclear energy had the additional advantage of not increasing the amount of carbon in the atmosphere. On the other hand, it had three types of drawback: public reluctance to accept it, particularly since Chernobyl; uncertainty about plant safety; the problem of waste disposal.

To give the public greater security, thorough research must be performed on all links in the chain from fuel to plant, including reactors. Fast-breeder reactors, although recently rejected by the French government, were still a possible means of improving nuclear-energy efficiency. At the European level, the researcher Carlo Rubbia proposed the power amplifier, which would make accelerators safer whilst limiting the quantity of waste produced.

Regarding the latter point, out of 2.5 kg of waste, only 10 grammes presented disposal difficulties. France produced 500 tonnes of long-lived radioactive waste each year. This figure was, of course, too high and research must be concentrated on how to manage the quantity concerned in the best way. The policy pursued to date by Germany was based on the idea that nuclear energy could soon be replaced by renewable energy. Such an idea might appear over-optimistic because it would take many years before renewable energy could really be exploited.

(iii) Renewable energy

Renewable energy was based on numerous substances, the most important of which was water (hydroelectric power) and biomass (wood, agricultural fuels). Wind and photovoltaic energy were still little-used techniques. By definition, these energies did not play a part in the build-up of carbon in the atmosphere. However, the extent of the environmental damage which could be caused by these forms of energy should not be underestimated. The construction of wind-power installations and the use of farm land for energy purposes limited the area that could be used for traditional agriculture. Wind installations also produced sound pollution while hydroelectric energy could lead to environmental problems. In addition, the energy produced per unit was more expensive because the price of concentration had to be paid.

Examining the foreseeable scenarios, Mr Audouze stressed that, although every form of energy had advantages and disadvantages, demand for energy was becoming increasingly insistent. Because the industrialized countries had monopolized two thirds of the world's energy up to now, the developing countries were rightly demanding that the former should pay for the disorder they had created. The opening- up of access to the various markets in the coming years would be crucial in reducing the severity of the conflict. He suggested that countries without genuine electricity problems should conduct a study of the impact of their energy tariff systems. If energy consumption continued its existing trend, the world's carbon emissions would reach prohibitive levels, the rate of energy consumption would be extremely high and the disparities between developed and developing countries would intensify. If, on the other hand, society adopted a policy of energy restraint, the developed countries would have a much smaller advantage. Moreover, energy demand would be reduced whilst allowing a satisfactory standard of living, and carbon emissions would fall.

Stressing the importance of the risk-management question, Mr Audouze told COMEST that the working group had identified three risk categories. First of all, there were climatic risks. It had not yet been proved that CO_2 levels were responsible for global warming; this could be the result of the earth's angle of inclination. The nuclear risks, which did not need spelling out, were considerable, as also were the risks of environmental degradation. He recognized that there was no zero risk. That was why it was vitally important to adopt a risk-management approach in all situations. This approach was regrettably not adopted by all countries.

Energy needs would continue to increase as a result of population growth, the multiplicity of uses, transport propensity etc. An ethical decision was needed in order to balance access to energy, which was currently very unequal. The factors described above should enable principles to be defined for use by policy-makers.

Sustainable development meant that it was the duty of individuals worldwide to leave for future generations an earth and conditions comparable to or even better than those of today. Although the oil price per barrel was very low, oil should not be used recklessly. Application of the equity principle was not the same as justice. Human beings must have guaranteed access to the energy they needed, irrespective of their geographical position and their cultural status. People on the African continent should not be penalized in comparison with those in North

America. In addition, the precautionary principle might be the best or the worst of approaches. A lookout should be kept for all signs of irreversibility. For example, although it was not known whether CO_2 emissions really caused global warming, every precaution should be taken to limit their presence in the atmosphere. Dual-purpose solutions such as co-generation or 'least regret' methods must be investigated.

Concluding his statement, Mr Audouze said that humankind had only one world at the moment and would have to be content with it for very many years yet. The frenzied use of energy was therefore extremely disquieting. Preservation of the planet earth depended on human prudence and maturity. Every decision must be weighed and the individual consequences examined. For example, the construction of a hydroelectric dam could deprive farmers of water and disturb the ecosystem. To make better choices in energy matters, humankind must carry out considerable research and, above all, guide it in the best possible way. The proportion of resources devoted to nuclear research was currently excessive; all forms of energy must be fully developed.

All those interested in the ethics of energy must keep four ideas in mind: the importance of the geography, time and population factors; a duty to plan ahead, manage risks and control energy whatever its nature; a duty regarding research, culture and education; the role of States and international agencies. Mr Audouze reminded the meeting that final decisions were the responsibility of policy-makers. National and international working groups would continue to be important work forums. However, ethics groups, however distinguished, must not hold up decision-making since any delay could have fateful consequences.

Debate

The discussion that followed Mr Audouze's presentation brought out a number of topics which participants wanted to have included or further developed during preparation of the final version of the report. In the first place, several speakers, whilst approving of the way in which the report highlighted the sensitive question of risk management, wanted the ethical considerations relating to energy production and use to be further expanded on so that the public could be better informed. The first duty of scientists and specialists was to provide the public with full information. However, it became clear that the question was so complex that no final conclusions could be reached.

(i) Necessary change in mentalities

Commenting on the proposals by the working group's co-ordinator, a COMEST member expressed doubts about the possibility of asking developed countries to reduce their energy consumption by a factor of 5 or 6. How could the inhabitants of North America be persuaded to do without air-conditioning or heating, and not to use their cars for trips of only 100 yards? How, in short, could individuals be persuaded to do without some of the comforts they were already accustomed to? It would simultaneously be necessary to convince the developing countries that the standard of living of the Americans and Europeans which they saw on television and in the press was not the ideal. Regarding this point, it was made clear that a problem had to be shown to exist before solutions could be proposed and that this was the approach adopted by the working group and the report. Legislative action was pointless unless it was based on an effort to educate . Changing the way of life of certain populations, something that could be regarded as necessary, would depend on a change in mentality. Since the Rio Earth Summit the position of the United States of America could be seen to have changed slightly; efforts should now be started at local level.

A COMEST member felt strongly that the problems of society could not be solved in the short term either by legislation or by strict pricing policies. He referred to the criteria used to define 'developed' countries, namely a high level of domestic consumption, as a measure of the necessary change in mentalities. A new ethics of energy must not only give a new definition of development but also underline the need to find more economic and efficient forms of energy. Energy savings must be accompanied by new lifestyle choices. While it was impossible to apply the same model to all individuals, efforts must be mobilized to limit pollution and make the best use of the Earth's limited resources. In this connection, the importance of educating young people, in conjunction with concerted media action, was restated.

(ii) Comparison between energy sources

Participants discussed the forms of energy mentioned by the co-ordinator of the working group on the ethics of energy. Regarding nuclear energy, one speaker considered that nuclear-installation safety had made no significant progress in recent years. Bearing in mind that developed countries were hard put to it to control this type of energy, it was virtually impossible for developing countries to use it under satisfactory safety conditions. Instead of helping the developing countries, nuclear

technology was liable to destroy them, especially if it were used for arms purposes as happened in several countries. A participant stressed that this form of energy was a good deal more sophisticated than was suggested by the wording of the preliminary report. While certain countries were indeed considering replacing nuclear energy by renewable energy, they were aware of the importance of improving the efficiency with which such forms of energy were produced, distributed and transported.

Regarding the virtues of hydroelectric energy, a participant referred to the linkage between the water and energy sectors. Water was more or less routinely required for electric and hydroelectric production. The latter resulted in noticeable changes in the temperature pattern and flow rate of rivers. For nuclear production, large quantities of water were needed to cool the generating stations. Conversely, geothermal energy and seawater desalination required large quantities of energy. The water crisis was therefore liable to turn into an energy crisis. It should be remembered that the energy industry itself needed large amounts of energy. Cement was used for electric barrages, oil transport and refining etc. This aspect of the problem therefore posed an interesting ethical challenge.

(iii) Framing new policies

The changes in certain societies which abandoned production activities for service activities were mentioned as having the potential affect of lowering consumption levels in industrialized countries. Replying to a certain scepticism about the validity of forecasts, the co-ordinator of the working group on the ethics of energy said that the group had taken a set of data and examined the implications. In such a complex area, which depended simultaneously on technology, mental attitudes, government policies and fiscal measures, it was necessary to bring a certain order, if only provisionally, by imagining future scenarios. To show that forecasts were a means of anticipating reality, the example was quoted of countries which had not drawn up a national policy until an accident (nuclear or non-nuclear) had occurred.

Referring to the risk-management question which was given particular attention in the preliminary report to COMEST and which was extremely important in policy preparation, a COMEST member challenged the idea of ‘reversibility’. Translating an initiative into practice gave rise to irreversible situations. Although less polluting than fossil fuel, hydroelectric energy could well cause irreparable harm. It was impossible to go back on one’s action if a river was diverted or a part of nature destroyed. It was inherently impossible to restore nature. In absolute

terms, everything was irreversible, although some types of irreversibility were less far-reaching than others. For example, forest fires were irreversible because the burnt trees were destroyed forever. While this type of event had no impact on the world's future because new trees grew in place of the old, a rise of about 6 degrees Celsius in average temperature would have disastrous consequences. Likewise, an accident in a nuclear power station would be catastrophic. In the meaning in which it was understood in the preliminary report, irreversibility could attach only to events which had a considerable impact on the planet as a whole.

Speakers unanimously recognized the importance of population growth which constituted, particularly in the megalopolises, one of the greatest obstacles to a successful new policy of water and energy management. Water management and prudent energy use were considered to be the keys to human life on earth in the future.

(iv) International co-operation

Regarding this question, after congratulating the working group on its extremely comprehensive report, a COMEST member proposed certain new subjects for study. In point of fact, humanity was not facing an energy deficit. The present situation could be likened to that of a society prior to the emergence of the market in societies where suppliers and buyers were actuated by their respective interests.

A participant suggested that it was the responsibility of bodies like COMEST to think about how to narrow the gap between human needs and real access to energy. This gap was the result of basic flaws in international justice and led both to want and to the destruction of existing resources. It resulted from a refusal to recognize differences, from a rejection of the Other.

The matter of the quotas laid down at the Kyoto International Conference, which allowed certain countries to pollute, was raised. It was stressed that, being a product of carbonic gas, CO_2 was not a pollutant.

A participant considered that it was not enough to take an interest in energy production and use but that the waste produced and its treatment should also be studied. By refusing to examine this question in detail, the developed countries would be condemning the developing countries to the same evils as those they suffered from themselves. From the viewpoint of energy quality, China was among the wealthiest countries in the world but in terms of energy consumption per capita it was among the poorest. Its economy, which was at a transitional stage, needed to learn the lessons of the wealthiest countries which it had been taking as models for twenty

years. Since China was second to the United States of America in CO_2 emissions, many campaigns had been launched aimed at a new energy approach, the main thrust of which was the limiting of pollution and universal access to energy. Account should also be taken of the interests of all parties concerned, i.e. local and national authorities, State enterprises, business and the public.

The importance of research financing was stressed, particularly the development of new technologies which could lead to substantial savings. Some participants considered that it was the responsibility of the wealthy countries to provide such financing both for the poorer countries and for future generations, while others strongly denounced this proposal which smacked of economic Darwinism, taking the view that industrialized countries should not just provide resources but should join instead with developing countries to form a durable alliance.

Regarding global warming, a COMEST member said that the social consequences of the Kyoto Protocol were important because of the ethical questions they raised. Currently 50% of trees felled were burnt and used for energy purposes. Electric lighting had recently been introduced in Senegal in order to reduce deforestation. The calculations of the international agencies had turned out to be quite wrong; as a result of electricity, the inhabitants of that country had been able to stay up later and had burned even more wood for heating. This example illustrated the great importance of cultural factors in the implementation of international initiatives.

(v) Development of new technology

Hydrogen-based technology was mentioned and two COMEST members asked for clarification of the working group's conclusions on this point. It was indicated that no recommendation had been drawn up owing to the absence of precise data about systems employing such technology. In addition, the explosive nature of the substance made all study particularly difficult. A speaker pointed out that the study of hydrogen had nonetheless been continuing for a long time. It was, in fact, a secondary source of energy just like electricity. Some progress could be reported, particularly regarding water electrolysis. In the long term the scientific community hoped to be able to use hydrogen for transport in place of oil products. It would also be interesting to combine hydrogen with a primary source which did not produce CO_2 for example nuclear or solar energy. The use of hydrogen was still marginal since it depended on natural gases, and it would not be viable in the long term.

(vi) Perspectives

COMEST's attention was drawn to two recent initiatives by the World Energy Council. The latter had decided to review a document entitled *Energy for Tomorrow's World,* which offered an overall analysis of the world's energy problems in the year 2020. The chief purpose of the study was to draw up a plan of action in order to help solve the problem of access to energy by the 2 billion persons lacking a source of modern energy. The council had also launched an ethical project in the energy field. This project would concentrate particularly on assembling real-life cases and practical experiments carried out by various enterprises in the energy sector and could contribute to COMEST's work. A participant stressed that contemporary society was naturally energy-consuming. Business, industry and the trade unions sought greater profitability and yields, all of which involved heavy energy consumption. Developing countries could be expected to need increasing amounts of energy to forge ahead economically.

On the assumption that future generations, at present voiceless, would want energy consumption to be reduced, it was therefore desirable to identify bodies which could already start to defend their interests through international agreements. With regard to the future, a speaker said that energy in itself was not as important as the activities to which it opened the way, for example heating, air-conditioning, production, transport etc. It was unrealistic to think that humankind could solve all future problems by cutting present consumption. The challenges facing humanity were too formidable to be dealt with quickly and the concept of equity must be given concrete application immediately.

An *ex officio* member of COMEST proposed that the two existing working groups should draw up a scheme for carrying out audits relating to ethics. This type of initiative already existed in industry and ecology. To apply it in the fields of water and energy ethics, the opinion of all sectors and all social classes must be consulted. Concrete recommendations must also be made to help public authorities and industry with their decisions. It was essential that such recommendations should be based on specific cases if they were to be genuinely applied in society. An international audit similar to that instituted for human rights was suggested. Those preparing such an audit should bear in mind the following three questions. What are the aims? How can they be obtained? How is an action plan to be chosen? It was felt to be worthwhile for COMEST to examine this possibility so that the results could be communicated particularly to the industrialized countries, which used the

biggest proportion of natural resources and were responsible for an equally large proportion of world pollution. In the absence of penalties, those countries should pay for the damage they caused to the environment.

(vii) Role of the COMEST in regard to the ethics of energy

Certain participants said that they were concerned about the way COMEST would operate and hoped that it would not go over old ground. A large number of studies based on prospective and explanatory models already existed. COMEST must concentrate on making good the enormous deficit in the ethical field. What were the problems regarding the ethics of energy? What types of models could be constructed to describe them? While ethics was fundamental for humanity and should be a part of all international discussions about energy policy, COMEST's function was to promote the essential balance between economic needs and human and environmental necessities, a dialogue between producers and consumers, developing or transitional countries and industrialized countries. The emphasis should be on two types of solution depending on national needs: integrated resource planning at world level; least-regret choices.

A participant stressed that the in-depth action needed to produce changes in behaviour were the sole responsibility of States, which could take suitable legal measures, accompanied where necessary by sanctions, or employ tax incentives. However, the international agencies played an important part inasmuch as they could encourage States to take the necessary steps by informing them about the issues at stake and their implications. Mention was made of the importance, now that globalization had entered the picture, of launching an educational campaign on the subject of ethics, particularly in the industrialized countries.

VI. Contribution of the COMEST to the World Conference on Science (Budapest, June 1999)

The Director-General of UNESCO Chaired the sitting which examined this item of the agenda. He mentioned the recent World Conference on Higher Education which had looked at, among other things, the question of the diffusion of knowledge and at the way society could promote fresh discoveries. He stressed that scientists, who devoted themselves to the quest for knowledge and to invention and discovery, should enjoy the best conditions so that they could improve the human lot.

The Director-General spelt out the tasks required of the scientific community: to advise decision-makers, sound the alarm when risk situations arose and make their knowledge serve prevention. Prevention was, in fact, the most important action which the scientific community could perform.

He paid tribute to the importance of the contribution of a body like COMEST. The latter's task in the face of the new major challenges of the time was to define, according to a multidisciplinary approach, the ethical principles to be followed in exploiting the applications of knowledge, bearing in mind that policy decisions must be taken with reference to concrete situations and not to theoretical circumstances. This contribution should be based on several ideas: the globalization of society; the need for a long-term vision; the possible irreversibility of certain events. As soon as certain situations showed signs of being irreversible, scientists and policy-makers had a duty to mobilize without delay. The Director-General referred to his experience as a biochemist and as a specialist in cerebral illnesses in the new-born. During that period he had often found himself obliged to take rapid decisions without being able to await a full diagnosis.

Society, too, risked finding itself confronted by such dilemmas. It was regrettable that the warnings given by scientists often clashed with the incomprehension or inaction of policy-makers. The scientific community was often asked to draw up a new report or to perform an analysis even though the means to react existed. For biochemists, the perfect method of diagnosis was the autopsy, which gave a complete and accurate picture of the disease. This, of course, came much too late. In addition to the preventive function of the United Nations, UNESCO had a duty to build peace, to go to the source of conflicts. It had to work to reduce poverty and to end the frightful conditions in which so many people lived, among whom women in particular were often at a disadvantage. He stressed the importance of making access to education universal and of ensuring an equitable sharing of resources the uneven distribution of which led to so many conflicts.

Referring to the tacit contract which had long existed between science and society, the Director-General of UNESCO said it was important to develop access to scientific education from the early years of schooling, as numerous international bodies had often stressed. While the applied sciences were important, the democratization of knowledge was even more so.

He mentioned the hope he was placing in the conclusions which could emerge from the World Conference on Science. Like every international

conference, it would be an opportunity to take stock of the scientific community's actions. The conference would have to examine the contribution which the community could make to bringing about a change for the better in world morality. At this very moment the major powers were proving that humankind had not progressed but was choosing rather to impose its will, to dominate and to believe that only brute force brought results.

The human will had created previously unimaginable opportunities. Who would have thought that the Minister of Foreign Affairs of Norway would receive Irish political leaders in order to start a peace process, thus giving people the hope of being able to live side by side in peace and mutual respect as free and equal beings, in the spirit of the Universal Declaration of Human Rights. The Director-General said that the human imagination was in his view the light that would guide society towards the 21st century. Force and power would have to give way to clear-sightedness and intelligence.

He said that the Budapest Conference would be a chance to study the current problems of science by remembering the past but looking to the future. He congratulated COMEST on bearing in mind its ethical task and choosing to study relevant subjects such as water, energy and the information society. Referring to UNESCO activities in the field of the ethics of life sciences, he mentioned as an example of an ethical action the adoption by the UNESCO General Conference of the Universal Declaration on the Human Genome and Human Rights, which had recently been endorsed by the United Nations General Assembly.

The Director-General then referred to the role of the United Nations, whose next General Assembly would be held against the background of the millennium and constitute a memorable moment in contemporary history. The United Nations was currently the world's only international democratic body. However, States which had struggled for democracy inside their frontiers were trying to demonstrate by their acts that democracy was unnecessary at international level. They were challenging the structures which they had put in place with such care. If the authority of the United Nations and the Security Council weakened, institutions would have to be modified and the democratic framework of the international community strengthened. Citizens must be able to make their voices heard. At the moment they were only listened to when there were elections, opinion polls and referenda. Then they represented an anonymous numerical mass. True democracy was that which enabled a real dialogue to take place between a people and its government.

The citizen must count and must not represent just a vote at election time: all parties must be involved in taking decisions, for example

regarding the technological application of scientific know-how, instead of being the passive subject of decisions taken over their heads. Through the World Conference on Science, the scientific community would make its views known and claim its the place on the international stage. The Director-General mentioned his first journey to the Soviet Union as a young scientist, when he had been struck by the prevailing silence, a peaceful but imposed silence. Humanity's ideal was not a peace of that nature which sprang from silence, but the silence which sprang from peace. Such a peace could not function without justice and freedom of expression and action for everyone, including the scientific community.

He said that the world stood on the threshold of a new era and that he intended to propose four new social contracts to the Millennium Assembly which would be held at the United Nations. He believed that the first social contract was necessary in order to reduce inequalities between peoples and between individuals and ensure that freedom was accompanied by equality. UNESCO, whose Constitution affirmed the importance of intellectual and moral solidarity, must assume the task of achieving the aims of this new social contract. The second contract concerned nature and the environment, the protection of which involved recognizing the consequences of industrialization and of the creation of a world market. The basis of the third contract was culture. Culture was vital to peace and to the assertion of identity. The Director-General mentioned the 'Report on Education in the 21st Century', in which it was stated that people must learn to live together and to accept difference. People were all unique and equal, their differences were infinite but humanity united them. The final contract concerned ethics. Fortified by these four contracts, human beings could make a fresh start.

This fresh start must take account of the younger generations, which had often been disappointed at seeing their elders disregard their political and moral obligations. In 1974 the OECD countries had pledged 0.7% of their GNP to the developing countries. With the exception of certain countries, including Norway, these pledges had not been kept. At the Earth Summit in Rio in 1992, States had undertaken to make organized efforts to protect the environment. This had not been done. There had been a similar failure to implement the recommendations and declarations adopted at major conferences, whether on population (Cairo), human rights (Vienna) or social development (Copenhagen and Beijing). If the four contracts mentioned were adopted and complied with, the human beings of today could promise their children a fresh start.

Debate

The discussion that followed the introductory address by the UNESCO Director- General showed the interest taken by COMEST members in the World Conference on Science, in the 'Draft World Declaration on Science and the Use of Scientific Knowledge' to be submitted to it and in the thematic meeting which would be devoted on that occasion to the topic 'Science, Ethics and Responsibility' and which H. E. Mrs Vigdís Finnbogadóttir had agreed to Chairperson. A number of points were made by various speakers.

(i) Inter-institutional co-operation

A COMEST member stressed that the discussions at this first session had allowed questions to be raised such as the need to protect the environment, the complexity of the problems of fresh-water and energy management and the necessity for developing information to the public and education. These were subjects which could interest the World Conference on Science. He felt that, through co-operation between the International Council for Science (ICSU) and UNESCO, it should be possible to incorporate the conclusions of this first session of COMEST in the 'World Declaration on Science and the Use of Scientific Knowledge' which was to be adopted in Budapest. On this point the Director-General of UNESCO reminded participants that a document prepared by the ICSU Standing Committee on Scientific Responsibility and Ethics was among the working and information documents for the first session of COMEST and that the conclusions of this first COMEST session and the reports resulting therefrom would form an invaluable groundwork for the four new social contracts mentioned. He stressed the importance of a COMEST contribution to the Budapest Conference Forum concerning 'Science in Society'.

An *ex officio* member stressed that, in the case of ethics, prevention was essential, 'therapy' being only a last resort when the former had failed. He gave COMEST an assurance of co-operation from the International Social Science Council (ISSC), which was in a position to take a hand with UNESCO in achieving the objectives set out by the Director-General. He also hoped that that NGO would be able to play an active part in circulating the conclusions of the Budapest Conference. The ISC and the ISSC must join forces to bring them to the notice of international bodies, which could then see that they were circulated. The ISSC had been asked to organize the thematic meeting on 'Science and Democracy' at the Budapest Conference.

(ii) Points to be included in the COMEST contribution to the Budapest Conference

Mentioning the example of bioethics, a speaker said that COMEST should emphasise the importance of an analysis of the cultural context before drawing up ethical principles for a given situation. Such principles should be adapted to the natural, economic and cultural environment of societies. The same applied to the relationship between science and public authorities in connection with decision-making, in order to ensure that the principle of equity and individual well-being was applied.

A member of COMEST suggested that participants in this first session who would be attending the Budapest Conference should get together to see that COMEST enjoyed balanced representation in the various workshops that would be held. The ethical case must be represented in all the discussions and COMEST must be recognized at world level.

Another member of COMEST hailed the excellent presentation by the Director-General, and its emphasis on the question of complexity, long-term vision and necessity for forecasting. For educational and practical reasons, science had adopted the habit of reducing complexity to its simplest form. It was desirable that stress be placed at the Budapest Conference on the need to incorporate analytical knowledge into complex systems in order to draw up forecasts and reach ethical conclusions.

It was stressed that one of the challenges facing COMEST was, in order to turn words into action, to bring about acceptance and application of the ethical principles that must be identified if the results of the Budapest Conference were not to be ignored as happened to so many international meetings. Means enabling that event to result in concrete changes must therefore be envisaged. The conference's conclusions must be circulated through the international agencies, which could employ the new information technology for that purpose. Communication and circulation arrangements must be established in academies of sciences and the UNESCO national commissions. The latter were currently just letterboxes where documents ended up, when they should instead be staging posts. The conference, which came at the end of the millennium, must show it was different by leading to genuine change. In this connection, participants in the Budapest Conference could fulfil a very important role after the conference by acting as contacts in their respective States vis-à-vis national ethics committees or interested national bodies. The effectiveness of the future Declaration would depend on the determination of States to convert international directives into national regulations.

Three topics were proposed as COMEST's contribution to the Budapest Conference.

The first topic concerned the considerable and increasing gap between North and South in the science field. Important questions were raised by the privatization of science in the countries of the northern hemisphere, reflected in the growing number of patents issued to industry in respect of different products and processes. Would the 21st century be the century of scientific apartheid? Economic inequalities were currently becoming intellectual disparities. An answer would have to be found to the problems raised by the ethics of scientific development.

In the second place, scientists in the North must agree to throw the research field open to all countries. Eighty per cent of the global family consisted of consumers of science, not producers. The South could make substantial contributions ranging from wisdom to actual technical capacity. Unfortunately it did not possess the means needed to make itself known, to gain access to the scientific publications and virtual journals which were becoming increasingly numerous and important. Communication between scientists in the North and their colleagues in the South must be developed so as to bring about partnerships. COMEST could play an important part by bringing the different sides into contact.

The third topic concerned, in particular, scientists and decision-makers in the countries of the southern hemisphere. The difficulties in those countries were not solely economic. Certain values had to be developed. In those countries it was essential for the advancement of science to encourage creativity and this demanded improved working conditions. The practice of science, moreover, could yield fruit only if it were based on certain moral values which it was COMEST's duty to foster.

The first of these values was probity. Any scientist guilty of falsifying data must be permanently excluded from the scientific community, even posthumously. There was no greater crime than the falsification of data.

Creativity demanded great open-mindedness and a determination to be constructively subversive. Science could advance only if the established order were overturned, as the scientific revolutionary, Albert Einstein, had done in disputing Newtonian physics. It was necessary to upset hierarchies, be willing to adopt new methods, accept competition and indulge in critical examination.

Tolerance constituted a third value lacking in the countries of the South. It was not necessary simply to live and let live but to recognize that the most unexpected ideas could be valuable, could deserve to be

explored, tested and discussed. Society must accordingly be given the assets needed to deal with essential problems, forge the new social contracts described by the Director-General and found a true scientific community which would bring North and South together. In providing solutions to those problems, the Budapest Conference would stand out as a key moment in the history of science.

A participant pointed to the role of scientists, which was a topic to which COMEST could also make its contribution. Public opinion had a sometimes absolutist and paradoxical vision of science: it expected everything from science but blamed science for everything. Observance of the ethical principles relating to scientific knowledge and to technology seemed to him to be an answer to all problems. As regards scientists, they realised that they were dependent on a number of external conditions, including in particular funding, which played an important role in the drawing up of scientific programmes, the choice of scientific research subjects and the application of the technologies derived therefrom.

A COMEST member supported the Director-General's position that particular attention should be devoted at the Budapest Conference to the necessary co-operation between scientists and policy-makers. The scientific community must be the partner of the political world. It must show it that its advice and analyses were valuable. Decision-making was too often regarded as composed of two distinct elements, the ethical and the political. Stress was also laid on the importance of sharing scientific know-how and of personal and institutional involvement by scientists in the educational process. Scientists had a dual responsibility: to enable young scientists to acquire a thorough knowledge of their main field and develop their ethical awareness. The technologies that had been born of science had not always been 'delivered' ethically. The association of ethics and scientific knowledge would give fresh legitimacy to scientific discoveries and the resulting technology.

It was stressed out that the proposals made during this discussion went beyond a COMEST contribution to the Budapest Conference. They represented lines of action which could be developed by COMEST under its terms of reference.

VII. Ethics and the Information Society

This sitting was Chaired by Mrs Suzanne Mubarak, member of COMEST, Chairperson of the Egyptian Society for Childhood and Development.

In her introduction to the debate, Mrs Mubarak emphasized that information technology, which constituted a genuine modern revolution, raised problems for governments, society and individuals. States must take advantage of the new technology to expand and enrich their communication systems whilst side-stepping potential dangers. They would also have to find a way of making information accessible to the greatest number in order to reduce economic and intellectual inequality. The transnational nature of new technology meant that States must pay heed to ethical and social aspects both nationally and internationally. Every State must determine a specific policy providing all citizens with access to information and guard against the risks inherent in using the new methods of communication without limits or policing. She was anxious about the trend of this technology in a world where inequalities were so pronounced and where a number of 'Have' countries dominated the rest of the world. Whilst the younger generations must have the greatest possible access to different cultures and be aware of ways of living that differed from their own, the specific culture of each country must be preserved. An ethical code for the new communication technology demanded a multidisciplinary approach on which scientists, economists, jurists and policy-makers must collaborate.

Mr Suman Naresh, Professor of Law at Tulane Law School (New Orleans, United States of America), was invited to make a statement.

Before getting down to his subject, Mr Naresh indicated his four main themes: definition of the information society, the relevance of ethics, the role of ethics in contemporary society, the risks of ignoring ethics.

(i) Definition of the information society

Many authors and intellectuals had endeavoured to define the information society without success. It was, in fact, impossible to lay down definitive limits for a process which was still actively evolving. The information society was the society that was now being born. One of its features was the massive use of electronic means to store, circulate and analyse information. Humankind would undoubtedly end up using electronics in every sphere of life, particularly education, analysis, creation, trade and human relations. The ramifications of this radically new way of life would be numerous and important. The opportunities for social and human fulfilment, for example, would be greatly increased. However, these advantages were not without drawbacks. The cost of social exclusion would be much more significant than at present. Those who could not be part of the information society for political, economic or

social reasons would be deprived not of a few, but of a whole closely interlinked host, of opportunities. Without these means, individuals would be unable to achieve fulfilment. Accordingly, whilst trying to develop electronic means to the maximum, an effort must be made to give the greatest possible number of people access to them.

(ii) Relevance of ethics to information

In the traditional sense, ethics was a tool enabling the behaviour of individuals to be assessed and good to be distinguished from evil. It might be difficult offhand to see the relationship between ethics and the social phenomenon of information technology. The former concerned what should be, while the latter concerned what already was. Yet it was in this antithesis that the link between ethics and the information society lay. That society, being still evolving, followed no law. Ethics, which was the basic law of humankind, was the ideal tool for fashioning a new set of rules, whether social or political. Ethics would furnish the principles that must guide decision-making by politicians, business and local, national and international bodies. As the information society was built up, ethics would remind humankind that the purpose of new technology was human fulfilment.

The place accorded to ethics by contemporary society was unfortunately not very large. Decisions of an ethical nature were certainly taken every day either by legislators or by international bodies, such as the Council for the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs Council), the World Intellectual Property Organization (WIPO), the International Chamber of Commerce and the United Nations Commission on International Trade Law (UNCITL). At the national level, the courts could be asked to consider questions raising ethical principles such as the cases of Microsoft or the telecommunication companies.

It was noteworthy that only one voice made itself heard: that of private groups wishing to defend their economic interests and strengthen their power. The rules did not take systematic account of the public interest which, in its broad sense, included access and information providers as well as users. The latter studied and analysed information and interpreted it with a view to carrying out new types of research, improving products and creating new patterns of trade.

The concept of user naturally included the developing countries in the same way as industrialized countries. At the moment there was no national or international forum where those users could voice their opinions. Legislation over the last 15 years concerning the information society showed significant inequalities at the expense of users.

(iii) The ethical stakes

Some would say that such inequalities were normal and that action by pressure groups always caused private interests to prevail. This was one of the consequences of the market society, whose purpose was to share resources among the largest users, thereby accentuating inequalities between societies and between individuals. Thus, despite its admitted effectiveness, the market principle was not necessarily the best. Access to information must to some extent be regulated in order to make chances more even.

The information circulating on the Internet was abundant and available to all users. This situation revealed an economic problem as against a distribution problem. The development of information provision must be encouraged. To this end it would be sensible to be able to give information providers the certainty that their activities could yield them satisfactory conditions of existence by attaching a commercial value to that information.

Regarding intellectual property, legislation had always sought to strike a balance between the needs of users and those of information providers. Whilst incentives should be offered for creation, they should not be excessive. Likewise the emergence of monopolies must be prevented. The balance between access and incentive which had been sought by international legislators for nearly 150 years had become more difficult to attain as a result of the rise of the information society.

The current debate allowed only one of the parties concerned to express its view, whether in the legislative, judicial or economic field.

This was why the intellectual property right was now so important. Formerly limited to certain very specific fields, it was now claimed by all, particularly the authors of data bases. An international treaty on this subject was currently under negotiation. At the same time, specific legislation on the matter was being drawn up in the United States of America and the European Union. Not only did intellectual property extend to an increasingly large number of fields but it also encompassed concepts of every greater scope.

Unless arrangements allowing the most disadvantaged to make their voices heard were established, the aforementioned tendencies would be perpetuated. Scientists, who were among the most important information creators, would be particularly affected by what was currently happening and what was in danger of happening. The involvement of UNESCO in the field of ethics, science, culture, education and communication made it an ideal medium for the most deprived to have their say.

Debate

The discussion that followed this introduction revolved round four major questions.

(i) Need to define the ethics of the information society

A member of COMEST compared the three subjects addressed by COMEST during this session, namely water, energy and the information society. She pointed to the paradox whereby the ethical questions raised by these subjects were simultaneously different and similar. The common denominator of these three subjects was the problem raised by access to resources, with as its corollary the need to share those resources equitably. The point where they diverged concerned the nature of the resources. The questions of water and energy were homogeneous; they concerned science and the implementation of the technology resulting from it. Information, on the other hand, was a heterogeneous field in that it could be economic, social, private etc. It was extremely difficult to know what purposes it would be used for. Contemporary society did not act ethically for this implied that it reflected, that it took the time to study the possible consequences of its acts. Ease of access to information was liable to exaggerate that tendency. Individuals would be so busy finding information that they would cease to think about its utility. Regardless of the quantity of information one possessed, it was never possible to choose in a 'full' knowledge of the facts. However comprehensive, legislation would never be able to change mentalities. The decision, a moral one, must come from humankind. It was a question of individual responsibility.

The problem was the following: how could the distance and duration needed for reflection be incorporated in a situation in which the trend of technology was to compress space and annihilate time?

A participant requested that, for symbolic purposes, the term 'information and communication society' be used in order to remind people that interaction occurred between the parties and that intersubjectivity existed. How could the communication of knowledge be made to enrich the party which originated it? Teachers were well acquainted with this phenomenon. By expressing themselves, by sharing their knowledge, they got something back and witnessed a ripening of their thought.

(ii) Intellectual property rights

A COMEST member indicated that it was difficult to visualize information being accessible to all owing to the importance of intellectual property rights belonging to parties in the private sector. In the few cases where scientific knowledge constituted a national or international good, the bodies responsible for it often ended up selling the property rights to the highest bidder. This kind of selection based exclusively on economic criteria was contrary to the policy of opening up access to information. Thought should thus be given to the responsibilities of fund providers. If the monopoly of scientific research were left to business, scientific knowledge would serve not humankind but commercial companies. In a reference to the question of data bases, it was stated that once upon a time the only means of protecting them had been to apply for copyright. However, as data bases did not constitute original works, their originators had been unable to obtain such rights. To ensure their survival, they had therefore had to obtain new legal protection measures, which represented a good example of the adaptation of legislative structures to the commercial context of information.

An *ex officio* member of COMEST reaffirmed that the circulation of information was essential for the strengthening of democracy. Governments had taken decisions without the public being properly informed, for example in water engineering when the authorities had decided to build dams or dykes without consulting or informing the public, even though such projects had a considerable impact on citizens' daily lives. The public must be able to inform itself about current decisions, projects under study etc. COMEST could examine such situations and derive ethical principles from them for circulation to policy-makers.

(iii) Need for a change in approach to the information society

A COMEST member said that although legislation played a very important part in society reliance should not always be placed on public authorities. A critical spirit must be cultivated. Languages must be taught so that young people could be made aware of other cultures. The pre-eminence of English had already been discussed on many occasions and needed no further mention. However, it was important to remember that the information circulated over the Internet came in symbolic form. Human communication was not confined to that particular mode. Furthermore, machine translation, which was increasingly used, conveyed only a tiny part of language content. This triple simplification of the thought process was a great impediment to any critical approach.

Since the market was effectively blind to inequalities, UNESCO and other international bodies must try to compensate for its shortcomings. UNESCO's task must be to take action in its own special field, namely the protection of knowledge and its unimpeded distribution. It was now clear that cyberspace must be public in nature. Those who visited that terrain would be new citizens, 'cybercitizens', whose rights and duties had still to be defined. The information society linked all countries and would thus form the basis for a new type of education. UNESCO must keep abreast of the latest trends in order to continue promoting education and culture.

The development of the Internet must be policed since, far from being a neutral tool, it reflected all society's inequalities. For example, women currently accounted for only 25 to 30% of the users of the network. These users were also concentrated in the industrialized countries at the moment. The Internet was still a mystery to the inhabitants of the southern hemisphere and to women, the traditional victims of exclusion.

Referring to the activities of the Intergovernmental Programme for the Development of Communication (IPDC), a speaker mentioned various initiatives designed to make the implications of the development of the information and communication society better known. He pointed out that, while the market was effectively blind to inequalities, the countries of the North were insensitive to the complaints made by those of the South. They had neither supplied the resources necessary for the South's development nor understood the latter's needs. How could the quality of information be discussed when people had no access to it and when the technical means were lacking?

(iv) Legal aspect and the protection of individuals

On the subject of intellectual property, a COMEST member raised the question of national data bases, for example those concerning biodiversity. Would they be subject to the same types of intellectual-property rules as the others, despite not being the outcome of individual research or research by a particular enterprise? The bases concerned were, in fact, important ones assembling the investigative results of a large number of individuals. The way they were treated varied with national legislation. In the majority of cases, public data bases were not subject to the law on intellectual property. However, as soon as the information was reorganized (by a company or other external structure) and suitably classified it might become the subject of an application for intellectual-property rights. The countries concerned had to solve this question by mutual negotiation.

Another COMEST member raised the matter of the educational aids made available on the Internet. Up to now, to prevent false information from reaching the public, scientists had used a system of third-party verification. However, the ideas expressed on the Internet were not subject to selection, so there could be radically different texts concerning the same subject. Of course, this type of problem also occurred in the written press. However, journalists had a responsibility towards their publishers; the creators of WEB pages circulated over the Internet were as yet responsible to no one.

Replying to this question whose relevance he acknowledged, Mr Naresh said that the traditional filters protecting the public from erroneous information did not exist in the Internet universe. Efficient filters must therefore be created but without falling into censorship. Up to now, the quality of information had proved less of a problem than its nature (pornographic, political etc). When the United States of America had passed legislation to control the type of information published on the Internet, the Supreme Court had immediately rejected it as being contrary to the Constitution. International consultation and co-ordination, although extremely difficult, now seemed to be indispensable.

The Director-General of UNESCO said that Article 19 of the Universal Declaration of Human Rights concerned freedom of expression. With respect to Article 1 of the UNESCO Constitution, he said that the free movement of ideas must be ensured. One of the tasks of COMEST could be to study other major documents dealing with freedom of expression and its limits. He mentioned the International Declaration on Childhood, which defined a number of key principles concerning information aimed at children and hoped that those principles would be universally applied. It was intolerable, for example, that electronic games should encourage children to persecute specific enemies. He also mentioned the problem of use for immoral purposes, especially when it involved children. At the moment, over 500,000 photographs were being circulated over the Internet, some of which showed scenes of torture practised on children 2 or 3 years old. Here there could be no question of demanding freedom of expression. UNESCO had alerted Interpol and commissioned special lawyers to look into the phenomenon. In addition, UNESCO had already concluded an agreement with the University of Gothenburg (Sweden), which was the home of the International Observatory for Violence on Television, the Screen and the Internet. Every year that body made a list of the pictures and information which the international community must endeavour to control, especially in order to protect minors.

It was vital to identify the fields in which limits must be imposed on the freedom to circulate information, and possibly to visualize the drawing up of a declaration on ethics and the information society. Such a declaration could emphasise the importance of ethical criteria in taking public and private decisions. However, while allowance must be made for the economic interests of owners and providers of access and information, the educational and cultural needs of all users must never be forgotten.

The Chairperson of the COMEST stressed, on her part, that all individuals must have access to information. The staggering progress of technology and communication had overturned the former barriers of space and time. This technology was now part and parcel of the life of the developed countries and produced new products, services and occupations every day. The advance of science was speeding up and the changes were only just beginning. Society must now prepare and adapt.

VIII. Future Programme of the COMEST

On the subject of its future programme, COMEST decided to examine the constantly evolving topic of the ethics of energy in greater depth and to complete its discussions on the ethics of the use of fresh-water resources. The Chairperson of the COMEST introduced Professor Alain Pompidou, Professor at the René Descartes University (Paris, France), who had been asked by the Director-General of UNESCO to co-ordinate the working group which would be preparing a report on the ethics of outer space. She reported that this activity was being undertaken in collaboration with the European Space Agency (ESA).

Outer space represented a fresh challenge to man whereby he must define his place in the universe. The question was both philosophical and scientific: humanity wanted to conquer, understand and explain space. First it must sound its own depths, and then scientists must try to obtain a better understanding of public opinion in all its cultural expressions. One question to be explored concerned the impact of the miscellaneous debris circulating in Outer space on the environment and public perception. Both a scientific and a cultural approach must therefore be brought to bear on this question.

Professor Pompidou said in his survey that the group had been set up on a multidisciplinary basis and would work in close co-operation with existing international bodies such as the Committee on Space Research (COSPAR) created on the initiative of the International Science Council (ISC), UNISPACE and the United Nations Committee on the Peaceful Use of Outer Space, better known as COPUOS.

He said that the project owed its existence to the Director-General of UNESCO, who had realized that the consequences of the space race required the ethics of the subject to be discussed in an international context, especially as outer space had been recognized as being a common heritage of humanity. Once a mythical immensity, space was now a reality. Icarus had burnt his wings in attempting to approach the sun. Since then, advances in astronomy, astrophysics, ballistic and propulsion technologies and information software had allowed human beings to launch themselves into the skies, walk on the moon, explore the universe and invade nearer interplanetary space by means of orbital stations and satellites. The last-named were instruments for communication and earth observation and for the location of earth-based moving objects (GPS in the United States of America, GLONASS in the Russian Federation and soon Galileo in Europe).

Describing the work already done by the working group on the ethics of outer space, the co-ordinator said that at its first meeting on 28 January last the working group had defined four study themes.

(i) Manned flights

What interest was served by humanity's entry into space? What progress could be expected from experiments performed under conditions of weightlessness? More than anybody else, astronauts had to systematize and share their knowledge, otherwise they would be relegated to the status of robots acting simply as vehicles for technical feats.

(ii) Use of space technology

It was not sufficient to expand human knowledge by exploring the universe and other planets; it was also necessary to initiate strategies for utilitarian purposes, for example the improvement of human communications by employing increasingly effective satellites. With these it would be possible to observe the earth for weather purposes, sound the oceans, whose level might show signs of the greenhouse effect, and prevent and control natural disasters.

Regarding funding, apart from the dilemma posed by the cost/benefit ratio the aim was to define viable means of funding and apportion them as appropriate. The ethical concern here related to the ownership of information. At the moment, the only patents on the equipment used in satellites were American. Not only must ownership of the information passing through satellites before being received on earth be protected but also access to that information must be guaranteed for all.

(iii) Protection of the earth's environment

The earth's space environment must be protected in the interests of the long-term development of space technology. Currently over 10,000 objects exceeding 10cm in size were in low orbit while thousands of objects exceeding 1m in size were in geostationary orbit (36,000 km from earth). More than 35 million objects less than 1cm in size were also revolving around the earth. This abundance of objects was moving at an immense speed ranging between 10,000 and 30,000 km per hour. They could obviously collide.

How could such space pollution be limited? How could the future of the nuclear mini-reactors installed on satellites and space probes be managed? The cost of limiting space debris would have to be borne by all in order to avoid the risks of distortion and competition inherent in the market. An international legal framework was clearly needed. At the same time, the safe return of the Mir orbiting station and the consequences of all or part of it falling to earth should be provided for.

(iv) Protection of individual freedoms and respect for cultural identity

The ethical aspects of electronic surveillance, satellite communication and satellite positioning systems must be considered. It should be borne in mind that such systems enabled all moving objects (cars, ships, aircraft) to be located.

In conclusion, Professor Pompidou said that access to space made possible the exploration of the universe, the exploitation of outer space, communication and earth observation. Above all, it greatly increased human means of action and observation. The working group recognized the sometimes dual, i.e. civil and military, nature of space technology. It decided not to deal with purely military questions, though not to exclude certain matters relating to them.

Space technology, which was both promising and disturbing, had considerable capital locked up in it and embodied a power struggle between the nations involved in space conquest. Adoption of an ethical standpoint enabled a purely emotional context to become a context of objectivity and transparency. It integrated human activity into an approach based on moral reasoning and kept the human being at the heart of the debate. The ethics of science and technology concerned simultaneously the morality of action, the weighing of risk and recognition of the Other.

The group would accordingly ask itself three questions: What are the motivations for the project? What is required by public opinion and the

Universal Declaration of Human Rights? How can equal access to the use of products resulting from space technology be ensured or restored?

Professor Pompidou said that it was COMEST's duty to respond to the anxieties felt by the public by means of an objective, independent and transparent analysis in often emotional circumstances which were sometimes inflamed by the media. The challenge was to steer clear of an over-utilitarian view which would destroy humanity's ability to dream, which in many cases was the driving force behind its inventions.

The working group would analyse the economic and social consequences of the progress springing from space technology. Its main concerns would be to protect the planetary environment; provide protection for intellectual property relating to scientific instruments and commercial products; and safeguard individual freedoms and the cultural identity of users. In the light of the outcome of that work the group would consider proposing that COMEST draw up guiding principles concerning the ethics of development and the use of space technology.

Debate

During the brief ensuing discussion a participant recalled that the International Space Conference Unispace III would be held on 19 July 1999, thus representing a follow-up to the Unispace II Conference of 1982. That event would be an opportunity for UNESCO to provide information on the working group's latest discussions.

A participant pointed out that many of the points made by Mr Pompidou were already covered by the United Nations space agenda. Why this duplication of effort? Did UNESCO really have to deal with these matters? Mr Pompidou explained that the United Nations Committee drew up standards and rules aimed at ensuring that launchers and satellites did not generate excessive quantities of debris, while the particular brief of the working group on the ethics of outer space concerned the human values underlying those standards such as transparency, communication etc.

Another participant said that one of the biggest problems was that of space debris and this made transparency important. A second ethical question concerned access to space technology by all countries. Remote sensing, a technique which was vital for agriculture and energy, was not available to all countries because of its extremely high cost. Mr Pompidou explained that remote sensing was still a highly expensive technology and

that instantaneous positioning was more accessible and would become increasingly cheap.

A speaker recalled that 1999 had been declared the Year of the Older Person by the United Nations. COMEST could usefully bear older persons in mind in its discussions. The speaker referred to countries which had initiated a policy giving its citizens, and particularly older persons, access to the Internet. The importance of this category of society had been recognized and it would be a pity if it were to be cut off from a world in which technology was evolving ever more rapidly.

IX. Closure

Four well-known persons spoke during the final sitting of this first session of the World Commission on the Ethics of Scientific Knowledge and Technology.

In her address, H. E. Mrs Anne Enger Lahnstein, Minister of Culture of Norway, stressed the role played by science and technology in all spheres of life, thus justifying the anxieties of certain people about the way things were going. The novel and difficult questions that had still to be resolved required that the ethical dimension of science be kept in mind. However, it was not enough just to realise this; genuine changes must be encouraged, as had been done by UNESCO in setting up COMEST, which would undoubtedly succeed in advising science on the right way to proceed. Referring to the experience of previous international commissions such as the Brundtland Commission, she said that it was important to circulate the conclusions of the present meeting. The subjects discussed during both the plenary and round-table meetings, which had covered the ethics of fresh water and energy, the rights and freedoms of scientists and the ethics of the information society, were of crucial importance to the development of States and the international community. Those attending the current session must therefore promote a debate on these questions in their respective countries and draw the attention of decision-makers to the ethical challenges posed by scientific knowledge and by technology.

She referred to the COMEST emblem, an eye with the pupil represented by the terrestrial globe, reflecting UNESCO's desire to keep watch over the scientific world so that it could fulfil itself. As this first session came to an end, Mrs Anne Enger Lahnstein hailed COMEST as a very special international forum for dialogue on ethical questions.

Mr Thomas R. Odhiambo, a member of COMEST, said that the establishment of this body showed that the international community was determined to plan for a world composed of justice, co-operation, equity and mutual trust. He mentioned the Ancient Greeks and their definition of the four elements governing the world: air, which was shared by all countries and must be protected; fire, or in other words energy; water, the basis for all forms of life; earth, the home of humanity.

Pointing to the importance of water, he wondered about the main ethical questions arising in this field. What could existing society do to ensure that future generations had plenty of good-quality fresh water? Should Article 21 of the International Declaration on the Environment, which gave sovereign States the right to utilize water as they saw fit, be observed? How could water pricing be decided in a future water market? Given the unequal distribution of the fresh-water resource, how could one be sure that all populations had access to clean water?

He said that these were serious questions which, if unanswered, could lead to conflict in the future. In making the equitable sharing of water a human right and an international obligation, society would have succeeded in solving a whole number of extremely complex ethical questions.

He said that human beings, being selfish animals, had instituted a market policy in their own image aimed primarily at their own interests. But they were also animated by a desire for morality, ethics and fraternity. Faith, hope, justice, equity and human trust were to be seen in every human action.

Mr Odhiambo quoted Francis Fukuyama who, in his work entitled 'Trust', had said: 'The most accomplished communities are those whose members share the same moral values. They need no documents, no rules. Living together is sufficient for them to create mutual trust'. This type of community could only be created over time since it sprang from habit. Mr Odhiambo proposed that participants take up this long-term challenge to lay the foundations of common justice, trust and equity and learn to live together.

The Director-General of UNESCO thanked the Norwegian Government for its generosity in inviting COMEST to hold its first session in Oslo. He said he was joined in his thanks by the Chairperson of the COMEST who had been the mainstay of this meeting, the members of COMEST, the participants and the Norwegian National Commission for UNESCO, which had had overall responsibility for organizing the meeting and was chiefly responsible for its success. He also expressed his appreciation for the generosity of *Norsk Hydro ASA* for its help in arranging this event.

In his address the Director-General emphasized the pressing need for an ethical code for water, energy and outer space. These codes would shortly be joined by a code for the environment. He had confidence in COMEST's ability to deal with these questions by reason of its multidisciplinary nature, which enabled it to conduct an ethical debate combining the scientific aspect with ethics and a respect for diversity. He said that the past offered valuable lessons for making a fresh start and for selecting new partners with whom to trace the shape of things to come. He stressed that COMEST had an important educational role in circulating information.

In conclusion, he paid tribute to the wisdom of Mrs Vigdís Finnbogadóttir, who in her opening speech had stressed the balance that must be maintained in action between the achievable and the acceptable with regard to the applications of science. He called attention to the importance of the prevention and anticipation principles which must be applied by policy-makers if the fruits of knowledge were to be used for the good of humanity.

The Chairperson, Mrs Vigdís Finnbogadóttir, thanked the Director-General for his message of hope and for his support for the undoubtedly difficult tasks which COMEST would have to discharge under its remit.

In her closing address she referred to a gem of Nordic literature written 1200 years before and entitled 'The Sibyl's prophecy'. She would like humanity to share the optimism of that work as a result of COMEST's action. Quoting the philosopher Hans Jonas who had said: 'Responsibility springs from a concern, which becomes a duty, to be other than ourselves', she stressed the responsibilities of men and women in dealing with the advances of science and technology.

Transparency was necessary in the practice of science and one of COMEST's roles was to anticipate its possible consequences. All new discoveries demanded complex and difficult thought. They opened the way to new opportunities, new freedoms and thus new responsibilities. The inexorable advance of science raised fundamental social and ethical questions. Fired by their recently acquired knowledge, human beings could make different choices but must respect the moral principles imposed on them by individual and collective ethics.

Mrs Vigdís Finnbogadóttir then spoke about the necessary to democratize access to knowledge and to enable scientific discoveries to be brought to the knowledge of the greatest number. Science was not fully exploited at the moment. While States had signed major strategic agreements to defend their frontiers, they had made no provision to

alleviate the sufferings of humanity or to resolve the problem of the environment. They did not consider it worthwhile to defend water, earth and air even though these elements were threatened with irreparable damage. Because of irreversibility, national and international bodies must face up to their responsibilities: when there was a serious risk of destruction, demanding a new report or carrying out a further survey was an unaffordable luxury. It was necessary to act. For such action to be effective and fully adapted to the situation, scientists, decision-makers and representatives of the general public must be able to enter into open dialogue and work together on the basis of a long-term vision.

Concerning this point, Mrs Finnbogadóttir stressed the importance of ethics. The technology resulting from science was no longer limited to the industrial or commercial domains. Technology was now part of the daily life of every individual. The danger was clear: whilst opening new doors, technology engendered risks and made human beings anxious. It also formed a useful risk-management tool through the vigilant application of the principles of precaution and transparency, whilst promoting solidarity between different cultural and geographical areas with the aim of sustainable development.

The Chairperson of the Commission said that in the course of its action COMEST would pay special heed to respect for natural resources and for different cultures and to the development of a collective awareness of responsibility given the irreversible consequences of using certain technologies. Because of its multidisciplinary composition, which was representative of the different regions, COMEST would be in a position to make its voice heard on the international scene and thus to make decision-makers, scientists and the general public aware of the ethics of scientific knowledge and of technology. Expressing her satisfaction at the variety of subjects discussed at this session and at the open-mindedness of the debates, Mrs Vigdís Finnbogadóttir said she was confident of COMEST's ability to ensure that citizens ceased to be locked into the role of ignorant consumers but were able to share actively in scientific and technological decisions, thus realising the ideals of democracy.

IX. Conclusion

This first session of COMEST demonstrated the power to influence nature conferred on humanity by the development of science and technology, in contrast with science's longstanding function of pursuing knowledge rather than of being a foundation for action. Now that it has become a vehicle for action, science is prompting new questions and

awakening fresh anxieties. Until recently it was developing without checks or safeguards because of the well-being it was assumed to provide. Today, however, scientists are called upon to be vigilant regarding the uses to which their researches are put. For the democratic management of society it has therefore become vital to assess the worth of technology. A number of conclusions can already be drawn from COMEST's discussions.

Firstly, it is felt to be necessary to create a parliamentary office for the evaluation of scientific and technological choices in those countries that do not yet possess one. Such offices, whose purpose is to guide Parliaments in their decisions, also constitute forums for discussion and dialogue between the scientific community and political circles regarding the interests and needs voiced by the nation.

Secondly, COMEST will set up three sub-commissions dealing respectively with energy, fresh-water resources and the information society. The first two sub-commissions, Chaired by members of COMEST who will rely on inventories drawn up by the corresponding working groups, will have as their goal the formulation of ethical principles as a guide for both public and private decision-makers. The information society sub-commission will have to determine its own remit, which should cover in particular the transformations currently at work in our image- and information-based societies, with a view to arriving at guiding principles. It will be necessary to ensure that all Commission members are regularly briefed about the proceedings of the sub-commissions.

Thirdly, in order to take account of the ethical dimension of decisions concerning energy and fresh-water resources, COMEST will examine the possibility of proposing an 'ethical audit' along the lines of the environmental audits carried out in certain countries. In accordance with its brief, the World Commission will be able to define what is meant by 'good practice' in the fields it has studied. It will, of course, be for the Commission to choose the principles and define the criteria to be used in such ethical audits.

Fourthly, COMEST intends to study the possibility of establishing an office of mediator or ombudsman whose role would be to resolve conflicts of interest regarding technological choices.

Finally, as regards procedure, COMEST considered that one meeting every two years would not be sufficient for it to fulfil its remit satisfactorily. It would like to meet every year, at least in restricted session.

Chapter 2

REPORTS OF THE ROUND TABLES

1. **'Ethics and Energy'**

2. **'Ethics and Fresh-water Resources'**

3. **'Protection of the Rights and Freedoms of Scientists'**

Round Table on 'Ethics and Energy'

(29 April 1999)

Led by

Mr Nicholas Ashford (United States of America),
Professor of Technology and Policy,
Massachusetts Institute of Technology

With

Mr Garigen Aslanian (Russian Federation),
Director of the Centre For Energy Policy, Moscow

Mr Jean Audouze (France), Professor of Astrophysics,
Director of the *Palais de la découverte*, Paris

Mr Inge J T Johansen (Norway), Chairperson of
the Norwegian Committee of Ethics in Science and Technology

Mr Yonglong Lu (China), Research Professor,
Research Centre of Eco-Environmental Sciences,
Chinese Academy of Sciences

Mr Claude Mandil (France),
Deputy Managing Director of *Gaz de France*

In his opening remarks Mr Nicholas Ashford stressed the importance of energy, which fulfilled an essential role in meeting human needs, namely heating and cooling (necessary for well-being, for a suitable learning and working environment, for food preservation); the production of goods and services; transport and the solving of environmental problems. Given that the sustainable development of society required a concentration on questions of equity in access to energy sources and in their generation and allocation, the effects of extracting, generating and using those sources and of the resulting income posed questions of justice and equality. Equity had to be considered from the viewpoint of its impact on distribution between generations, between States, within States and between human needs and the environment.

Mr Ashford pointed to the scope of the ethical problems raised by decisions on energy matters, which required a greater democratization of decision-making, and stressed the changes demanded as a result of the pressure exerted on societies by the environment and the economy. The limits of growth were particularly important in regard to energy use. Improvement factors ranging from four to ten were necessary in respect of energy efficiency, energy demand (consumption), energy sources and supply. To reach these levels of improvement, a whole 'panoply' of means must be employed: emphasize education and public information, ensure payment of the right price (including social costs), draw up suitable regulations and focus scientific research on sustainable development.

These means had distributional and equity consequences. More specifically, countries of the North must assist those of the South by helping developing countries not only to reduce their energy dependency but also to improve their standard of living and aim for national self-reliance.

It had to be recognized that the market suffered from serious imperfections and was at a loss to deal with problems which spanned many generations, such as global warming.

He concluded by stressing the central role of governments and the advisability of concluding international agreements focusing both on energy as a technical problem and on the equity consequences of energy policies.

In his statement, Mr Garigen Aslanian dealt with the ethical aspects of energy in connection with what he recalled the strategy of least regret.

Energy today played a crucial role in society. It was an essential ingredient of social development and economic growth. It provided basic needs and services. Energy was a highly important factor of production in all sectors of industry. Energy needs depended mainly on three factors: population growth, economic development and technological progress. These needs had increased very much in line with the global speeding up of population growth and economic activity, thus giving energy great strategic value. Mr Aslanian referred to the likelihood of conflicts arising if concerted resource management were not introduced.

The existing energy situation was based on the widespread acceptance of several basic propositions.

(i) Resource availability and disparities in energy consumption

The resource scarcity perceived in the 1970s had not occurred as originally presumed. Recent data showed that the available geological energy resources over the next century could meet the growing energy demand with no slowdown in global economic development. However, the distribution of energy resources and access to them were unequal. Increasing dependence on imports and lengthened supply lines would create availability and price problems even within the next thirty years. Disparities in the availability of energy resources reflected the economic disparities between the different world regions.

(ii) Environmental dimension of energy use

All energy use affected the local, regional and world environment. He mentioned a number of negative effects stemming from the use of the various forms of energy. Concern about the harmful effects of energy production and consumption were nothing new. People were already complaining of air pollution from the burning of coal in the 13th century. However, air and water pollution only started to exceed the environment's assimilative capacity with the coming of the industrial age and the concentration of energy consumption in urban and industrial areas.

The type and extent of pollution were closely linked to the degree of economic development and industrialization. In the developing countries, environmental problems were related to indoor air pollution. High concentrations of particulate matter, sulphur dioxide and nitrogen oxides represented another problem. Over a billion people in the Third World were exposed to unacceptable levels of particulate matter and sulphur dioxide significantly exceeding World Health Organization guidelines. Other problems were connected with radioactive waste and clean drinking water. The anxiety aroused by these effects on the global environment could only get worse as the expected increase in energy production occurred.

(iii) Role of energy efficiency

Energy use by country and the effectiveness of such use were generally measured by an 'energy intensity' indicator corresponding to energy consumption per US dollar of GDP. Long-term analyses of the trend of energy intensity in a number of countries showed that this indicator grew during the initial development phase when a heavy and inefficient industrial infrastructure was being established, reached a peak and then steadily fell. Latecomers in the development process followed

the same pattern as the first arrivals but with less pronounced peaks: they had no need to reach high intensity levels in the first stage of their industrialization because they were able to take advantage of modern and much more efficient methods of energy supply. In other words, the coupling of energy and GDP growth, which were previously regarded as inseparable, was not a general feature of modern economies.

The question was raised whether, from an ethical viewpoint, it was acceptable to endorse the idea that it was both necessary and desirable for the world energy level to be aligned on that of the industrialized countries. One of the ways in which developing countries could get out of their plight might be to leapfrog the path followed by industrialized societies in their development process.

(iv) The ethics for satisfying energy needs

Mr Aslanian considered that meeting the increasing demand for energy over the coming decades would obviously require changes in attitudes, dimensions, systems and, not least, development planning. A code of energy ethics based on sustainability and least-regret principles would have to be drawn up. This implied priority for the needs of the developing countries. Relieving poverty in those countries and supplying them with the energy needed for their sustainable social and economic development represented a fresh challenge to the world community. The goal would never be attained if, under the new ethical code, the developed countries did not facilitate the transfer of technology to the developing countries and the mobilization of the necessary funds at local and world levels.

(v) Sustainable development

The need to reconcile, via the concept of sustainable development, the vital needs of economic growth and the equally legitimate concern to protect the planet and its inhabitants was no longer questioned. Ethical norms must require environmental protection and economic development to go hand in hand and to cease to be regarded as mutually antagonistic. In this matter too, the energy community was at a turning point, and ecological and environmental-protection groups would have to adapt as well. The possibility of reducing energy demand lay mainly between the demand for primary resources and the end users. Future energy services must be cleaner, more efficient and more transparent. Furthermore, it was fundamental for demand that the price of energy should reflect its real cost, including a certain environmental cost, such that consumers would

be aware of the general consequences of their acts and preferences, that resource use was optimized in terms of investment in energy supply and efficiency and that investment funds could be mobilized worldwide. It was therefore desirable to establish an institutional framework in every country that would encourage the free movement of funds at world level. The prevailing view was that the sums needed to try to meet the energy needs of developing and transitional economies on a sustained basis were not excessive in absolute terms given the capacity of world markets, provided those sums were spread over a period of time.

(vi) Environmental actions and a 'least regret' strategy for climate change

Efforts would have to be made to reduce local and regional pollution by adopting ever cleaner technology and discouraging the most polluting and least cost-effective energy uses. Overcoming these local and regional problems was more important for most people than possible climatic effects. However, in view of the continuing uncertainty about climate change, its potential risks should not be underestimated. There were no 'miracle solutions' to world environmental problems. A 'least-regret strategy' for climate change, combining preventive measures and more extensive research, should be adopted as a key element in a new code of ethics.

(vii) Sustainable development and transfer of technology

Technological progress was one of the foundations of an enduring future and should be encouraged and strengthened rather than shelved because of current economic problems. This implied a strategic view of research and development activities and not just a tactical approach based on cost reduction and the prospect of abundant short-term reserves. There too the priority was to improve energy efficiency, environmentally friendly technologies and renewable and nuclear energy. There was no reason to abandon nuclear energy provided people's concerns about plant safety and waste disposal could be fully and openly allayed. The necessary funds must be raised in order to improve the supply of goods and services so that the necessary improvements in the power stations in the countries concerned could be identified and implemented and provision made for alternative energy sources where these were required.

(viii) Different priorities for different economies

Mr Aslanian concluded his statement by stressing that a code of ethics embracing world society should include different priorities regarding energy matters for developing, transitional and developed economies. The challenge for world institutions was to go beyond these different priorities and secure general progress on all fronts, preventing such progress from being impeded by sectoral interests and establishing machinery to facilitate dialogue between industrialized and developing countries. He hoped that COMEST would draw up guidelines for a code of energy ethics and circulate it to policy-makers.

Mr Jean Audouze said that energy ethics also concerned the extraction, processing and use of energy by individuals and groups. He mentioned three types of energy: fossil fuels (coal, natural gas, oil), nuclear energy and renewable energy (wood, biomass, water, solar energy etc.) plus geothermal energy. Particular attention must be devoted to electricity, which was the most convenient form of secondary energy. He described the respective advantages and disadvantages of these energy sources. Fossil fuels were particularly easy to use and thus relatively cheap. However, they increased the carbon content of the atmosphere and would start to run out in the fairly near future. The nuclear option did not increase carbon levels in the atmosphere and had a very low cost per unit of energy but required a large financial outlay. In addition, there were doubts about its acceptability to the public and there was as yet no satisfactory way of managing the long-lived waste produced. Renewable energy did not further increase the carbon level of the atmosphere but was not always environmentally friendly.

He made particular mention of demographic factors, particularly the rapid increase in the populations of the developing countries, which were largely excluded at the moment from the energy-consuming communities and whose energy demands would therefore increase very rapidly. In addition, there was a trend towards urbanization, i.e. towards a relative increase in the number of people living in cities, where the high energy requirement compared with that of less demanding rural populations would continue to grow in the years to come.

Before any ethical recommendations were drawn up regarding the energy field, he considered that all the technical aspects should be weighed, for example the capacity of the different types of energy to adapt to an increased energy demand, the foreseeable improvement in energy yields and in the technologies specific to each domain etc. High priority

should also be given to the research effort and spirit, which meant that no solution could be automatically ruled out and that everything must be done to assess the risks of these activities as accurately as possible.

The ethical recommendations which would result from the foregoing and from the usual considerations in this type of analysis concerned the equity principle whereby every individual and every nation had a right to adequate sources of energy. They also concerned the precautionary (or anticipatory) principle - to be employed as appropriate and always in conjunction with the 'feedback' principle - which laid stress on surveillance of the various systems (e.g. technological, economic or ecological) affected by energy matters and on 'sustainable development' considerations according to which the planet's resources must be used for the benefit of present and future generations.

He accordingly stressed the importance of:

(i) regarding it as a priority to utilize available resources as economically and rationally as possible by making all parties, particularly industry, operating in the different energy sectors aware of their responsibilities;

(ii) emphasizing the prominent role of States in ensuring equity and justice and encouraging solidarity in those fields;

(iii) reminding all parties that it was necessary not only to avoid irreversible situations regarding the environment and energy management but also to encourage research on the matter and on methods of better anticipating and guarding against risks;

(iv) remembering that the unit price of energy must be the essential factor in choosing between different forms of energy;

(v) bearing in mind that, in this context, the preservation of cultural diversity remained an absolute obligation and that the citizens of the various States must receive adequate education and information.

Mr Inge J.T. Johansen talked about the ethics of energy. It was his belief that the extensive use of energy was the basis of the standard of living and well-being of the populations of the industrialized countries and that energy insufficiency was hampering the developing countries' progress towards a better life. He stressed, however, that data increasingly showed that the existing level of energy consumption could lead to climatic changes, with harmful consequences for the environment and future generations. It was therefore essential that politicians, industrialists, experts, the scientific community and the general public should realize the complexity of an apparently insoluble problem, namely

whether or not to reduce world energy consumption. He pointed to the close empirical link between economic growth and increased energy consumption, between electricity consumption and GNP.

He referred to the case of developing countries in which energy consumption per capita represented a very small fraction of that of the OECD countries. It should be clear to all that this energy shortage was impeding social and economic development. While labour costs were much lower than in western countries, electricity was more expensive. An increase of 10 to 20% in energy consumption was nonetheless being observed despite a chronic shortage. It was also clear that the current energy-consumption trend would have serious consequences for the world's climate and for future generations many members of which would still be alive in 50 years time. There was an ethical dilemma in trying to share out the burdens and advantages fairly between the rich and poor countries of today, and between the present and future generations. Who would take the initiative and guide the international community towards the best possible energy policy?

In the current situation it was necessary to turn to the scientists, who would have to take a greater interest in the problem as a whole than they did at present. Sound work was currently being done on the development of safe renewable energy without long-term climatic effects and with the aim of finding more effective uses of energy. Mr Johansen also mentioned the existence of world climate models which illustrated the various threats to humanity. Economic models likewise showed how free trade could be synonymous with a better use of available energy sources. These various aspects should be examined in greater detail and put into practice.

He referred to technologists who for some time had been developing water-heating systems based on solar energy in countries like Greece, where climatic conditions made solar energy an economic proposition. It would be interesting to know why such models were not applied in countries with similar conditions. Looking at the matter globally, he stressed that all the relevant fields of science and technology should combine their efforts and take integrated action, in contrast to the current trend for scientists and technologists to work in separate compartments.

An integrated approach possessed certain definite characteristics. It must be international for two reasons. Greenhouse gases knew no frontiers. Limiting the emissions of such gases was therefore an international responsibility. International free trade made such a joint approach even more necessary. There was reason to be pleased with the agreement reached on quotas at the Kyoto Conference even if it represented only a

modest start on international burden-sharing. Furthermore, the industrialized countries must give much more active help to the developing countries by supplying skills and resources so that those countries could install efficient energy systems suited to their needs, especially as the increase in greenhouse-gas emissions was expected to come mainly from the developing countries. He mentioned the case of his own country, Norway, in order to point out the responsibilities which, in his view, devolved on small States wielding considerable muscle in the field of energy and possessing a healthy economy and appropriate skills and technology in energy matters. It was necessary in such countries to reconcile the wishes of defenders of the environment and of future generations with the wishes of those who contended that the social and economic interests of the present generation had priority.

Mr Yonglong Lu gave a presentation on the ethics of energy as viewed by China. The ethics of energy must concern the whole energy cycle from extraction and distribution to consumption and waste disposal. Without this last aspect the energy cycle was incomplete and the problems of energy ethics could not be viewed as a whole. Gas emissions of energy origin into the atmosphere posed numerous ethical problems relating in particular to the environment and human health.

He developed three main arguments.

(i) Ethical problems of energy

There was an inequality in the spatial distribution of energy resources and per capita reserves and consumption in the world. China was one of the richest countries in the world in terms of energy reserves, ranking third in coal reserves, tenth in oil, sixth in natural gas and first in hydroelectricity. On a per capita basis, however, China was one of the poorest countries in both energy reserves and consumption. The geographical distribution of energy resources was also uneven in China. Interestingly, those regions with lower energy reserves were undergoing rapid economic development and consumed a larger share of energy production which they had to bring from other regions. Fossil fuel had taken a dominant part in China's energy production and consumption and had thus caused environmental pollution. China was the second largest producer of CO_2 and SO_2 emissions and the third largest as regards acid rain.

Conflicts of interest existed between the various stakeholders. In China, the State owned the energy resources but the developers were not only State-owned companies but also local companies or even private companies. This generated conflicts of interest regarding the sharing of profits and infrastructure, environmental management and field administration between the State and local authorities, between the different developers and between developers and local authorities.

Over-exploitation had speeded up the depletion and exhaustion of non-renewable energy resources. Inefficiency in extraction and consumption had caused great losses of energy resources. All this had compromised the ability of future generations to share the same or a better endowment of energy resources and had increased intergenerational inequity.

Referring to the scope of risks, Mr Lu stressed that this varied with the energy source. In the case of fossil fuels - coal, oil and gas - the most serious danger was connected with greenhouse-gas emissions and the pollution of air and water on which life systems depended. The predatory exploitation of non-renewable energy resources could lead to the exhaustion of natural resources to the detriment of the right of future generations to possess resources of the same quality. The use of modern means of transport to convey energy presented four major risks: an increase in greenhouse-gas emissions, leakages of liquid or gaseous materials, the spread of toxic pollutants and the risk of road accidents. Solid waste from power plants was a threat to soil quality and to the health of neighbouring populations. Hydroelectricity could cause accidents such as flooding due to the collapse of dams and electric discharges. Nuclear energy was usually safe if carefully maintained, but tragic accidents could occur if the problem of storing radioactive waste were not solved for the lengthy period of time concerned. An additional concern was nuclear proliferation since nuclear-energy production could generate raw materials for atomic bombs and represent a source for the proliferation of nuclear weapons.

(ii) Present initiatives for the ethics of energy

China was now on the right road as regards the rule of law. More than thirty laws and regulations had been implemented in order to rationalize energy extraction, distribution and use and covered marine and terrestrial energy extraction, energy transportation, energy saving, the comprehensive utilization of energy, pollution prevention, environmental impact assessment and environmental treatment.

A change from reliance on non-renewable fossil fuels to renewable oriented energy was taking place in Chinese energy consumption. Four types of measures were being taken to this end aimed at producing clean coal, restricting or prohibiting the use of high-sulphur-content coal, replacing coal by natural gas in the major cities, making more use of hydroelectric power, reducing the use of leaded petrol and, finally, using alternative energy resources such as biogas, wind and solar energy. He mentioned the action taken by the Chinese State Council, which in January 1997 had adopted a plan for the zoning of acid rain and SO_2

pollution control. The plan set both long-term and short-term objectives for air-pollution control and air-quality improvement in all regions and departments concerned. He referred to the importance attached to the prevention and treatment of SO_2 emissions from whatever source, to research on and development of new technology and equipment for the prevention and disposal of SO_2 emissions.

Mr Lu said that the Chinese authorities had played a key role in risk evaluation and management. It was the responsibility of government to ensure that risks were evaluated on an objective basis and to protect society against catastrophic hazards. Risk and safety management had been introduced step by step at all levels, the national, sectoral, industrial and local.

(iii) Perspectives

Regarding perspectives, Mr Lu stressed the importance of defining an ethics of energy involving active public participation. To this end, a knowledge of the ethics of energy extraction, distribution and use, such as equity, justice, efficiency, mutual benefit and conflict resolution, must be made available to the public through the mass media. Workshops, training programmes and demonstration projects should be set up for the public to be involved in enhancing the awareness of energy ethics. Government had a role to play in co-ordinating the interests of the different stakeholders in energy extraction, distribution and use. The stress should be placed on economic incentives for the extraction, distribution and use of energy and waste disposal. Great efforts should be made to evaluate energy resources, particularly non-renewable resources. Resource-accounting systems should be established. Likewise economic instruments such as pricing, tax and credit should be used to make adjustments in the structure of energy production and consumption.

The future utilization of fossil fuels in China would depend on environmental considerations and technological innovation. R&D programmes must be reoriented so as to focus on developing technologies that would eliminate any harmful impact.

In conclusion, Mr Lu said that rapid economic globalization would be accompanied by a trend towards the international distribution of energy resources. In this context, global thinking was necessary about the ethics of energy, and a general consensus or agreements should lead to action programmes carried out with the industrial sector, whose co-operation was vital for the development of ethical principles regarding energy.

The last speaker, Mr Claude Mandil, presented his statement as an appeal to philosophers which should be borne in mind by scientists and technicians in their activities. He mentioned three types of question.

The first concerned the concept of equity in the energy field in the light of different situations. He wondered whether happiness depended on energy-consumption levels and, accordingly, whether it was desirable to adopt the highest consumption level. He wondered what was meant by equitable burden-sharing in efforts to combat the greenhouse effect and considered that difficulties in the negotiations at the Kyoto and Buenos Aires Conferences had been due to the impossibility of reaching agreement on scientific responses to the questions posed by the development of the energy question.

He then wondered how the economic effect of a decision in terms of expenditure, revenue and value could be compared over time. If the capitalization rate were taken, there was no doubt that, if the period of time concerned did not exceed twenty to thirty years, the comparison could be carried out by one and the same person on his or her own behalf. But what did capitalization mean when dealing with events which would occur in five hundred years time? Or five hundred thousand years time? The answer was that it meant nothing at all and that economists were completely powerless with regard to problems such as nuclear waste and the greenhouse effect, for example, or the exhaustion of non-renewable resources.

He too stressed the importance of risk evaluation. If the economic response alone were considered, it was sufficient to multiply the cost of a given risk by its probability of occurrence. If the capitalization principle so dear to insurance companies were added, it was found to be difficult to allow for risks of extremely low probability and extremely high cost of occurrence. In other words, what meaning could be given to the product of zero by infinity? In such a case, which corresponded to a nuclear accident but also to the bursting of a major dam, the philosophers had given a reply which they called the precautionary principle. Mr Mandil viewed this principle with equal respect and wariness. He respected it for its actual nature, namely the necessity to allow for the most unfavourable hypothesis. He was wary of it because of the use to which it was often put and which sometimes led to nothing being done. He hoped that this necessary precautionary principle would be applied in a flexible, though doubtless less pure, manner which would nevertheless act as an incentive to the sort of action counselled by age-old wisdom, namely not putting all one's eggs in the same basket. He concluded by appealing for flexible positions to be adopted on energy policies leading to restraint in technological and scientific choices.

Debate

The brief ensuing debate revealed participants' interest in the application of the ethical principles described by the main speakers. The importance of energy in the ethical debate was emphasized, particularly with regard to application of the precautionary principle and the management of low-probability risks. One contributor said that any examination of energy policies must take place in four stages: analysis of, and research on, difficult choices; definition of the options for action; identification of the parties involved; choice of alternative solutions. He referred to the responsibility falling on both the public and private sectors in the implementation of any energy policy and even considered each party's individual responsibility, particularly regarding energy consumption.

The importance of the equity which had to be established between North and South countries was stressed. International co-operation must be developed so as to promote the transfer - which must be accompanied by an awareness of the duty to perform research - of the technologies needed for the sustainable development of the developing countries. The importance of developing education in ethics as a support for scientific education proper was highlighted.

Several contributors referred to the perverse effects of globalization and of the policies pursued by the markets, which hardly bothered about ethical principles. This made the countries of the South even more dependent on those of the North. This dependency could be partly alleviated by the development of research. A participant considered, however, that the decline in State monopolies currently taking place as the markets began to open up could act as a brake on research funding. Governments were now no longer able to devote large funds to R & D activities. The private sector was tending to become the chief provider of funds for such activities, although it would encourage only those that promised to be profitable. It was therefore a matter of urgency to involve the industrial sector in the ethical process. However, States would continue to be the chief operators in the energy field for some time to come and would therefore monitor energy use.

It was felt, in conclusion, that the ethical domain was not a fixed domain but one of constant tensions representing the basis for a process of long-term reflection on which it was COMEST's duty to embark.

Roundtable on
'Ethics and Freshwater Resources'

(29 April 1999)

Led by

Mr Ismail Serageldin (Egypt),
Chairperson of the Global Water Partnership
and Chairperson of the World Commission on Water for the 21st Century

With

Mr James C. I. Dooge (Ireland), Former Minister of Foreign Affairs,
Former President of the International Council for Science (ICSU)

Mr Liu Changming (China), Academician,
Institute of Geography of the Chinese Academy of Sciences

Mrs Monica Porto (Brazil), Hydraulic Engineering Department,
Polytechnic School, Sao Paulo

Mr Kuniyoshi Takeuchi (Japan), Member *ex officio* of the COMEST

Mr Martin Trolldalen (Norway), Professor,
Centre for Environmental Resources Management, University of Oslo

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In his introductory speech Mr Ismail Serageldin summarised the main issues to be discussed. The problem of dealing with water is one that is found at the global, national and regional level. It involves governments, the private sector and civil society including NGOs and community based organisations. We must find ways for all of those to work together.

The problems show an enormous variability in terms of quantity, in North America for example we are talking about 10,000 cubic meters per person per day and in Egypt that figure drops down to 1,100 cubic meters per person per year, in Jordan it is down to 260 cubic meters per person per year. There are also enormous changes within these national averages: in Bangladesh which often suffers from floods there is also a drought prone region where people suffer from water shortages.

In terms of quality, there is a strong health component. In terms of time and space can occur periods of droughts and floods in the same year and in the same place. This enormous variability adds to the issue of the vulnerability of the poor who depend on either rainfall for agriculture or who have precarious dwelling which is affected by floods.

The issue involves multiple claims between agriculture for food, industry, municipal water use for people, hydropower, navigation, etc. and how to arbitrate these various claims. Therefore, that requires values that help both bring the actors together and create means of arbitration.

There is a general agreement on values such as equity, fairness and compassion for the poor and the vulnerable and a certain responsibility for future generations in terms of protecting the environment on which they will depend when we are no longer on this planet.

Also involved are the ethical issues of distributive justice (one target figure could be 50 litres per day per person), of minimising waste, of mediating competing claims (might should not make right), of rights of the concerned people to participate in decision-making (especially women who tend to be those who suffer most from current inequities).

Finally Mr Serageldin pointed out that there have to be social constructs to provide a framework for incentives that will provide the reasons for the private sector to invest or behave in certain ways. The market being a tool and not just an end in itself, what sort of social constructs and incentives would be provided?

Mr Kuniyoshi Takeuchi described the criminal pollution of water experienced in many parts of Japan, in the 1960s, when the rivers where highly polluted and the groundwater level decreasing. The very dangerous disease called Minamata was caused by a fertiliser company releasing organic mercury into water courses. At that time the government could not prevent the company from releasing the pollutant into the rivers because there was no conclusive proof of its noxiousness; moreover, there was an aim of producing a fertiliser as cheap as possible.

Today, in Japan the situation is stabilised and rivers are clean. How was this made possible? The government dealt with this serious problem by establishing very high environment quality standards to control the quality of effluents discharged into the rivers. Thus, companies had to treat waste very carefully. Today, effluents are so clean that the water can be used again. Japan has one of the highest percentages (77%) of recycled industrial water in the world. This also resulted in stopping pumping of underground water.

However, when externalities are internalised, someone has to pay the shadow prices. Certain countries are at a stage of development with which they are not able to put the Japanese experience to use. Therefore, it is not quite sure that this success story may serve as a paradigm.

Mr Takeuchi underlined the need to examine different conditions region by region. He concluded his intervention by the following question: is it possible to establish a universal code of ethics in industry?

Mrs Monica Porto underlined the fact that several countries do not have enforced standards regarding water quality. There are standards related to organic pollution that are rather easy to enforce; they would at least control contaminated water and water infectious diseases.

As regards toxic chemicals, the problem is not so simple to deal with because there is an estimate of 100,000 different chemicals in our environment whereas we possess only 200 water quality criteria. We know about the behaviour and the consequences of just a few of those toxic chemicals (Minamata disease, for example, mentioned by Mr Takeuchi). This is an ethical issue related to health: today we do not have any other solution to safe drinking water except to protect the drinking water supplies from industrial pollution, otherwise we face a problem of drinking water standards.

On the other hand, we see the success of Japan in recycling water. Therefore, when we deal with ecology and ecosystems, we shall have to address the issue of reuse of water. The problem of the enforcement of drinking water standards is one of the issues that make us look into the need to increase recycling, to increase reuse.

Finally, Mrs Porto recalled that it is not possible yet to reuse water for drinking purposes because of the toxic chemicals, but that the technology is available for recycling water for industrial purposes.

Mr Martin Trolldalen addressed ethical matters related to water resources induced conflicts where environmental aspects are of crucial importance.

Four categories of actors are involved in mediating conflict of interest over deteriorating water quality and sharing of quantities: the individuals, the governments, the international organisations such as NGO's, multilateral banks and UN organisations, and the industry.

He focused on the ethical principles that governments should apply. Governments deal with international water resources both from a water quality and water quantity perspective in a different way. They apply

different principles for co-operation or conflicts and take into consideration the impact of water quality aspects on political stability.

Ethical matters are sensitive in the sense that if we apply a moral yardstick to governments on how to manage the various resources, we would be driving in the wrong direction. But if we start from the international agreements and especially the second generation of international environmental laws, three principles are crystallised.

The first principle relates especially to international water ways. It is the principle of social equity or 'social fairness', i.e. the grand-fathering principle which is included in international agreements.

The second principle which relates to pollution is the environmental protection that is also embedded in international protocols and conventions, the latest being the UN Convention on the non navigation use of international water courses.

Economic efficiency is the third principle which is often debated by the down stream countries. But it is not in itself a panacea for solving any kind of international water conflict.

It is the combination of these three principles and what kind of water resources we are dealing with that could be the proper way for conflict resolution.

Mr Changming Liu pointed out major ethical problems related to freshwater resources in China.

There is an uneven distribution of fresh water between the south eastern and the north western parts of the country in time and space. In the south eastern region of China there is a big pressure where 96% of the population is concentrated and allocation of water supply unequal.

In the future most of the population will live in urban areas, and use more and more water. That is why water management should be tackled in a productive and innovative way.

There is very low water use efficiency in agriculture. Water shortage places a major pressure on the environment. To renew the water system is the basis for sustainable development. Particularly in the North West part of China, poor people suffer from water scarcity.

In order to realise equal distribution of water and a better use of it for drinking and production, Mr Liu proposed a five R-solution: water recycling, water reuse, rainwater harvesting, recharge of groundwater and reallocation of water resources.

Mr James Dooge spoke about ethics of water-related disasters that are to be distinguished from hazards that are geophysical events: too much water in a place, too little water during a prolonged period in another place. We combine a hazard, a certain degree of vulnerability and we get the risk of disaster.

What is it that turns a hazard which is a natural phenomenon into a social disaster? He pointed out that, within a given locality, there is a wide variation in vulnerability to disasters which depends largely on social status.

In fact, most disasters are acts of men. They are due either to the positive action of groups or to their neglect or lack of foresight.

To tackle the question of water-related disasters, we have to consider the different phases of a disaster: anticipatory (folk memory), alarm, immediate impact and reconstruction and rehabilitation.

It is possible to mitigate disasters by reducing the vulnerability, thus to plan ahead of time. Firstly we need continuous monitoring of the hazard.

One of the tragedies of the moment in the developing world, many parts of which are extremely vulnerable to floods or droughts, is that the actual monitoring systems are declining disastrously. For example as regard the rainfall records in Africa there is a catastrophic decline because governments, under financial stress, reduce these items in their budget. It means that the debt crisis is having an indirect effect on the impact of disasters.

It is also necessary to prepare groups in the government service who are experts and will know from the monitoring when we need to enter the alarm phase. We need to train groups in all parts of the community on how they should react when the alarm is raised. In the immediate aftermath of a disaster such as a flood, people are dependant on themselves and do not receive help from outside. Therefore, there is a social problem of making people aware of what they can do for themselves.

Immediately after a sudden flood, people are not affected psychologically, they do the right thing promptly. So what is needed in this respect is the preparedness and the participatory approach.

Finally, Mr Dooge summed up what should be done to face water-related disasters: mitigation, anticipation, preparation, information, participation, all processes which should, to be effective, involve central government, local government and the community.

Debate

The discussion centred on the major topics highlighted by the speakers at the round table.

Ethical guidelines based on universal principles

To speak about a 'universal code of ethics' is not realistic. For example, in Scotland you are not allowed to plant trees right next to streams because of adverse effects on water quality. In Western Canada you are not allowed to take trees away from streams because of water quality. Thus, the question is how to apply ethical principles in a relevant way to water problems.

Ethical principles are easier to apply on the individual level, but on the regional or the government level they are more difficult to express and identify.

It was pointed out that what we need is awareness and internalisation of universal principles. When making its recommendations, the COMEST should formulate guidelines based on these universal principles.

Research and multinational corporations

COMEST could usefully organise into hierarchy different ways of dealing with water problems from fundamental research to decision-making and ethical issues. When budgets are cut back, attention should be paid to ensure that knowledge and technology transfer as well as capacity-building are not overlooked.

In Africa for instance, large multinational corporations will pollute waterways because legal procedures at an international level are expensive; legal representation to be found locally is difficult; the actual process of cleaning up is expensive. Therefore the COMEST should look into establishing an arbitration mechanism to help developing countries in this respect.

More research and data exchange is needed. The knowledge of the hydrological cycle, especially scales, should be increased. Incentives should be found to associate multinational corporations in order to establish new ways of co-operation to solve health-related water problems. In this respect, the COMEST should look particularly into patent rights and privatisation.

Decision-making and management

The debate went into these issues more closely. It was asked if decisions were always in keeping with local reality and culture of the people. It was also pointed out that shortcomings in decision-making often

result in failing to reach stated goals. Law enforcement on waste water discharged into rivers and government subsidies are two effective tools of water management.

It was recalled that water collection can take up to 60% of the day-time of females in the developing countries and therefore, the urgent need for women to be associated in all phases of water projects management. With regard to the ethics of water, women should be supported as collectors, as users, as consumers and above all as decision-makers.

Watershed management should be based on the recognition of the local ecology of the water cycle, the topography, the climate, soils, vegetation and land use. It was requested that the COMEST include in its report a special section on the management of land in the upper watershed

Co-operation and conflict resolution

In the case of watersheds shared by different institutional entities, the upstream users of a catchment area have a definite advantage over the downstream users. This situation could be rather serious and be a source of dispute in case of watersheds shared by different institutional entities. It was underlined that there is no legal instrument that would regulate the behaviour of governments with respect to water resources.

Therefore, a question was raised on what ethical principles dealing with quantity and quality could be used in mitigating possible conflicts among upstream and downstream users. Although a common understanding for a co-operative action versus coercive action, has always benefited riparian States, and although it is possible to apply operationally those principles, it was stated that a water mechanism, at this stage, is not feasible in political and realistic terms.

Conclusion

The round table was brought to an end by a summary of the main alternate models proposed throughout the discussion.

The solidarity model: building on existing technologies and existing institutional arrangements as well as on potentially new technologies and institutional arrangements, a behavioural change could be reached through well-targeted research investment programmes and adequate incentives for the private sector to mobilise its very massive resources.

The market model: society being a web of economic, social and cultural transactions, the prescriptions should be how to remove obstacles to the fluidity of market.

The power model: control of power by particular groups or institutions who allocate the public resources.

Different protagonists for different solutions have implicit models that have not been made sufficiently explicit when they discuss with each other. Making those models explicit could facilitate a more constructive discussion. Action will have to come on all of three fronts. Ethical recommendations and guidelines should perhaps recognise that diversity of use.

Round Table on the Protection of the Rights and Freedoms of Scientists

(29 April 1999**)**

Led by

Mrs Ágnes Heller (Hungary), Member of COMEST

With

Sir Michael Atiyah (United Kingdom), *ex officio* Member of COMEST

Mrs M. R. C. Greenwood (United States of America), Member of COMEST

Mr Olav Kjorven (Norway), Representative of the Norwegian Minister of International Development and Human Rights

Mr José Sarukhan (Mexico), Member of COMEST

The discussions during this round table covered four main subjects: academic freedoms and professional ethics in scientific research; research funding; the responsibility of researchers regarding the use and misuse of their research findings; the situation of researchers who 'blow the whistle' on research which they consider unethical.

A clear convergence of participants' positions emerged and the discussion highlighted concerns about:

- shifts of emphasis in the funding of scientific research, with relatively larger investment being provided by the private sector compared with the public sector, especially in the developing countries;
- the increased 'merchandizing' of research findings;
- the brain drain from countries of the South to the North; etc.

Opening the sitting, Mrs Ágnes Heller said that before the rights and freedoms of scientists could be protected one had to know what they were. Several questions must first be answered. Did the freedom of scientists mean freedom of research? Did science follow its own specific logic? Did religion, ethics and politics constitute limits on science? Did scientific freedom mean freedom of technological progress? Must scientists prevent their discoveries from being put to possibly dangerous use? This question was particularly relevant to weapons and drugs. Should scientific discoveries be regarded as universal goods to be utilized by all countries or should they be the exclusive property of a State or enterprise? Did the ethics of the natural and physical sciences differ from that of the social and human sciences? Who defined the freedoms of scientists? All these questions arose in the discussions during the first two days of the meeting.

Mrs M. R. C. Greenwood reminded the meeting that the opinions expressed by participants were entirely their own. They were not speaking on behalf of their institutions, although in her case she was probably reflecting the positions adopted by the American Association for the Advancement of Science (AAAS), of which she was President, which had concerned itself with the rights and duties of scientists for many years.

She referred to the AAAS Declaration approved in 1975 which stressed the importance of research freedom and academic freedoms. Scientists must be able to exchange ideas and information with other scientists; publish the results of their research; attend national and international symposia; collaborate with other scientists. These freedoms conformed to those set out in the Universal Declaration of Human Rights and were recognized in numerous documents, particularly in the UNESCO Recommendation on the status of scientific researchers adopted in 1974. This recommendation made it clear that society had a duty to encourage scientific creation, while showing the greatest respect for the research autonomy and freedom necessary for scientific progress.

Without freedom, scientific creativity, independence and rigour were compromised. Galileo was one example among others of the excesses of a blinkered and dogmatic society. However, while the rights of scientists had to be preserved, scientists also had to be given duties. In the first place, scientists had a duty to society. Their work must go beyond the limits of their interests or discipline. With the approach of the 21st century, the different scientific disciplines were increasingly converging. Since the problems to be resolved in the future would require multidisciplinary solutions, scientists would have to reason differently. They would have to

develop a professional code of ethics reflecting the overall approach to their field. The discussions at this first session of COMEST had already revealed the importance of the cultural context in scientific developments.

Mrs Greenwood expressed the hope that COMEST would help to move the scientific community forward by defining the relationship between scientists and the general public, helping to promote scientific achievements and drawing up principles for regulating the development of science in the 21st century.

The complexity of scientific activity, particularly in its relationships with the public, was stressed. The protection alone of academic freedoms did not guarantee the full development of science. A whole set of subtle but important parameters, such as resource allocation and chains of command in the laboratory, also played a part. A fundamental quality - the courage that every scientist must display - was needed in order to overcome these practical obstacles. Mrs Greenwood was anxious to know whether ethical rules existed in the scientific field and, if so, which ones. It was made clear that the majority of scientific associations in the northern hemisphere possessed an ethical charter in which the most important obligation was frequently transparency and accuracy. Results had to be demonstrated, confirmed and circulated. Contrary to what the public believed, most scientists kept to this principle, even if certain recent scandals had certainly led to a distrust of scientists and caused the public to doubt their integrity.

Yet scientists were also men and women and had the same weaknesses as the rest of humanity. However, the vast majority of them were deeply concerned with ethics and the good of humanity. A fresh approach must be adopted in order to bring the public closer to the scientific community.

Firstly, the general public must be involved in decision-making. The medical profession was already beginning to include ordinary citizens in hospital decision-making bodies. This type of initiative was leading doctors to communicate differently and to adopt a more accessible vocabulary. For their part, citizens must learn the rudiments of public health.

Secondly, the scientific community must accept contact with the public without scientists who made an effort to communicate being accused of undue popularization. This was the only way of solving the frequently mentioned problem of public distrust.

Finally, scientists must agree to explain how the public funds allocated to them were used and the reasons for their research choices. This involved the need for accountability by scientists.

Sir Michael Atiyah supported the principle of providing information to the public through enlightened scientific popularization. Twenty years earlier, a science broadcast had been given by three researchers highly gifted in communication and teaching. They had immediately and wrongly been labelled pseudo-scientists and phoneys. This prejudice had now disappeared. The United Kingdom Royal Society awarded an annual prize for the best popularization project and the number of science books aimed at a general readership was increasing.

As an example of public misunderstanding of science and scientific issues, he mentioned the case of mad-cow disease which had arisen in the United Kingdom some years before. At that time the authorities had stated that beef consumption presented no risk and went as far as to use radio and TV to support their statements, although scientists tried to explain to the public that science was by no means certain about the matter. The perception of science by public opinion was therefore a crucial question; doubt motivated and mobilized the scientific community but scared the public.

The discussion then turned to the place of science in society through the balance between the freedom to be accorded to the scientific world and the latter's duties.

Scientists undoubtedly enjoyed special rights. Yet these were conferred on them for a specific purpose and must not be taken lightly. A participant pointed out that the concerns aired by this round table were likely to appear quite futile in the developing countries, which simply sought to obtain the minimum to survive. However, it was decided that it was important to discuss the limits on the protection of scientists' rights. Scientists could not demand advantages and resources without prior reflection. Any unjustified use of resources should therefore be condemned without the scientists responsible being entitled to appeal to academic freedom.

Mr José Sarukhan said that scientists had definite duties. They must notify policy-makers of the results of their researches which could be applied in the field of natural resources and particularly in that of biodiversity. Scientists had here a crucial role to play: to devote their time and energy to a dialogue with decision-makers and announce the results of their research in order to influence the approach adopted by States

regarding the ecology. Energy and water problems resulted from the need to safeguard the ecosystem and preserve life worldwide. The situation was one of particular urgency in the Latin American countries, where biodiversity was under severe threat.

It was asked how scientists could influence political decisions. Should they make their voices heard in the same way as every other citizen or should they take advantage of their skills and authority? The contribution of scientists to spheres of decision was compared to that of doctors in the sphere of human health. The importance of action by ethics committees to set aside projects considered harmful to humanity was stressed. In many cases scientists hesitated to start a fight with the authorities who allocated the resources needed for research, although they were often the only persons capable of assessing the sometimes harmful spin-off from certain decisions and really should intervene.

Mr Sarukhan mentioned the external factors imposing limits on science. Science was constrained in many cases not by religious, ethical or philosophical considerations but by much subtler political mechanisms. He quoted the examples of the World Bank and the International Monetary Fund (IMF), which required developing countries to cut their higher-education and scientific-research budgets on the grounds that it was the private sector's responsibility to fund research. In point of fact, nearly all scientific research in those countries was carried out in State universities. Abolishing State funding would prevent the next generation of scientists from working and making discoveries in new fields. However, if States were asked to increase their research budgets, how could the need for funding be reconciled with the fear of external sanctions?

Funding sources in most industrialized countries were diversified, which enabled various degrees of balance to be struck between the weight of the State and that of pressure groups. By contrast, it was difficult in the developing countries to gain access to several sources of funds. No international body was in a position to finance major projects in those countries without imposing fairly restrictive conditions. As States were the only resources of research funding, they were therefore free to control research as they wished. Such control could take the form of real censorship, particularly in the human and social sciences whose research results were liable to displease politicians.

Mr Olaf Kjørven, the representative of the Norwegian Minister of International Development and Human Rights, said that protecting the rights and freedoms of scientists was essential for human survival. Observance of this principle was fundamental to progress. He referred

particularly to the need to protect and assist those who wished to devote themselves to science. He raised the question of international co-operation within the North-South framework. One of the necessary conditions for the development of research was the existence of skills and techniques in the science fields. The majority of developing countries had no opportunity to develop their very real potential because of economic problems. Cutting expenditure on education had led to lower educational levels, the abolition of training programmes and the impoverishment of libraries. Developing countries were therefore still unable to develop their capacities. The scientific stagnation of certain countries could also be due to political circumstances. Researchers sometimes had no right to publish their findings. He said that Norway had given a pledge to certain developing countries to help them develop research and higher education, as well as primary and secondary education, in order to help citizens in those countries to participate in the democratic process.

Mr Kjørven indicated, secondly, that an effort must be made to narrow the gap between rich and poor countries in the fields of education, research and access to information. These objectives appeared in the 1998 Development Report of the World Bank. One solution would be to arrange projects for co-operation between those countries. This type of initiative financed by northern-hemisphere countries too often ended up strengthening the dominant position of the wealthy countries by weakening that of researchers in poor countries. The former determined the research subjects, drew up the action plans, enjoyed public recognition and retained the exploitation rights, while researchers in the southern countries often found themselves assigned executive tasks, which was not what co-operation was about. Mr Kjørven hoped that COMEST would be able to draw up principles which would bring cooperation between North and South countries back into balance and reverse the brain drain.

Regarding the place of ethics in society, Sir Michael Atiyah said that any discussion of ethics must examine the question of 'whistle blowing', namely the denunciation by a researcher of unlawful actions or dangerous research being carried out in a scientific institution. The risks of so doing and/or the prospect of finding research appropriations withdrawn sometimes made it difficult for a scientist to make the facts concerned public. Whistle blowing must, however, be really justified and should not be aimed at destabilizing research institutions or creating a diversion by panicking the public.

The relations between biology and weapon production were mentioned. Although several international agreements had been drawn up with the object of preventing, limiting or banning the manufacture of biological weapons, such weapons were unfortunately easy to hide. Regardless of their frequency, external controls were insufficient. Scientists must therefore have the right to denounce practices by their colleagues without having to fear reprisals. It was for the industrialized countries to give the example and show that all human rights must be protected.

Sir Michael Atiyah also stressed the importance of the way in which scientific advances were presented to the general public. Scientists were concerned about the accuracy of their data and the impact of their work on the public, but how could the uncertainties of science be conveyed? As far as the public was concerned, science was synonymous with truth and explained the universe. Should scientists be asked to disclose their doubts? Should science be confined to laboratory experiments or should it also take part in public life? Scientists knew that science was not composed entirely of certainties. It put forward probabilities, which strengthened with time. The public, however, wanted definitive answers. Any uncertainty was therefore seen as ignorance or deceit. Scientists must now inform the public and make it understand the functioning and nature of their work by applying the transparency principle. Transparency must also be encouraged in the distribution of resources, the development of international partnerships and the drawing up of codes of conduct.

Sir Michael Atiyah also mentioned the problem of the corruption of the ends of science. Perhaps, like the Hippocratic Oath, there should be a scientific oath committing scientists not to use science for warlike purposes. While some were already taking such a decision for themselves, others continued to work without the slightest heart-searching. Unfortunately, as most research projects were State-financed, scientists often had no freedom of choice. However, there was a risk that by imposing bans one would be giving the signal that all that was not banned was acceptable.

Sir Michael Atiyah concluded by saying that, after calling in science to improve the quality of life, society had perhaps now become its hostage. The more science advanced, the more resources would have to be devoted to research. Science would be financed not only by States and industry but by all sectors. It would penetrate all spheres of society and every area of life.

The round table ended with a reminder of the prospects of science and the necessity to effect a return to humanism. The deeply human act of sharing information was unfortunately difficult to preserve in a world where everything had its price. Individuals no longer disclosed their knowledge for fear of ceasing to be indispensable. The right to choose one's research field was essential for the advance of science. For science to retain its full integrity, the scientific community must rediscover its cohesion. This already existed at national level in many countries. It was important for each region to be able to develop its own specific rules, methodology and approach. It was in order to meet this observed need in the developing countries that the Third World Academy of Sciences had been set up. It would be a pity if science became a slave to investment decisions and profitability calculations or if it were reduced to a series of experiments, discoveries and applications, since its duty was to serve knowledge and the whole of humanity.

Chapter 3

Opening Addresses

- **H.E. Mr Jon Lilletun,**
  Minister of Education, Research and
  Church Affairs of Norway

- **Prof. Mambillikalathil G.K. Menon**,
  Former Indian Minister of Science and Technology,
  Meghnad Saha Distinguished Fellow of the
  National Academy of Sciences, India

- **H. E. Mrs Vigdís Finnbogadóttir,**
  President of the Republic of Iceland 1980-1996
  Chairperson of the COMEST

I. H. E. Mr Jon Lilletun,
Minister of Education, Research and Church Affairs of Norway

Your Majesty,

Excellencies,

Ladies and Gentlemen,

On behalf of the Norwegian Government, it is an honour for me to welcome you to Norway and to the first session of the World Commission on the Ethics of Scientific Knowledge and Technology. The commission is of interest not only to scientists, but also to experts in other fields, politicians and members of society in general. I am pleased to see so many of you here today.

In modern society, many people feel a strong need for ethical reflection. Never has scientific progress and technological innovation shaped production, social relations and life-styles as they do today. And never has the general public been so keenly aware of the changes that are brought about by science and its applications.

In my opinion, UNESCO has taken a very important initiative by setting up a world commission on the ethics of science and technology. The challenges for science and technology are more significant than ever. Many of the problems that we see in the world today are of a serious nature. Threats to the environment easily come to mind. Often these problems are of a global nature. Science and technology is an important tool for tackling such challenges. Therefore it becomes a moral responsibility for scientists to try to find solutions to our problems.

Scientific experts play an important role in society today. Policies are often based on scientific results. Science helps us every day. But there are areas of science and technology that pose new and difficult questions. The Commission will be discussing some of these questions over the next two days, related to information technology, energy, fresh water resources

and the environment. I am pleased to see that the Commission will look into these areas from new perspectives, and focus on aspects which are not often discussed. I am also pleased to see that the Commission will prepare a document to the World Conference on Science in Budapest, and I look forward to your contribution.

New technologies are often welcomed without criticism. But it is clear that progress and benefit to humanity can only come about if we address the underlying issues of values. We will have to strike a balance between what is technologically possible and what society can accept, - and also what nature can survive. These questions are essential to our future, and I am glad that the Commission will give them first priority.

First of all, we need a public debate on the many and often conflicting ethical values that we face. In some parts of the world, such debates do take place. In other parts, this debate will have to be encouraged. Organizations such as UNESCO can fulfil an important task in drawing attention to this need on a global scale, and in creating suitable fora, where they do not already exist.

As I said earlier, I am glad that UNESCO has taken the initiative to establish a world commission on such a topical theme. It is a theme that I am personally much concerned about. Later this morning, Norwegian experts will present some of the institutions and activities in the field of ethics of science in this country. Therefore, I will only give some general comments on this work.

The freedom of research is considered essential in most countries. But we have seen in the past and will probably also see in the future, many examples of research being used for dangerous and even evil ends. Society certainly must avoid abuse of science, without putting undue restrictions on research itself. Scientists should be allowed to use their own curiosity and creativity when looking for new solutions and new knowledge. However, they must also be conscious of the ethical consequences of their work.

So, what can we do to increase the awareness of ethical problems in science and technology? Should we establish extensive control mechanisms and bring scientists into the courtroom - should ‘research policy’ be the same as a ‘research police’? I don’t think so. First and foremost, the responsibility must lie with the scientists themselves. They have to be aware of the part they play in producing certain knowledge and certain products, and the use of this knowledge. They also have to learn to look at their work in the context of moral values.

This can be achieved through education, information and advice. Therefore, we need to give young scientists an education that includes ethical issues. To make sure that ethical aspects of science are not forgotten, we need some kind of 'support system', - either inside or outside the research institutions, or both. Norway has established a system that seems to work well.

So I see no need for a 'high court of ethics'. What we do need is a body or bodies that can act both as a kind of watch-tower and point out the important issues, and as an advisor in specific questions. Maybe the main goal is to start a debate. Ideally, the debate should begin among the scientists themselves, but it should also include politicians and other decision makers and the general public. Therefore, we need bodies that can act as meeting-places between scientists and the public. And I hope this Commission will be such a meeting-place.

In my view, a new contract between science and society is necessary - a contract that is based on the ability and responsibility of science to solve the problems at hand. I hope this will be possible. 1 assume that you who are here today are willing to join me in this hope.

This new contract can contribute to a democratic society where scientists and the public together work for the common good. They may not have the same answers, but it is important that they agree on what some of the basic problems are. That is a good platform for discussion and debate. I sincerely hope that the debate in this commission and in the round tables will be both comprehensive and fruitful. I also hope that the debate that has been started here will find an even larger audience when the meeting is over.

To conclude, I would like to wish you a happy and useful stay in Norway, and I would also like to express my most sincere wish for a greener, healthier and more peaceful future for all of us - with the help of science and technology.

II. Mr Mambillikalathil G.K. Menon,

Former indian Minister of Science and Technology,
Meghnad Saha Distinguished Fellow of the
National Academy of Sciences, India

Your Majesty,

Minister,

Excellencies,

Ladies and Gentlemen,

It is a great honour and privilege for me to be asked to deliver this opening address at the First Session of the World Commission on the Ethics of Scientific Knowledge and Technology.

The advancement of science and technology is among the greatest creative human activities in the world today. The material world we see around us and the way society functions is a direct manifestation of these advances. From its earliest days, science has been embedded in society; its origins lie in the evolution of the human brain, and the intrinsic sense of curiosity to explore the world around; and then use is made of this knowledge for applications of benefit.

Earlier in history, scientific advancements related largely to felt needs. There were, of course, some visible scientific accomplishments not related to felt needs. These were motivated by a desire to know and to understand nature. Sometimes, this led to conflicts with the Establishment, constituted of those who wielded the power of religion or State authority. These are exemplified by the persecution of Galileo, the conflicts that arose in the acceptance of the heliocentric theory of Copernicus, disagreements that still continue concerning the Darwinian theory of evolution, and more recently atrocities under the totalitarian régimes of Nazi Germany and of the Soviet Union for non-conformity with State authority. Often, these conflicts involved individual scientists; and related to conceptual developments.

In looking back on this past, there is a lesson for us today. It is clear that scientific inquiry should proceed unhindered, without having to conform to theologies, ideologies, views of authorities or fashions that may be in vogue. We must never forget this - as otherwise the mainsprings of creativity will dry up. When I think of science and its role in society, I am reminded of the last message from one of the great scientists of all time, Louis Pasteur. His advice to students was to 'live in the serene peace of laboratories and libraries'. He spoke to the foreign delegates of his 'invincible belief that science and peace will triumph over ignorance and war, that nations will unite, not to destroy, but to build, and that the future will belong to those who have done most for suffering humanity'. Let us always remember this vision.

For a long period in human history, science and technology moved forward on a gradual basis; there were some high points and peaks. However, it is over the past few hundred years that we have witnessed an exponential growth of science and technology that is still continuing.

Compared to the earlier period, science is now a large organised enterprise, inextricably intertwined with technology and applications. We need to appreciate the nature of the problem that we face before we look for solutions. There are a number of characteristics of science today that can be briefly listed as follows.

Firstly, the scale of scientific advance has increased almost out of all recognition. This can be seen in the number of scientists engaged in this activity; in the number of papers published; in the investments and expenditures involved; in the wide range of applications and the like. Science is no longer a stand-alone activity at the fringe of society, but one closely coupled with industry, agriculture and other production activities and with the governmental and inter-governmental sectors; it is connected with armaments; and it permeates and affects society as a whole.

A second important characteristic is the rapidity with which scientific discoveries are being applied for practical purposes. This is particularly so because of the close synergistic and symbiotic relationship between science and technology. Knowledge today is being applied with increasing rapidity, leading to new products and processes in the market place.

Thirdly, there is major scientific activity now in the form of individual mega science projects, as also very large efforts involving international collaboration. These call for wholly new forms of organizations and management, more characteristic of industry than academia.

And then, of great concern to the society, is the strong coupling of science and technology with armaments.

As a result of all these important features, there have been profound changes in the characteristics of science itself, in the motivation and practice of it, and in its relation to the society. There is a telescoping of the whole system: of discovery, applications, technology, production, commercialisation and rewards with large money involved. There is rapidly increasing knowledge, understanding and capabilities arising through the advances in science and technology. Francis Bacon has remarked that 'Knowledge is power'. And we must recognize that this increasing knowledge, and correspondingly increasing power, implies the need for a much greater sense of responsibility - not only on the part of science and scientists, but of governments, business and of society.

With such powers becoming available to humanity, one would have thought that it would be possible to meet all basic human needs; and the world would indeed be an Utopia. However, this is far from true.

On the image of science today, Bishop has stated that 'We live in an age of science, when many of nature's great puzzles have been solved... The fruits of science have vastly improved human welfare and understanding. Yet science now finds itself in paradoxical strife with society: admired but also mistrusted; offering hope for the future but also creating ambiguous choice; richly supported, but unable now to fulfil all its promises; boasting transcendent accomplishments but criticized for not serving more directly the goals of society'.

We need to reflect on this deeply. Why is it so? Let me consider issues in a few different areas.

First consider the link between science and armaments. The interest of scientists and inventors in machines of war, and consulting for the military is not something new. It has had a long history. Leonardo da Vinci, who is generally known to society for his greatness in the creative arts, was also a great scientist. In his letter to the Duke of Milano, to whom he offered his services, he dwelt extensively on his skills in the art of invention of apparatus of war; indeed it is only at the end of his letter that he mentioned the skills he possessed as an architect, sculptor and painter which might be of use in times of peace. Leonardo recognised that there could be circumstances that might make it necessary to become involved in military work. He said: 'When besieged by ambitious tyrants, I find a means of offence and defence in order to preserve the chief gift of nature, which is liberty'. It is precisely this reasoning which led Albert

Einstein, a pacifist, to write to President Roosevelt, proposing that a project to develop an atomic bomb be taken up; to ensure that the Allies would be ahead of Nazi Germany in this.

But equally, Leonardo was aware that inventions could be used in ways neither originally conceived nor to the liking of their originator. In commenting on his ideas for a submarine, he said 'Now by an appliance many are able to remain for some time under water. How and Why? I do not describe my method of remaining under water for a long time... and this I do not publish or divulge, on account of the evil nature of men, who would practice assassination at the bottom of the seas by breaking the ships in their lowest parts and sinking them, together with the crews who are in them'. He was thus opposed to the indiscriminate development of weapons of horror to be used purely for conquest and exploitation.

It is during this century, with the use of aircraft, tanks and poison gases in the First World War, and the development and use of radars, sonars, missiles and of atomic weapons of frightening power during the Second World War, that science truly became related to the military enterprise. And we have witnessed the further developments in the area over the past half century.

The largest of the destructive weapons developed through scientific efforts was the nuclear bomb. It did arouse, particularly because of its use, and later the fears of mass destruction, the social conscience of the scientific community. This was characterised by the tone of the Russell-Einstein Manifesto of 1954 which states: 'We appeal, as human beings, to human beings: Remember your humanity, and forget the rest': and the award of the Nobel Prize for Peace for sustained work against nuclear weapons to the Pugwash Movement and to Professor Rotblat.

We must remember that many advances arising through science are being increasingly used by small groups interested in anarchy and terrorism. This has added a new dimension in recent times to terror, to which our growing knowledge has contributed.

Another area I would now like to look at is modern biology.

Life sciences have seen revolutionary advances over the past half century. It has become increasingly possible to unravel the structures and functions of living systems at the molecular and cellular levels. Already the process of transgenesis is being implemented. In the case of plants, this is being done to improve their ability to handle stress and obtain desired characteristics. Whilst such advances could have tremendous

value in improving food security and nutrition, there are great fears that the current Intellectual Property Rights systems are inequitable; whereas knowledge to effect transgenesis will come from the scientists, the larger-scale applications, wholly driven by commercial considerations, will be due to multinational companies who wield enormous clout; and other stakeholders who relate to the environment, the farmers, and particularly developing countries, will not have a role.

My view is that genetically modified organisms (GMOs) will be essential for our future. But the analysis, regulation, monitoring and control of applications should not be in the hands of those who are the interested parties and are wholly driven by crass commercialisation. If the GMOs are meant to improve the livelihood security of the poor through improved disease resistance or increased yields, they would be particularly relevant. But society has a right and a duty to discuss the implications.

One can see ahead capabilities to transform the human species. One of the most ambitious projects taken up, and which will soon be accomplished, is the Human Genome Project, which is to decipher details of the human genome in terms of its physical and linkage maps. Whilst such knowledge will have enormous positive value for problems in human health, the question is what other uses would be made of it? Will this increasing knowledge related to genomics be allowed to dominate the future of living systems or will environment, nature and culture be allowed to play their rightful roles? It is for this reason that a specific financial allocation for ELSI (ethical, legal and social implications) was made right from the start of the project, at the instance of Jim Watson. We have to be particularly aware of the risk of concentration of knowledge in the hands of a few. Shulston, the Director of the Sanger Center, has remarked ‘It will not be helpful to medicine if, by the year 2003, control of every single gene is tied up by one company or the other for 20 years’.

UNESCO very correctly set up an International Bioethics Committee (IBC) in November 1993, which drafted the Universal Declaration on the Human Genome and Human Rights. The 1946 Founding Charter of UNESCO explicitly mentions ‘the democratic ideal of dignity, equality and respect for human rights’. These indeed constitute the foundation of moral ethics. The Declaration is directed towards ensuring that science continues to advance, to help civilization to progress, whilst at the same time, the rights and liberties of individuals are protected, and in all of these there is full solidarity with the efforts and needs of the less developing countries. An important aspect of the IBC was its composition,

which was truly high level and fully interdisciplinary. Apart from the most distinguished life scientists, the IBC had on it eminent experts from law and the judiciary, philosophy, social and physical sciences.

There are many other areas in which the ethics of scientific knowledge and technology can and needs to be looked into. Apart from water and energy which we are discussing at this meeting, there are the major human needs of food, health and shelter, the area of natural disasters, of bioethics and medical ethics, of environment and sustainable development, informatics, and the impact of commercialization on the openness of science and relations within the scientific community and the very organization of the scientific effort. We must remember that science and the scientific direction of research do not take place in a vacuum. Indeed, the direction and priorities of scientific trends at a given time are influenced by circumstances that construct the reigning paradigm.

There are three points that I would like to briefly state before concluding. First, that continuing pressure of public opinion is important, and does produce results. Second, that business is becoming aware of these issues and does take remedial action: earlier examples are in the areas of pollution reduction, efforts to reduce destruction to the ozone layer, biopiracy issues in the area of biodviersity where now rights and rewards are given to the regions and communities concerned with the biowealth. Thirdly, education and creation of awareness are very important; and it is here that UNESCO has an unique role to play.

I would like to pay a warm tribute to the Director-General of UNESCO, Professor Federico Mayor, who has introduced the much needed emphasis and focus on ethical, moral and value-based issues in all of the work of UNESCO, and particularly in the area of science and technology. Professor Mayor, a distinguished scientist himself, is more than aware of the increasing scale of effort and rapidity of change involved in the advancement of science today and the manner in which it permeates all aspects of life and living - about which I have spoken; and therefore of the need to ensure that we have the capabilities to identify, debate, formulate policies and establish monitoring systems to regulate the areas of application; keeping in view the ethical, legal, social, psychological, cultural and economic consequences on individuals, families, communities and the human race and environment in general.

Of all the great international institutions, UNESCO is the one uniquely placed to ensure that the newly developing situation concerning ethics of scientific knowledge is kept under continuing examination.

I would like to conclude by quoting from the Nobel Prize winner, Cecil Powell, under whom I worked. Referring to the scientific community, he had remarked: ‘They are in a unique position to appreciate early the problems, the dangers and the advantages likely to follow from scientific developments and to make their findings known to governments and to peoples’. It is precisely this that the scientific community has done in recent years: in detecting the ozone hole over the Antarctic, and pointing out the dangers of ozone depletion; in measuring the increasing build-up of CO_2 in the atmosphere and the consequent dangers of global warming, with its hazardous implications; in the loss of biodiversity. As a result, in all these areas, there are now remedial actions in progress at international, business and scientific levels. He went on to state: ‘Of course, the solution of many of our problems depends upon great political issues in which most scientists have no particular competence; but nevertheless, we ought to help with their resolution and never to tire in bringing before the people of the world the immense possibilities for human advancement which are now within our grasp if science is rationally employed in a peaceful world’.

My views in conclusion are: science and technology will continue to advance rapidly as we move into the next millennium. What is important is to ensure that these advances benefit humanity as a whole. Parochial considerations of narrow commercial interests, nationalism, fundamentalist and religious aspects, and inflexible ideological divides, have to give way to the basic ethics of human dignity and human rights, and harmony with nature: these are value systems outside the realm of science, but are needed to guide its applications and require education, awareness and new institutional frameworks.

III. H. E. Mrs Vigdís Finnbogadóttir,
President of the Republic of Iceland 1980-1996,
Chairperson of the COMEST

Your Majesty,

Minister,

Excellencies,

Ladies and Gentlemen,

I would like to begin by thanking the Norwegian government for its magnanimous gesture towards UNESCO by hosting the first meeting of the World Commission on the Ethics of Scientific Knowledge and Technology.

We deeply appreciate this opportunity to meet here in Norway and begin the work which we hope will inspire people around the world to think more carefully about the planet they live on and share, to steer development into more positive channels and ensure that scientific progress will serve humankind and the environment, and not vice versa.

Norway and the Norwegian people enjoy global respect for their firm democratic values and their continual readiness to act towards the peaceful reconciliation of disputes and differences. Every year, the world's attention focuses on Norway and Oslo when the Nobel Peace Prize is announced and awarded. With its reputation for moral leaderhsip, its integrity and mature vision of harmony in the world, Norway is a prestigious starting point for COMEST's work. I must also emphasize that the willingness of *Norsk Hydro ASA* to be associated with the work of UNESCO in the field of the ethics of scientific knowledge and technology is clear evidence that ethics has become an essential component in both the corporate operations of the industrial sector and communication strategies with the general public.

It was on the initiative of the Director-General of UNESCO, Federico Mayor, that the World Commission on the Ethics of Scientific Knowledge and Technology was establshed. His ideas and vision became reality with the resolution passed at the Twenty-ninth session of UNESCO's General Conference and the appointment of all the members to the Commission was completed in September 1998. It was gratifying and a genuine inspiration to see the way that everyone who was approached about contributing to the Commission was immediately prepared to join in its work.

My steadfast belief is that ethics in scientific knowledge and technology need to be in the forefront of all decision-making. To many citizens of the world, science and technology are giants that they watch marching blindly forwards, towering over everything, taking control, creating a world so complex that few people understand where its momentum derives from. It is vital that these same citizens of the world should know that such issues are actually being discussed by people who are pondering what is right and wrong about them, how they can either enrich our life or degrade it. This is a case we in COMEST must do from today onwards, for the governments of the world and for the general public that elects them.

The World Commission on the Ethics of Scientific Knowledge and Technology has the following mandate:

- to serve as an intellectual forum for the exchange of ideas and experience;
- to detect, on that basis, the early signs of risk situations;
- to fulfill an advisory role for decision-makers in this respect; and
- to promote dialogue between scientific communities, decision-makers and the public at large.

The World Commission on the Ethics of Scientific Knowledge and Technology should also play a crucial role in improving international scientific cooperation, particularly between developing and developed countries.

It is the task of the World Commission on the Ethics of Scientific Knowledge and Technology, as a forum for reflection, to formulate on a scientific basis principles that could provide decision-makers in sensitive areas with selection criteria that are other than purely economic. Furthermore, the Commission will advise UNESCO on specialized questions which are submitted to it or which it may take up. While the Commission must preserve the memory of the gains of science and

technology, it must rigorously delineate the challenges of the future because ethics, quite apart from scientific knowledge and technology know-how, must set the limits between what is possible and what is acceptable. The Commission will help to improve risk management. In doing so, it will be the keystone of a culture of responsibility and solidarity.

Ethics can be simply defined as an attempt to evaluate choices from an essentially human perspective. For most people today, energy in the form of electricity or petrol has become one of the basic necessities of life, but its use still involves choices or controversial decisions. For example, what is the balance between rights and obligations when an energy resource is utilized? Likewise, energy used in one place affects the entire world, not just local users - which is the reason underlying the need for ethics to address issues such as global warming. Even the choice of an energy source can involve complex choices. Fossil fuels pollute the global atmosphere but are relatively cheap, while nuclear fuels pose risks on an unprecedented scale. But, even pollution-free renewable resources such as hydropower entail sacrifices. In my country, Iceland, a fierce debate is going on today about whether our pure and natural highland landscapes should be sacrificed for hydropower development. Which is more precious, and how do we quantify such values?

Fresh water is a similar problem, involving a resource which most of us take more or less for granted. One dilemma here is how to balance the right to this prerequisite for life with the right of ownership - how to agree on preventing contamination or selfish exploitation of a shared basic resource. Access to fresh water has increasingly been identified as a major potential threat to world peace in the coming century. As the working group on fresh water pointed out in the conclusions of its report, ‘Water development during this century has provided great socio-economic benefits but has also given rise to some serious environmental problems. These problems are more related to water quality degradation than to water scarcity. They are not only related to water mismanagement but mainly to land use and to industrialization. Thus, we need to take a more integral look at human activity to understand water’.

Natural resources such as energy and fresh water are close to what the Greeks believed to be the fundamentals of life itself, the archetypal elements of earth, air, fire and water. Their use affects human survival and aspirations towards material advancement and the quality of life, but developments in science and technology make the issues surrounding them more complex every day. However, we should not allow scientific specialization, which is a product of the quest for knowledge, to leave

those of us who are not scientists feeling disqualified to discuss these issues, since as human beings we are all affected by them, and have a different set of values to contribute towards their development.

But within the past ten years or so a fifth archetypal element has been added to human experience. I am referring of course to cyberspace, the new dimension which is omnipresent but also invisible and therefore calls for a different range of ethical responses. These include a new definition of literacy - an approach to the way that computer literacy or illiteracy will probably widen the gap between rich and poor even further. Another complex issue is access, not only to computer technology and the benefits it brings, but also access to computerized information, which calls for both technical and political safeguards against misuse.

The World Commission on the Ethics of Scientific Knowledge and Technology, comprised of well-known personalities from all around the world, has a challenging task ahead of it. Working groups have been addressing the issues I have just mentioned, in order to feed the Commission with material for its deliberations. Reports on energy and freshwater have already been made and a UNESCO committee on infoethics is putting the finishing touches to its report.

I often wonder and am often asked myself, what is the benefit of appointing these commissions and committees to discuss topics which very often remain unquestioned. What does our work actually produce? Nothing immediately tangible, perhaps, since we cannot give orders around the world and would not want to. But the important point is that we are talking about these issues, making issues of them; striving to establish perspectives on them instead of blindly accepting or rejecting them for better or for worse. Our discussions are an example of an ethical stance - trying to weigh up what is right or wrong, positive or negative, beneficial or harmful, in the decisions made by others around us. The contribution we can make is new perspectives, a new frame of mind.

I mentioned before that we cannot issue orders; but we can and will put forward guidelines, present reasoned and humanistic arguments, and offer leadership. These contributions can then be incorporated into agreements and policies about how to control the use or misuse of knowledge. We can lay down certain basic principles, for example, that the search for knowledge must not damage the environment, and we also need to insist on some reliable way for laymen to weigh up the issues at stake in a highly complex field. Furthermore, since new knowledge is by its very nature unpredictable and therefore impossible to control in advance, above all we need to develop a critical frame of mind and

system of values which prepare us to judge each new issue as it evolves. Regulations, however, must not and probably cannot stop progress from being made; they should simply channel new knowledge into the most beneficial fields for individuals, societies and the global community as a whole. We hope to instil critical awareness not only among those who are affected by the onward march of science, but also among those at the head of that procession.

It is our role in COMEST to prompt people to think about their environment and the world they live in, prompt them to respond. If there is a single precept that we can teach, it must surely be that the worst position of all to be in is to do nothing, simply because one mistakenly believes there is nothing that can be done.

Your Majesty,

Ladies and Gentlemen,

It is the culture of nations that will be remembered in history - their attitude, not their wealth. As I see it, this Commission is working for the benefit of the future of the whole world, for the personal hope of individuals in all parts of the globe. It is there to remind us all, wherever we are, that the lives we lead today were once a distant future too, in the eyes of generations before us - who as far as we know did not worry so much about it. The new future that lies ahead of us is more unpredictable than our grandparents could ever have imagined. It is this future - which we ourselves will not see - that we have to anticipate and analyze. We have ample cause for worry today, and must not allow later history to look back and condemn us for apathy or ignorance. For being incredibly naive bystanders or onlookers, passively watching man's understanding or misunderstanding of his capacity and powers as they grow beyond his control. Rather we would like to be remembered as the generation that swung human ingenuity, the might of thought, back towards the devoted service of humankind. May this meeting be the first of many such turning points.

Chapter 4

Closing Addresses

- **H. E. Mrs Anne Enger Lahnstein,**
  Minister of Cultural Affairs of Norway

- **Mr Thomas R. Odhiambo,**
  Past President, The African Academy of Sciences (AAS),
  Vice-Chairperson of the COMEST

- **Mr Federico Mayor,**
  Director-General of UNESCO

- **H. E. Mrs Vigdís Finnbogadóttir,**
  President of the Republic of Iceland 1980-1996,
  Chairperson of the COMEST

I. H. E. Mrs Anne Enger Lahnstein,
Minister of Cultural Affairs of Norway

Director General

Excellencies,

Ladies and Gentlemen,

As Minister of Cultural Affairs with responsibility for UNESCO affairs in Norway, it is a great pleasure for me to address the new World Commission at the closing of its first session.

In almost every field of modem society, science and technology play an important role. But many people today are concerned about the development of science. New and difficult questions are being raised. Therefore, it is essential that we do not underestimate the ethical dimension, and that we always keep it in mind. But observation is not enough. We must also be willing to change the course of development, if necessary.

It is highly appropriate and commendable that UNESCO has taken the initiative to appoint this Commission. The theme is well suited for an international group, because science itself is international. So are many of the ethical issues. I believe that our efforts to find solutions to the difficult problems ahead will benefit from this Commission. It means that our discussions will get valuable input from people with a varied background, representing all continents. Hopefully, this will add new possibilities and dimensions to the national committee structure that we find in many of our countries.

The Commission has a wide mandate, and the task may seem difficult. But we have seen earlier that a world commission can bring about profound changes, both on the political agenda and in people's attitude to the development of our society. I am thinking of course of the Brundtland Commission, which was one of the starting points of a whole new way of thinking about our environment.

There is also a link between the two commissions. The term ‘sustainable development’, coined by the Brundtland Commission, is an important one. But it can only be put into practice if we are aware of the difficulties involved. These difficulties are often of an ethical nature. One of the challenges is probably to agree on common goals. What kind of technology will bring about higher production and a healthy environment? If we can agree on such questions, we have come a long way.

In this session, a few key questions have been singled out for further scrutiny. The main topics have been the ethics of energy and of fresh water resources, but there have also been fruitful discussions on the rights and freedoms of scientists and on ethics - in relation to the information society. These are topics of the utmost importance to the development of our society in a number of ways, both within our different countries and in our international relations. One of the challenges that lies ahead of you, will be to start a debate on these issues in your country, or to encourage it, if it is already taking place. Another challenge will be to turn the attention of decision-makers to these issues.

To be able to fulfil this task, you must be on the look-out, for risk situations and for ways to handle them. UNESCO has chosen a clear and very symbolic logo for the commission: an eye with the globe as its pupil. I take this to mean that you will keep an eye on science and technology, scientists and politicians, all over the world, - this is a great task indeed!

We have great expectations to the work of the Commission, as its mandate and tasks are central to Norwegian concerns. UNESCO as an arena for global dialogue and discourse is important to Norway. This is why we have taken great interest in the setting up of this Commission and invited you here to its first session.

Norway will follow the future work of the World Commission with interest and attention, hopefully also from a position on the Board of the organisation for the coming four years. I am pleased to take this opportunity to bring to your attention that the Norwegian government has decided to present its candidature for election to the Executive Board of UNESCO at the General Conference this autumn.

I should like to conclude with the hope that the World Commission will serve as an important instrument in an international dialogue on ethical issues. What this first session has shown, is that scientists, decision-makers as well as the general public are willing to start discussing these questions. You have all contributed greatly to the success of this meeting, and I wish you the best of luck in the work that lies ahead.

II. Mr Thomas R. Odhiambo,

Past President, The African Academy of Sciences (AAS),
Vice-chairperson of the COMEST

Madam Chairperson,

Madam the Minister of Culture of Norway,

Mister Director-General,

Ladies and Gentlemen,

When the ancient Greek sages, in seeking to determine the basic constituents of all things, settled upon four such constituents, they had actually defined the four resource systems that, today, dominate the human environment. These are: air (which is of global concern because of its transboundary nature); earth (which can be translated as land, or as the basic chemical elements of every substance); fire (which may usefully be translated as energy); and water (whose transboundary nature and its integral constitution in all living things makes its a basic human need). It is this fundamental, basic need for water by all humans, of whatever economic or social level, that makes water such an issue-intense affair, particularly in the face of its increasing scarcity throughout the world, and more crucially in the course of the next three decades.

Water is very largely a shared natural resource; and in the face of scarcity raises a whole nest of serious ethical problems, of which five are probably the thorniest:

- *First,* what safeguards can we provide that future generations can enjoy the availability and quality of freshwater that 20th century humans enjoy at present, even though this enjoyment may be extremely unequal and somewhat polluted?

- *Second,* even though Principle 21 of the Stockholm Declaration on the Human Environment, arising from the United Nations Conference on the Human Environment, held in Stockholm in 1972, enjoins us to recognize the sovereign right of States to use their water resources as they wish, yet it does impose a responsibility on the selfsame States to avoid damaging and polluting the water system flowing beyond their own boundaries.
- *Third,* the mining and use of fossil water raises momentous ethical issues.
- *Fourth,* in the face of the growing scarcity in the availability of clean freshwater in the world, some countries (e. g. the western United States of America and Australia) have already opted to develop a water market. In such cases, what is an effective pricing system for freshwater which would both assure availability to all segments of the society as a fundamental living requirement and yet assure conservation of this finite resource? Would one, for example, assume that industry should be allocated more of this commodity simply because of China's experience that industrial uses of water generate more than 60 times the value of the same quantity of water used in irrigation?
- *Fifth,* even though freshwater supplies are abundant in a global perspective, they are very unevenly distributed among and within States. In some countries in Asia, the rates of withdrawal of freshwater stocks are so high that supplies are rapidly being depleted from aquifers, and these countries are in a stressful situation. In making regional assessments of world water resources in 1997, the World Meteorological Organization regarded water consumption beyond 20% of available stocks as constituting water supply stress. Other than Canada and Scandinavia where freshwater is plentiful, and vast areas of the United States of America, South America, Central Africa, the former Soviet Union, Malaysia, Indonesia, the Pacific Islands, and Australia, which experience low vulnerability, all other countries are subject to a range of water stress. Yet, most of the accessible water reservoirs have already been exploited, at somewhat low cost; tapping any new supplies will prove 2 - 3 times more expensive. The ethical question is how to assure adequate, equitable availability to all people, including those living in low-capita income countries which simultaneously experience intense water stress.

The art and practice of equitable distribution of and access to freshwater for all people in the 21st century, as a fundamental human right and international obligation, is the mother of all ethical questions of all transboundary natural resources of a finite nature.

One is not always ready, or comfortable, to speak of living values in international scientific meetings concerned with world resources, such as water, as an illustration of the nature of this ethical conundrum in regard to the employment of science and technology for sustainable development. Yet, I must do so on this occasion, and in respect to this very precious resource which could very well lead to regional and international conflict in the next half-century or so if not addressed resolutely soon.

Humans are narrowly selfish individuals, and have consequently perfected their performance and competitiveness in the marketplace largely based on self-interest. Yet, humans have also a social and moral/ethical facet which eschews isolation and proactively seeks consolation, assurance, and recognition in any association, community, or society. This bond with other human beings - buttressed by the bond which connects humans with the natural world, including energy and water - can greatly strengthen these community and social bonds. As Terry Pratchett graphically states in the Introduction to the book, *The Evolution Man* by Roy Lewis.

> '[The book is] a reminder that the problems of progress didn't start with the atomic age but with the need to cook without being cooked, and eat without being eaten'.

While individual humans very much work in an introvert and self-centred way, the State is on the other hand too remote from individuals, and its relations are too much of an external and disjointed phenomenon. These relations do not penetrate to the persona of the individual, or his conscience, nor does the State socialise with the individual. The two appear to prowl about in their two separate corners of the shared activity arena. What may provide a link between the two prowling entities are the community, the enterprise fraternity, and the livelihood occupational groups. Once this linkage becomes manifest the living values of faith, hope, justice, equity, and trust become emergent throughout the whole continuum of the activity arena - whether one regards himself as purely legalistic and secular, or exists as the embodiment of religions morality and ethical conformity. This contrast has been perceived in very succinct terms by Francis Fukuyama, who avers in the following terms:

> ‘Groups can be formed at any time based on self-interest, and group formation is not culture-dependent. But while contract and self-interest are important sources of association, the most effective organisations are based on communities of shared ethical values. These communities do not require extensive contract and legal regulation of their relations because prior moral consensus gives members of the group a basis for mutual trust. The social capital needed to create this kind of moral community cannot be acquired, as in the case of other forms of human capital, through a rational investment decision. ... Acquisition of social capital, by contrast requires habituation to the moral norms of a community ... before trust can become generalized among its members.’

What we must challenge ourselves to do, then, is not simply to agree to a plethora of international legal obligations, which we have attempted to do in all the major areas of human heritage, such as the Law of the Sea, but rather to begin the long, arduous task of building a lasting foundation of community trust, community justice, and community equity in the availability of and access to freshwater resources by all people in the comity of nations in their entirety.

III. Mr Federico Mayor,
Director-General of UNESCO

Madam Chairperson,

Madam the Minister of Culture of Norway,

Professor Odhiambo,

Members of the Commission,

Ladies and Gentlemen,

I would like first of all to thank the government of Norway on behalf of UNESCO for all the facilities that you have made available to us and for your enthusiastic involvement from the very beginning. My thanks go also to Ms Vigdís Finnbogadóttir who has been from the outset a point of reference and a pillar for this Commission. I thank the members of the Commission, all the participants and the Norwegian National Commission which has played a very important role in the success of this meeting. I must also express UNESCO's gratitude to *Norsk Hydro ASA* for their financial contribution and support. I am particularly indebted to you, the First Lady of Egypt, Mrs Mubarak, for your presence here and for chairing this morning a very important part of this session so brilliantly.

Fresh water, energy and information are on-going issues dealt with by the Commission and now outer space and the environment are also on the agenda. I think the themes that you are going to consider in the future are fascinating. Your Commission is essentially a transdisciplinary body which has to try to establish inter-connectedness between many dimensions: the scientific, the technological, the ethical, social, cultural and also the past and the future. The lessons of the past are crucial but we must never forget the future. I insist on this very much because finally what really matters is to take into account the next generations. The already born and the unborn must be permanently in the minds of all those who are members of this very important Commission.

I am fascinated by the future. I have written a book called 'Memory of the Future'. We cannot write the past; the past has already been written. But we can and we must write the future. It is our best heritage because it is still intact. All together, we must try to make a new departure. For this we need new partnerships and I think that this morning the need was emphasised very strongly to work together with non-governmental organizations, with intergovernmental organizations, with the practitioners, with the policy-makers and with the parliaments because they are the voice of the people. Let us also not forget the city because the city is where the citizens live and it is where they can participate.

Education is at the very heart of this inter-linking function of the Commission. At the centre of our efforts is the extent to which we can provide education. Education is much more than information, much more than instruction. This morning we have been talking about the important role of the information society and of the information technology which facilitates the flux of information. I am happy that Mrs Mubarak is here because she is a promoter of reading as you know. This is one of the most important projects in UNESCO - to read in order to reflect because when we have a book in our hands, there is a dialogue. Finally what really matters is that we are able to think.

I was recently in the United States at a meeting of the American Physical Society with many distinguished people. Its President, Professor Jensen said at the beginning of his speech something that for me was very important and which I would like to share with you. His first word was inertia - only this word - and he said this is responsible for most of the problems we have. Because we do not dare to change this inertia - this trend. Yes, we do not dare and sometimes we do not dare because we do not know how to make changes. Sometimes we have the knowledge, but we do not dare use it. Risk without knowledge is dangerous, but knowledge without risk is useless. We must dare every day in order to contribute to the transformation of the world we live in. As we said this morning, now is the time for action. Professor Naresh reminded us of the cost of inaction.

Madam Chairperson,

I would like to tell you that I appreciated the reference that you made in your speech at the opening of this meeting of the Commission to what is feasible and what is acceptable. Although knowledge is positive, the application of knowledge can be negative or even perverse. We must try

to contribute to worldwide awareness, to worldwide consciousness that knowledge should be properly utilised for the benefit of humankind. In particular, we can utilise this knowledge in order to take preventive measures, in order to anticipate. But preventive action is not visible and this, for governments, is very important because actions must be visible in order for citizens and the constituency to appreciate that they have done something. Therefore we must try to make these intangibles more visible to encourage governments to pursue preventive action.

I will conclude by saying that if we can make people aware of the wonder of peace and of health and well-being, then governments and decision-makers will favour preventive action, anticipation, and not only always the curative action, the post-conflict action. Madam, you have an impossible mission - as in general in UNESCO we have impossible missions because we have preventive missions. We will try to ensure that what you are doing and what the Commission is doing becomes as visible as possible.

Thank you.

IV. H. E. Mrs Vigdís Finnbogadóttir,
President of the Republic of Iceland 1980-1996,
Chairperson of the COMEST

Madam Minister,
Mr Director-General,
Members of the Commission,
Ladies and Gentlemen,

We have a precious heritage here in the North, among many, which is said to have been written some eleven or twelve hundred years ago. It is a poem written in the ancient Norse language - the language of the ancestors of the Norwegians and the Icelanders. The poem is called Völuspá 'The Sybil's Prophecy'. In wonderful poetic verse, it tells about the creation of the earth; and how, from the void, it came into being and how it was protected and ruled by a number of gods who symbolised the different facets of the character of man, as in Greek and Roman mythology. There was evil on that earth too, that created strife and managed to seduce the gods into disagreement and a cruel battle. 'Brothers will fight one another' and bring about the destruction of the earth. A part of the poem relates the terrible war that raged - Ragnarök - which in fact inspired Wagner to write the music of the 'Götterdämmerung' - the false step of man that makes the earth sink into darkness. But at the end of the poem there is a bright, optimistic note. Earth has the incredible capacity to struggle out of the darkness. The last lines of the poem express the Sybil's vision.

She sees arise
A second time
Earth from the sea,
Green with growth.
Falls cascade,
The eagle flies high,
The one from the mountains
Who stoops for fish...

We have now come to the end of some very memorable days here in Norway at the first meeting of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), where we have cemented friendship through a mutual understanding of the problems of human attitude that we have been asked to tackle in order to share the final vision as written in The Sybil prophecy so long ago.

'Responsibility is concern, recognized and accepted as the duty to be other than oneself', said the philosopher Hans Jonas. At the dawn of the twenty-first century, the status of our scientific knowledge and the powers conferred on us by our technologies bring us, more than ever before, face to face with our responsibilities towards ourselves, our communities and humankind as a whole.

Although science has long been looked upon as a principle of knowing and not as the principle of an action, the modern age has seen such developments in sciences and technology that man is able to change nature. From speculation, science has become action, and, in that process it has given rise to problems and new concerns. Whereas, even as recently as yesterday, it was allowed to develop unchecked and without safeguards, for the sake of the well-being that it was supposed to provide, today it is required to furnish advance proof of innocence. From this observation has arisen an idea that is seen to be essential in scientific and political circles, - the idea of evaluating technology and that of identifying the major scientific discoveries likely to raise controversy. Mechanisms had to be set up to regulate the course of technical progress by anticipating its consequences. This is what the World Commission on the Ethics of Scientific Knowledge and Technology is all about.

Looking back, we can say that science has made great achievements - but some of its applications less so. Let us not forget that earlier this century, a horrified world witnessed the destructive capacity of certain scientific applications and their power to squash life on a scale unknown to date.

No one can predict the future as far as scientific discovery is concerned. Research is fashioned out of the unexpected and from uncertainties and I know that we all agree on the need to take a close look at the development and future use of recent discoveries. To speak of new discoveries is to assume that there are new choices which, in turn, imply new freedoms and these new freedoms call for new responsibilities. This new knowledge we are confronted with places us before new situations that lead to new choices. And that is when the crucial step is the very moment a choice is being made - and we agree that choices should be

guided by ethical values. But it will escape no-one's attention that this contains two levels: an individual level where each one forges his own moral law and his own ethics based on his personal taste and needs, his professional code of conduct, and at the same time of a collective level at which we strive to define common ethics of responsibility in order to live together.

On the one hand, science is one of the only values to have resisted the general erosion of society's landmarks. On the other, this science seems today to be ambiguous and often disputed, as it engenders good as well as evil. The traditional paradigm of the necessary benefits of 'scientific progress' has been profoundly questioned, and not the least by scientists who, for their part also, are seeking answers, through critical reflection, to the questions that science is putting to society. The social and ethical dimension of the problems created by the steadfast marching forward of sciences and technology calls for a broader and more accurate dissemination of know-how, which ought to widen the field of public debate.

Widening the field of public debate and creating enlightened opinion responds to the requirement of democratization, which seeks to inform the greatest number about scientific results as well as their provisional and revisable character, their modes of constitution, the epistemological problems posed by their new approaches, the ethical problems raised by their ends, their cost for society, etc. To achieve the widest possible sharing of knowledge, which is knowledge *in situ*, remains one of the pillars of democracy.

Science must be utilized much more than it is at present, as has often been in focus these last days, to alleviate human suffering: to respond to dramatic environmental changes, for example. We have - and that is a dramatic way to express it - powerful alliances for the defence of our frontiers. The most sophisticated technologies based on the most recent scientific discoveries, are utilized. What alliances do we have for the defence of our air, our water, our soil? Do they not deserve protection, when they face potentially irreversible damage? The risk of irreversibility places a particular responsibility on us: if a major risk appears imminent, it is not the time to commission a report or start another survey, it is the time for action.

Such ethical reflection calls for a free and open exchange of experience and ideas between scientists, decision-makers and representatives of the civil society in all its diversity. May they be capable together of identifying issues, setting points of reference and advocating a

range of forward looking options. Farsightedness must replace the short-sighted way of action. A genuine system of risk management must be put into operation.

The technologies arising out of the progress of science are now no longer mere tools for the production of commonly used industrial or consumer goods. They have entered the sphere of daily life. They entail the risk of being diverted from their purpose through the mere fact of their use, whether industrial or domestic. While new forms of know-how provide access to new forms of power, they create increased threats, giving citizens at times a feeling of fear of belonging to a society at risk. This leads to the question of wanting to know what societies wish to do with the knowledge that they produce. Ethics is also a form of risk management seeking to protect the human being as efficiently as possible.

This approach brings three principles into play: a principle of precaution to prevent any decision whose consequences would be irremediable; a principle of making profitable use of experience and a principle of vigilance in the face of perceptible signals of risk. There are two ethical requirements guiding the implementation of these principles. Firstly, transparency which, by establishing dialogue, provides citizens with active participation in the making of the decisions that they are entitled to expect in a demographic context. Thus, for example, with regard to companies, the management of professional risks must be negotiated on the basis of the different factors that set acceptable levels of risks. Secondly, solidarity must be developed both between different geographical and cultural zones and, as stated earlier, in the context of lasting development.

The examination of the preliminary report on the Ethics of Energy that was presented to you has shown that, alongside the current worldwide debate on energy policies, it is necessary that any talk of ethics, risk management and forecasting techniques, must include an examination of the progress of the overall balances seen in relation to the principles of equity and solidarity. Given the foreseeable increase in energy consumption in the world, it will be necessary to find energy sources that make it possible to satisfy needs and, in so doing, we must take care not to forget the industrial aspect. It is of paramount importance to take account of the big energy markets of the future, markets that will be big in terms of both industrial consumption, related to high rates of development, and domestic consumption that we shall witness in the future because of demographic factors.

Forecasting has been defined as arbitration between the present and the future, related both to ethics and to risk management in terms of costs and benefits. In this context, we are confronted with an evaluation of non-market values that is usually based on contingent techniques of assessment. For example citizens are asked if they are ready to pay in order to preserve the environment. The science of economics does not allow us to skimp on a democratic debate.

And may I add that I am convinced that we all here today, are in full agreement with the idea that water, as a vital part of the planet's heritage, should come under a world contract on water.

This world contract would affirm recognition by the international community that, as a resource common to humankind, availability of fresh water is a basic human right. The World Contract on Water could further the efforts currently being made to bring this right to the 1,4 billion people who are today deprived of it.

If no concerted action is taken in the next ten to fifteen years to set up an effective worldwide framework for the political, economic, legal and sociocultural regulation of water, there is a risk of numerous territorial conflicts and ruinous economic, industrial and commercial battles over its control. The principal source of life for humankind will be transformed into a vital strategic resource, and hence into a scarce commodity in new and particularly lucrative markets.

Madam Minister,

Mr Director-General,

Ladies and Gentlemen,

The World Commission on the Ethics of Scientific Knowledge and Technology has expressed the wish that the final report includes examples of good ethical practice in the field of energy.

It wants to propagate respect with reference to natural resources, changing behaviour, cultural sensitivity, reversibility and responsibility. As a perspective, we might develop principles and guidelines for ethical criteria.

The Commission appreciates the fact that as an interdisciplinary body, and with the diversity of experience of its members, it can indeed hope that its voice will be heard. It has asked itself how it can reach the public at large and seeks innovative ways and means to achieve this. The Commission has also reflected on how to tackle the complexity of scientific, social, political and cultural issues. And of course it is fully aware of the importance of ethical issues in education.

In conclusion, I would like to stress the point that the topics broached at this first session of the World Commission on the Ethics of Scientific Knowledge and Technology and the open-minded spirit that prevailed in our discussions, in which there was wide participation by representatives of the civil society, the world of politics and economic decision-makers, show, if it were necessary, that the World Commission is really the intellectual institution for exchanges of ideas and conclusions based on experience in the countries that make up the international community. I am convinced that the Commission will strive to detect the first signs of danger and advise decision-makers accordingly, that it will continue to invite the most qualified specialists from the world over to deliver their opinions, and finally that it will be able also to encourage the scientists, the decision-makers and the public to join in a dialogue. This kind of public debate will compensate for the excesses of specialization and will, without any doubt, enable the Commission to contribute to better risk management and thereby become the keystone of a culture of responsibility and solidarity. The citizen should be considered not only as a consumer of science and technology, but indeed an actor. Is this not one of the challenges to which societies must respond if they genuinely wish to base themselves on democratic values?

Chapter 4

Contributions

1. **'ETHICS AND ENERGY'**
   - Mr Nicholas A. Ashford
   - Mr Garigen Aslanian
   - Mr Jean Audouze
   - Mr Inge J.T. Joansen
   - Mr Yonglong Lu
   - Mr Claude Mandil

2. **'ETHICS AND FRESH-WATER RESOURCES'**
   - Mr James C. I. Dooge
   - Mr Liu Changming
   - Mrs Monica Porto
   - Mr Kuniyoshi Takeuchi

3. **'ETHICS AND THE INFORMATION SOCIETY'**
   - Mr Suman Naresh

4. **'THE ETHICS OF SPACE POLICY'**
   - Mr Alain Pompidou

INTRODUCTORY REMARKS

by Mr Nicholas A. Ashford
Professor of Technology and Policy,
Massachusetts Institute of Technology
(Cambridge, MA, United States of America)

First, it must be remembered that energy is not fundamental in the same way as food and water - although it is very important. Rather it provides an instrumental function, essential for satisfying a variety of human needs, including:

- heating and cooling (comfort and an enabling environment for learning, and working; food preservation),
- production of goods and services,
- transportation, and
- solving environmental problems.

Sustainable development requires that we focus on questions of equity in access to, and the generation and allocation of, energy sources.

Insofar as the effects of extraction, generation, use, and externalties associated with energy sources give rise to concerns of justice and fairness, equity must address the distributional consequences:

- between generations,
- among nations,
- within nations, and
- between human needs and the environment *per se*.

Since there are important ethical concerns in making energy decisions it is essential that we democratize decision-making related to energy. This means appropriate public involvement in the questions:

- what do we want with regard to energy?
- how do we get there?
- who makes the decisions, and for whom?

The changes demanded by environmental and economic pressures require more than incremental improvements. Limits to growth are especially important with regard to energy use. Factors of 4-10 improvement are needed through changes in:

- energy efficiency,
- energy demand (consumption), and
- energy sources and supply.

The tools and means to achieve the needed improvements include:

- education and information,
- getting the prices right (that is, internalizating the social costs),
- setting quotas and implementing other regulations,
- undertaking R&D for sustainable development focusing on both energy *per se* and on satisfying human needs and wants by shifting patterns of production and consumption.

The use of these means have distributional and equity consequences, and therefore policies must address these concerns directly, rather than after-the-fact. In particular, the North must assist the South, not only in helping developing nations to reduce their energy dependence, but also in helping raise their standard of living and encouraging national self-reliance, rather than dependency.

Finally, it must be recognized both (1) that there are serious market imperfections (such as monopolies and prices that do not include social costs) and (2) that markets are inherently imperfect in dealing with problems which span many generations, such as global warming.

For these reasons, there are important roles for both national governments and for international agreements and co-ordinated actions focusing on both energy as a technical problem and the equity consequences of energy policies.

The precautionary principle, initially applied to taking protective preventive action against possible adverse environmental effects from chemical and nuclear pollution, must be applied to energy problems in terms of both environmental consequences *per se*, and in terms of the distributional effects of energy generation and access to energy sources.

ETHICAL ISSUES OF ENERGY: THE LEAST REGRET OPTIONS AND RULES

by Mr Garigen Aslanian
Vice-President,
Centre for Energy Policy (Moscow, Russian Federation)

Energy plays a crucial role in today's society. It is an essential ingredient of social development and economic growth. Energy is a provider of basic needs and services. It is a commodity for households throughout the world, for heating, cooling, cooking, lighting, transportation, and numerous other activities. Moreover, it is a production factor of eminent importance in virtually all sectors of industry.

Energy needs - in the past, for the present, and in the future - are driven by three principal factors: population growth, economic development, and technological progress. The need for energy has grown, closely following accelerated world growth in population and economic activity. Energy has gained an enormous strategic value. The safeguarding of energy supply has even led to war, as in the oil-sensitive area of the Gulf. As a consequence, energy supplies are closely and continuously watched. The price of oil is announced on the news every day and governments throughout the world have implemented rules and regulations to monitor and control the energy sector, its reserves, production, trade, stocks, consumption etc.

The current energy situation is based on the widespread acceptance of three basic propositions.

Resource Availability and Disparities in Energy Consumption

The resource scarcity perceived in the 1970s did not occur as originally assumed. Recent knowledge indicates that available geological energy resources over the next century could be able to meet the growing energy demand and would not constrain global economic development.

But distribution of energy resources and access to them is unequal. Increasing import dependency, together with lengthening supply lines, will create problems of availability and pricing even within the next 30 years. Fossil fuels will remain the basis of supply: they are likely to increase in absolute terms under any realistic scenario. Equally, there is no new single source of energy in prospect at least for the next few decades.

But, in spite of energy availability, levels of economic development, standards of living, and access to energy are distributed distinctly unevenly around the world. Comparisons based on Gross Domestic Product (GDP) show the richest 20% of the world's population produce and consume 65% of the value of all goods and services globally. The poorest 20% dispose of only 5% of global GDP. *Per capita* GDP differs by a factor 17, for example, between South Asia and the United States of America.

Disparities in energy availability mirror the economic disparities among regions. The richest 20% of the world population use 55% of final and primary energy, while the poorest 20% use only 5%. Per capita use of final energy is varied by a factor 18 between North America and South Asia. Of all energy carriers, the disparities are largest for electricity. The richest 20% use 756% of all electricity, while the poorest 20% use less than 3%, reflecting their much more limited access to commercial energy in general, and to electricity in particular. In absolute terms 50% of the world's present population are living without supplies of commercial energy.

By 2020, with world population growth projected at 8.1 billion and expected to double by 2100, and with urban population to more than treble, there will be major growth in energy demand under the pressure of population increase in particular. At least 85% of the global energy consumption increase anticipated over the next few decades is expected to come from the developing world. 85% of humankind will live in what today are classified as the developing countries. Therefore, either billions more people will continue to live without even the most basic requirements for reasonable living, or the demand for energy will grow prodigiously.

Environmental Dimension of Energy Use

Every use of energy causes some kind of environmental impact on a local, regional and global scale. Here are some examples: combustion of woods and fossil fuels leads to indoor and outdoor atmospheric pollution of particulates and acid rains. Transportation of oil involves tanker accident resulting in a significant oil flow to oceans. The use of nuclear

energy is related to radioactive emissions and involves risks of accident with radioactive releases. Hydropower is often related to considerable loss of land and may even involve severe environmental damage when large areas are flooded.

It is obvious that concerns about negative impacts of energy production and consumption are not new. Complaints about indoor air pollution from burning coal date back to the 13th century. Only with the advent of industrialisation, however, and its resulting concentration of energy consumption in urban and industrial areas, did air and water pollution begin to exceed the assimilative capacities of local environments and became major issues.

The type and extent of pollution are closely related to the degree of economic development and industrialisation. In the developing world urgent environmental problems are related to indoor air pollution. Another urgent environmental problem consists of the high concentrations of particulate matter, sulphur dioxide and nitrogen oxides in urban areas. More than one billion people in the developing world cities are exposed to unacceptably high ambient concentrations of suspended particulate matter and sulphur dioxide, significantly exceeding World Health Organization guidelines. The situation in many countries in transition is not much better.

While some important energy related environmental impacts have been effectively mitigated mainly in industrialised countries, the situation seems more difficult for global environmental effects which occur far away from the location of emissions or which do not appear immediately and may thus be more significant to future than to current generations. From various global environmental impacts the most known is global climate warming caused by green house gas emissions, among which CO_2 is the dominating one. Others include radioactive wastes and clean water issues. The concerns with global environmental effects became more significant due to expected growth of energy production.

The Role of Energy Efficiency

The way energy is used in different countries and efficiency of its use is usually measured by an indicator called energy intensity, i.e. the ratio of energy consumption per US dollar of GDP. Long-term studies of the evolution of energy intensity for a number of countries show that this indicator increases in the initial phase of development when the inefficient and heavy industrial infrastructure is put in place, reaches a peak and decreases steadily.

What the data indicates, however, is that latecomers in the development process follow the same pattern as the previous ones with less accentuated peaks: they do not have to reach high values of intensity even in their initial stages of industrialisation because they can benefit from the modern methods of manufacturing and more efficient systems of energy services provision already developed.

In other words the coupling of energy and GDP growth, which was considered iron-locked to each other in the past, is not a general feature of modern economies. These trends started before the oil crisis of 1973 and the increase of energy prices and environmental concerns only accelerated the pace of energy efficiency enhancement in the developed countries.

In contrast, the energy intensity in least developed countries is increasing. The adoption of outdated inefficient technologies foisted on them by industrialised countries seems to be part of the reason for this trend. As far as the economies in the transition is concerned reasons for high energy intensity resulted from a continuing complacent attitude to energy, highly aggravated by negative consequences of ongoing economic reforms.

It is clear that humankind willing to meet the growing energy demand and to diminish existing large disparities, cannot afford for developing countries the energy path being exercised by industrialised ones. Although the ethical appeal of global consumption levels rapidly ‘catching up’ to those prevailing in industrialised countries is quite understandable but to what extent is it ethical to endorse its accomplishment.

One way out for developing countries from dilemmas posed by economic and environmental concern, is to leap-frog the technological path followed by industrialised societies in their process of development.

The Ethics for Satisfying Energy Needs

If one asked what was the prevailing ethic in our attitude to energy, the answer could be energy complacency and environmental illiteracy. Governance of those ethical issues led us to the challenges which humankind is facing in his energy needs.

It is clear that satisfying the growing demand for energy in the coming decades cannot be carried on by using energy in the ways we currently do. Change of attitude, change of system, change of dimension and not least change of development planning are required. On the whole we should think of creating a new ethical code in energy based on principles

of sustainability and least regret behaviour. Such new ethical codes in energy should be necessarily based on following behavioural norms:

- the least demand in resources,
- the least harm for environment,
- the least energy cost for society, and
- the least disparities in covering energy needs.

This makes us first of all focus on the needs of developing countries, where one billion or more people face a short life of disease and abject social conditions. To relieve the poverty in the developing world, and to provide it with the required energy for societal and economic development and to do this in a sustainable way represents a new challenge to global energy community, governments and industries alike and requires a radical reappraisal of many aspects of energy ethics. Our recognition of this need marks a turning point for the energy community.

The next must be that of economic development, through the increasing use of energy resources, and protection of the natural environment which are not, as once thought, in unalterable opposition, a conflict of good and evil. They are two sides of the same coin called ‘sustainability’. Thus it can be argued that an increasing standard of living in developing countries may bring with it some prospect of slowing down population growth, itself a major engine for greater resource use and environmental degradation. It also provides better means to care for the local environment, so often ravaged by the consequences of poverty.

That objection never could be achieved if developed countries in accordance with new ethics do not take the leading role in facilitating the mobilisation of appropriate local and global finance and transfer of technology to the developing nations. If they fail in this, the supply of energy on economic and abordable terms to meet basic needs and economic growth in the developing countries will be severely retarded.

Sustainable Development

It is now beyond debate that a way has to be found, through the concept of sustainable development, to reconcile the vital demands for economic growth with the equally legitimate concern to protect the planet and its people. Ethical norms must require that environmental protection and economic development can be made to go hand in hand, and are no longer to be seen as in irreconcilable opposition. This also is a turning point for the energy community and should be a turning point for the environmental and ecology groups as well.

The main prerogative to lessen energy demand is laid in transition from demand of primary energy supply to end point services which energy is the means of providing. Future energy services need to be more efficient, cleaner and obtrusive.

As a dominant for demand, energy prices must be adjusted to reflect their full costs, including certain environmental costs, so that energy consumers everywhere know what the consequences of their actions and preferences are, so that resource use is optimised in terms of investment in supply and energy-efficiency, and so that investment funds can be mobilised on a world scale.

Energy subsidies must be phased out and markets liberalised so that competitive market forces are free to provide adequate energy supplies through diversification rather than protectionism, and at the true cost of supply.

Institutional framework of law, regulation, and access to markets in every country must be developed and enshrined in such a way as to encourage the free movement of finance around the globe. The predominant view seems to be that the amount of finance required to make a sustained attack on the provision of energy supplies to the developing and transitional economies may not be excessive in absolute terms compared with the capacity of world markets - if spread over time.

International barriers to trade and competition in energy should be dismantled:

With sustainability in mind *Energy Ethics Code* should call for:

- positive programmes to encourage rational energy conservation by consumers everywhere and to improve the energy efficiency of the world's stock of capital goods used in production and consumption;
- positive programmes to encourage the development of renewable energy resources, recognising their own limitations and local environmental impacts;
- sustaining and developing the world's capabilities to deploy nuclear energy safety and without undue public concern;
- concerted efforts of international institutions to grapple more strenuously and urgently with organising 'least regret' programmes and adaptive measures to deal with possible climate change on an international basis.

Environmental Actions and a 'Least Regret' Strategy for Climate Change

Determined efforts must be made to tackle local and regional pollution by the adoption of even cleaner technologies and the discouragement of the more polluting and wasteful uses of energy. For the majority of people, overcoming these local and regional problems has a higher priority than the potential impacts of climate change. Nevertheless, given the continuing uncertainties of climate change, its potential risks must not be down-played.

There is no one set of remedies for global environmental problems. A 'least regret' strategy as a key component of new ethics must be adopted in relation to potential climate change with a balance of precautionary measures and further studies.

The further studies should seek to improve the scientific basis of our understanding, in particular with respect to the sources and sinks of greenhouse gases and the interactions of aerosols, clouds, volcanoes, and so on.

The precautionary measures should put the emphasis on conservation, increased efficiency in the production and use of energy, and the development of non-carbon fuel sources and appropriate ecological strategy.

Given the limited finance available, it would seem sensible for precautionary measures to be focused on those countries which will in the future be the largest sources of increased CO_2 emissions, taking advantage of the fact that those countries currently also tend to have low energy efficiency. It would seem wise, however, if governments and international institutions themselves started to give more consideration to how best to adapt our world to the consequences of climate change if current pessimistic forecasts should prove to be right.

We can only, therefore, do better with what we have and seek to diversify our energy sources. However, even if there is no prospective shortage of supply, we must not be complacent on the technical front if we are to satisfy the dictates of sustainability and care for the environment. The energy community, and behind them, governmental and intergovernmental institutions, should concentrate their development efforts on:

- improving the operational efficiency of existing energy facilities and reducing emissions, especially in developing countries and in the economies in transition;

- developing technologies that offer the prospect of higher production efficiencies and better environmental performance;
- reducing the capital costs of renewable sources of energy;
- improving efficiency in use of energy-using facilities and means of transport.

Sustainable Technology Development and Transfer

Technology development is a key to a sustainable future: rather than being shelved due to current economic problems, it must be encouraged and enhanced. This calls for a strategic view of R&D, not a tactical one driven by low energy prices and the prospect of continuing abundant supplies in the short term.

Key priorities here are again improvements in energy efficiency and environmental benign technologies, renewable energies, and nuclear energy. Provided widespread public concerns about the operational safety and waste disposal of nuclear power can be openly and fully satisfied, we should not turn away from nuclear energy.

The appropriate funds should be mobilised to support supply of goods and services to help identify and effect lie appropriate improvements to the nuclear plants in those countries, and for alternative energy sources where those are indicated.

Different Priorities and Different Economies

While being addressed to global society a new ethical code should comprise the different energy priorities of the developing, transitional and developed economies:

- for developing countries, the key issues are economic growth and access to adequate supplies;
- for the countries in transition, the main issues are the modernisation of the supply infrastructure, the promotion of the rational use of energy, and the transition to market-oriented policies and enterprises;
- for developed countries, the dominating issues are securing greater energy efficiency and continuous improvement to the technologies deployed in their own countries and overseas.

The challenge for the world's institutions is to rise above these different priorities and secure broad progress on all fronts rather than allow sectional interests to inhibit progress.

We should provide a mechanism for a better dialogue between the industrialised countries and the developing countries on technology transfer management and training, and the mobilisation of investment funds to deal more urgently with the energy needs of developing countries.

The mission of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) is to continue to expose the thinking of our meeting, to take a leading role in developing and formulating the principal issues of the Energy Ethics Code as well as drawing them to the attention of many involved macro and micro players on the energy scene at the national and international levels, including governments, parliamentarians, politicians, businessmen, journalists, scientists, technicians, ecologists ordinary end-use energy consumers etc. We are awaiting recommendations from COMEST of what we must do to carry matters forward.

THE ETHICS OF ENERGY

by Mr Jean Audouze
Astrophysician,
Director of the 'Palais de la découverte', Paris, France

The ethics of energy concern the extraction, transformation and the utilisation of energy by individuals or collective groups. Three channels can be defined: fossil energy and (coal, natural gas, oil), nuclear and renewable energy (utilisation of wood and of the biomass, hydraulic power, solar energy...) as well as geothermic energy. Particular attention should be made to electricity which constitutes a secondary form of energy (that is to say produced from another source) the most convenient to use. It must first be noted that: each one of these channels offers simultaneously undeniable advantages and disadvantages: fossil fuels which represent around 75% of primary energy are particularly easy to employ and therefore at a relatively moderate cost. However, they contribute to the increase in the level of carbon dioxide in the atmosphere and their 'fields' will become more and more rare in the not too distant future (around fifty years for the tradition oil fields, a few centuries for other forms of fossil fuels). Nuclear energy (-10% of supplied energy) does not contribute to 'carbonisation' of the atmosphere and the energy unit cost is very moderate. On the other hand, it involves considerable financing; its acceptability by the public remains problematic and the management of its ultimate long-life waste has not yet been satisfactorily guaranteed . Renewable energies (more than 15% of the total) do not 'carbonise' the atmosphere any more than the others but they are not all 'environmentally respectful'. Moreover, the cost of the energy unit of this channel will remain relatively high due to the inevitable cost caused by the corresponding concentration of energy. These facts lead to recommending increased efforts in all channels aiming to build up efficiency and performance, to encourage savings and to reduce as much as possible the disadvantages previously mentioned. Whilst recognizing

the respective values of nuclear and renewable energy, it is regrettable that research in the latter field is much more modest compared to that undertaken in the nuclear branch. Furthermore, fossil energy (and to a certain extent given the possible rarefaction in the long term, of uranium) there is a risk that energy that is produced by nuclear power will cease due to the impoverishment of mines and also because of growing demography and intrinsic energy needs that can only increase rapidly in the particularly highly populated developing countries.

Indeed, these demographic considerations are extremely important, further to the rapid increase in populations and particularly those of developing countries which are actually excluded to a great part from energy consuming communities whose requests for energy must progress very rapidly. From this point of view, there is a large disparity (by a factor higher than 20) in the demands for energy per inhabitant and per year between rich regions (North America) and the poorer (South Asia). Furthermore, the tendency to urbanisation, that is to say to the relative increase in city inhabitants where the demand for energy is increased in relation to the less demanding rural populations, will continue to increase in the years to come. Furthermore, in the field of energy, a multiplication of utilisation can be noted, particular as far as the tertiary sector is concerned: transportation, housing and way of life. It can also be noted that time is a parameter which acts in very different ways on the factors involving energy: some provide a rapid response, such as pollution, others are slower, such as demographic and climatic evolution or even everything concerning infrastructure (roads, buildings...).

As a preamble to some recommendations of an ethical nature likely to be formulated concerning the field of energy, all the technical aspects of this issue should be measured: the capacity of the different branches to adapt to an increased demand for energy; envisaged improvements in energy output and the specific technologies of each domain. Furthermore, high priority should be given to the effort and spirit of research, which supposes that no solution should *a priori* be put aside and that everything should be done to better evaluate the inherent risks of these activities.

The recommendations of an ethical nature which were put forward by the scientific group, flow from these facts as well as the considerations generally cited in this type of analysis:

- the principle of equity according to which each man, each nation has the right to adequate sources of energy;

- the principle of precaution (or anticipation) invoked at the appropriate time and always in relation to the so-called principle the so-called principle of making profitable use of experience which puts emphasis on the surveillance of the systems concerned by energy (technological, economical or ecological, for example);
- so-called considerations of ‘sustainable development’ according to which the actual use of the planet’s resources should be made from the perspective of the good of present and future generations.

From these statements and the afore-mentioned facts, the following recommendations can be formulated:

1 to consider as a (if not the) priority, the exploitation of available resources as economically and as rationally as possible, from this point of view all actors, particularly the industrialists involved in the different energy fields should be made ‘more responsible’;

2 to underline the leading role of states to ensure equity and justice and to encourage solidarity in these fields. The necessary decisions must be taken under the best possible conditions, ensuring the democratic character of the foregoing debates;

3 to recall the imperatives according to which not only must irreversible actions, particularly concerning the environment and the management of energies, be avoided, but research concerning them must be encouraged and those which aim to better foresee risks and to guard against them, at the same time recalling that zero risk does not exist. All this research appears indispensable;

4 to estimate the cost price of a unit of energy (or of energy service) is the essential factor of choice between the different sorts of energy and must guide economic and fiscal politics, as well as a more ambitious ‘rationalisation’ of energy;

5 to consider that, in this context, the preservation of the diversity of cultures remains an absolute obligation and that citizens of the different states must receive the necessary adequate education and information. International structures should also be crated to allow all nations to discuss everything relating to the production and use of energies. From this point of view, the first session of the World Commission on the Ethics of Scientific Knowledge and Technology can and must provide an essential contribution.

THE ETHICS OF ENERGY

Mr Inge Johansen
Chairman of the
Norwegian Committee of Ethics in Science and Technology

Extensive use of energy is a basis for the standard of living and the welfare of people in the industrialised countries. Lack of energy in a suitable form is hampering the development to a better life in the developing countries. At the same time there are more and more indications that the use of energy at the present level may create climate changes with harmful effects on the environment and future generations.

It is important that political authorities, the industry, the experts and the scientific community, and the general public realise the complexity of this problem which seems impossible to solve. Cutting down on energy use, and also not doing so, will both have large and global, although different types of consequences. One responsibility of the scientific community, technologists and economists included, is to give ideas on how to cope with this situation.

The importance of a working energy system may be conceived if we visualise a complete breakdown in the energy supply. Almost complete stop in all transportation, no heating and cooling to regulate, complete stop in all manufacturing processes and in all services, and a modem home would be hard to manage. The society would simply come to a standstill. This is the situation in an industrialised country.

The importance of energy is also evident from its direct economic impact. The price of all electricity production in Norway, which is about 40% of total energy use, is 40 billion NOK, using the prices households have to pay. This is very roughly 5% of the Norwegian GNP. In the years when Norway added production capacities according to annual increase in energy use, the annual investment was more than 10 billion NOK.

There also is an empirical tight relationship between economic growth and increase in energy use. Even though the total energy consumption is levelling out, the increase in energy consumption in the EU-countries in the form of electricity has nearly the same rate of increase as the GNP. It may look as if destiny has tied electricity consumption and gross national product together.

Let us look at the situation in a developing country. The energy consumption per capita is just a small fraction of that in the OEDC-countries. It should be clear to everybody looking into the situation that lack of energy is hampering social and economic development. Whereas the price of labour in those countries is a small fraction of what you have in the west, the price of especially electricity can be higher than in the efficient west. Even so, increase in energy consumption of 10 to 20% can be observed, parallel with a chronic shortage. The pressure on and the argument for increased energy use are everywhere and follow the arguments for economic growth.

Then the other side of the coin. It seems to be more and more evident that the present trend of energy use has some grave consequences on the global climate and for future generations, in fact our children and grandchildren. Many of them will be alive 50 years from now. In our economic models the value at that time is very close to zero.

It is certainly an ethical dilemma to have a just distribution of the burdens and benefits between the present generation in the rich and poor countries, and between the present generation and future generations.

Who has the responsibility for taking action, and be a guide to a best possible energy policy? In our context we should first turn our attention to scientists and technologists. To a much larger extent than today they should turn their attention to the entire problem. We can today find much good work directed towards developing safe, renewable energy sources with no long-term climatic effects and how energy can be utilised more efficiently. We have also seen global climatic models developed, that indeed have made us aware of the threats confronting us. We have also seen development of economic models that describe how free trade may mean a better utilisation of the energy sources available. All this is important and should even be strengthened. And we may wonder why the results are not being taken into use.

Let me take a small example. The technologists have since long developed systems for solar heating of hot water. This has in fact been widely used in Greece, where the climatic and economic conditions make

this energy use economical. Why has it not been put to use in Spain, where the conditions should be similar? Where is the business community?

What I would like to see is a systematic attack of the whole integrated problem. This will require that all relevant fields of science and technology join in a common integrated effort. Up to now the scientists and technologists have tended to be defenders of the importance of their research area.

There are certain trademarks in such an integrated approach:

- It must have an international outlook for two reasons: The greenhouse gases know no borders. Emissions in US are just as damaging for India and China as for US itself. It will thus be a common international responsibility to limit the emissions of greenhouse gases. Free trade among the nations makes such a common approach even more necessary. It is not difficult to see that most of the actions that one country can take alone is of very little effect, not because that country is a small part of the whole world, but because free trade will make the gain in that country to a loss in another country. Even though a modest beginning in obtaining an international sharing of the burdens, we should be very satisfied with the agreement achieved in Kyoto concerning the quota approach. Solid international ramifications on a free trade of energy is critically important.
- The industrialised nations should have a much more active attention on supporting the developing countries with competence and resources in building up efficient energy systems according to their needs. This is an important element in social and economic development. It is also expected that the bulk of the increase in the emission of greenhouse gases will come from the developing countries. If they shall succeed better than the OECD nations, they need all the competence and technology that the international community can muster.

As a Norwegian, I feel that Norway has a special responsibility. Even though a small nation, Norway is quite a power when it comes to energy. The electricity system is fully hydro-electric producing about 110 TWh annually. We are the largest exporter of petroleum in the world after Saudi Arabia. We have a good economy and quite a bit of competence and technology in a broad field of the energy area. Environmental concern has attention and research focused on environmental problem has a high

priority. With this position, the country should be in a leading position in attacking the problems confronting us. On this background, it feels for me somewhat embarrassing to say that every year, for some years ahead, we will have to increase the import of electricity to cover our own consumption.

I believe the Norwegian example illustrates my point. As in other countries, we have not succeeded in bringing the defenders of the environment and future generations together with the defenders of the social and economic interests of the present generation in a common effort. That is necessary, if we shall be able to tackle the problems confronting us.

THE ETHICS OF ENERGY: CASE STUDIES IN CHINA

by Mr Yonglong Lu
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The ethics of energy should deal with the whole life cycle of energy from its extraction, distribution and use to waste disposal. If waste disposal is not included, the life cycle is not complete, and the ethical problems of energy may not be taken into full consideration, as energy dependent emissions have raised many ethical problems such as damage to environment and human health. The wastes of energy include air emissions and solid wastes as a result of energy extraction, distribution and use.

1. Ethical Problems of Energy

There is an inequality in spatial distribution of energy resources and per capita reserve and consumption in the world. In other words, we are created unequal in terms of energy availability. For example, China is one of the richest countries in the world in terms of total quantity of energy reserve, ranking third in coal reserve, tenth in petroleum, sixteenth in natural gas, and first in hydro-power. But on a per capita basis, China is one of the poorest countries in both energy reserve and consumption, 53% of the world average in per capita coal reserve, 11.29% in per capita petroleum reserve, 14.28% in per capita reserve of natural gas, and 92.9% in per capita hydro-power. Spatial distribution of energy resources is also uneven in China, with 5.9% of the total located in north-eastern China, 9.6% in eastern China, 8.5% in central and southern China, 23.7% in south-western China, and 20% in north-western China. Interestingly, in those regions with less energy reserve such as north-eastern China, eastern China, central and southern China, there is a rapid economic development, they consume a larger share of energy production which needs a transfer from other regions. Almost 80% of the energy resources

are located in remote and mountainous areas in northern and western China where most of the poor people live. Because of poor access to the areas, it is difficult to exploit the resources. The energy resources are close to the poor, but not available for them.

Fossil fuel has taken a dominant part in China's energy structure of production and consumption, with some 75% of coal, 17% of oil, 2% of natural gas, 5.6% of hydro-power, and 0.4% of nuclear energy. The fossil fuel dependent structure of energy production and consumption has brought about many environmental pollutants such as SO_2, CO, NO_x, and smog, which has made China become the second largest country of C and SO_2 emissions, and the third largest region of acid rain in the world.

There exists interest conflicts between different stakeholders. In China, the State is the owner of energy resources, but the developers are not only state owned companies but also local governmental companies or even private companies. This generates interest conflicts in benefit and infrastructure sharing, environmental management, and field administration among the state and locality, different kinds of developers, developers and local communities.

Over-exploitation has sped up the depletion and exhaustion of non-renewable energy resources. Inefficiency in extraction and consumption has caused great losses of energy resources. All this has compromised the ability of future generations to share the same or better endowment of energy resources and strengthened the intergenerational inequity.

Extraction, distribution and use of energy have caused risks to both human health and natural environment, though risk intensity may be different for different kinds of energy resources. For use of fossil fuels - coal, oil and gas, the most serious risk they bring about is greenhouse gas emissions and pollution to air and water - the life support system. Predatory exploitation of non-renewable energy resources causes the risk of depleting and exhausting the natural resources, deprived of the right of future generations to share the resources with the same quality. Use of modern means of transportation to convey energy may bring in four major types of transport-related risks: the increase in greenhouse gas emissions, the leakage of liquid or gasified materials, the spread of toxic pollutants and the risks for road accidents. Solid wastes from power plants are a threat to soil quality and the health of the people in the surroundings. Hydro-power may have emergency incidents such as flooding as a result of collapse of hydro-dam and electricity shock. Nuclear energy is usually safe if carefully maintained, but potential dramatic accidents exist if the storage of radioactive waste is not solved

and secured for the long time span of concern. Additional concern is nuclear proliferation, as nuclear energy production may generate raw materials for atomic bombs, and can be a source for proliferation of nuclear weapons.

2. Present Initiatives for the Ethics of Energy

China is now on the right track of Rule by Law. More than thirty laws and regulations have been established and enforced for rational and efficient extraction, distribution and use, ranging from marine and terrestrial energy extraction, energy transportation, energy saving, comprehensive utilization of energy, pollution prevention, environmental impact assessment, and environmental treatment.

A change from reliance on non-renewable fossil fuels to renewable oriented energy is undergoing in energy consumption in China, the following are the major measures for making the change happen: (1) clean coal (processing, combustion, conversion, and environmental disposal); (2) restriction or prohibition of use of coal with high content of sulfur; (3) substitution of coal with natural gas in big cities; (4) more consumption of hydro-power; (5) reduction in use of leaded petrol; and (6) use of alternative energy resources: bio-gas, wind, and solar.

For dealing with the worsening air quality as a result of coal dependent energy use, the State Council of China approved the plan for Zoning of Acid Rain and SO_2 Pollution Control in January 1997. The plan set both long-term and short-term objectives for air pollution control and air quality improvement: (1) all the regions and relevant departments concerned are encouraged to make a stage-by-stage implementation plan for control over acid precipitation and air pollution, and to set aside appropriate budget for the action; (2) coal and other fossil fuels with high content of sulfur have been restricted for extraction and use; (3) for reducing sulfur dioxide, emphasis is put on air pollution control of coal burning power plants; (4) importance is also given to prevention and treatment of SO_2 emissions from chemical engineering, metallurgy, non-ferrous metal manufacturing and building materials industry; (5) research and development of new technology and equipment should be enhanced for prevention and disposal of SO_2 emissions; (6) pollution charges should be collected for SO_2 emissions, and other economic incentives should also be used to promote prevention and treatment; and (7) environmental monitoring and management are strengthened in the regions for acid rain and air pollution control.

To reduce the intergenerational inequity in access to energy and to get the poor people out of poverty, priorities are given to provide basic facilities for poverty alleviation, including road construction and transportation, electricity generation and supply, and telecommunication network establishment.

The governments at different levels have played a key role in risk evaluation and management. It is the responsibility of government to ensure that risks are evaluated on an objective basis, and to indicate above which limit a risk is unacceptable (maximum allowable level) and below which limit a risk is negligible. It is also the responsibility of government to protect society against catastrophic hazards that threaten the very existence of the community. A preventive approach, based on improved maintenance, better training, ergonomic instrument, is the best approach for reducing risk. Reducing either the probability or the consequences of a potential accident will result in reducing its risk. Therefore, work has been done on accident/disaster prevention as well as on the curative aspects of emergency response. Risk and safety management have been introduced step by step at each of the four consecutive levels: (a) national level: formulation and adaptation of legislation and regulations that pursue set safety objectives with a general purpose of risk prevention and avoidance; (b) sectoral level: adaptation of codes of good practice and guidelines for changes towards a better direction; (c) industrial plant level: the adoption or adaptation of internal working procedures and technical measures; and (d) public level: monitoring and evaluation of firm's behaviours.

3. Perspectives

Enhancement of the ethics of energy is not an easy undertaking, and needs a long-term public participatory process. To do so, the knowledge of ethics of energy extraction, distribution and use, such as equity, justice, efficiency, mutual benefit, and conflict resolution, should be made available to the public through mass media such as TV, radio, newspapers and Internet. Workshops, training programs and demonstration projects should be set up for the public to be involved in awareness enhancement of the ethics of energy.

Government has a role to play in making the co-ordination of interests between the different stakeholders in energy extraction, distribution and use. The major role of government in energy resource allocation should be resource survey, planning and zoning, regulation and law enforcement, and monitoring and evaluation.

Emphasis should be put on economic incentives for extraction, distribution, use, and waste disposal of energy. Greater efforts should be made in valuation of energy resources, non-renewable in particular. Resource accounting system should be established to incorporate energy resources into national accounting system, reflecting the true value of energy reserve and consumption. Other economic instruments such as pricing, tax, and credit, should also be used to make adjustment in production and consumption structure of energy.

The future utilization of fossil fuels in China and the world will be shaped by environmental considerations and technological innovation. R&D programs have to be reoriented to focus on developing technologies that would eliminate any environmental impacts associated with the use of fossil fuels while assuring the continuing availability of low-cost energy on one hand, on the other hand, developing ecologically sound alternative energy resources. The key to the technical innovation will be technical performance, cost-effectiveness, security, environmental impacts, and raw material availability.

With the rapid economic globalization, there will be a trend for international allocation of energy resources. In this context, global thinking is needed of ethics of energy, general consensus or agreements should be made on joint action programs. Not only political commitments but business practice can really enhance the ethics of energy in the world. Without the participation of business circles, the ethics of energy will still be a word on paper.

INTERVENTION OF MR CLAUDE MANDIL

Deputy Managing Director, Gaz de France

I myself am neither a philosopher nor a specialist in ethics. I am only an engineer, and it disturbs me sometimes to see engineers being given the responsibility, or taking responsibility of their own accord, for using their economists' tools to resolve problems that fall within the ambit of ethics and therefore need other tools. My contribution therefore will consist of an appeal to the philosophers: please be good enough to answer the ethical questions that are facing us and that we, as engineers, are unable to resolve.

I shall confine myself to three examples of these questions.

1. What is Equity in the Field of Energy When the Starting Points Are Different?

Is the average North American who consumes twice as much energy as the average West European really twice as happy? Should we take the ultimate goal of consumption for the average Chinese to be North American one? Or rather is it the West European goal? What is the meaning of an equitable distribution of the burden in the struggle against greenhouse effects and how should past efforts be taken into account? It is clear to all that the difficulties of the Kyoto and Buenos Aires negotiations resulted from the impossibility of agreeing on scientific answers to these questions.

2. How Shall We Compare the Economic Effects of a Decision (Concerning Expenditure, Income and Value) Today and at a Later Date?

I can hear you prompting the answer: the 'present value rate'! And in fact you would be right, at least so long as the time lag considered does not exceed twenty to thirty years which, as it happens, means that

comparisons can be made by one and the same individual for himself. But what does present value mean with reference to events that will take place within the next five hundred years? Or within the next five thousand years? The answer is that it means nothing at all, and that the economists are at a total loss here. You will have understood of course that I am referring to the problem of nuclear waste, but it is also the problem of the greenhouse effect and that of the depletion of non-renewable resources.

3. How Shall We Assess Risk?

Again, I can hear you giving the good economist's answer: it is enough to multiply the cost of the occurrence of risk by the probability of its occurrence. Add a dash of present value method and you get the actuarial trade currently practised by the insurance companies. And they do it very well, but how shall we account for extremely low risks of probability and extremely high costs of occurrence? In other words, what meaning can be given to the product of zero by infinity?

In this case, which is also that of nuclear accidents as well the breaching of big dams for example, the insurance companies are no longer willing to play, and so here we are at a total loss. Help! ladies and gentlemen philosophers.

The fact is that the philosophers have given us an answer that they call the principle of precaution. I have both high regard and distrust for this principle. High regard for what it really means: the need to allow for the worst possible case. Distrust for the way in which it is often used as an excuse for doing nothing. I tend to prefer a degraded version of this principle, one that is very probably less pure but provides greater encouragement to action. This is the version that the wisdom of nations has offered for centuries: let us not put all our eggs in the same basket.

And so I would say yes to nuclear power, but no to completely nuclear power (and yet, do we know that nuclear power accounts for only a third of the primary energy consumed in France, a smaller proportion than oil?). I would say yes to gas but I would not say the opposite which is no to gas in everything - but we have not yet reached that point. Yes to energy savings but no to 'savings and savings alone' which leads to a cramped and pessimistic version of existence; yes to renewable energy but no to 'renewable energy in everything'. But here I do not believe that we are taking any risks whatsoever!

ETHICS OF WATER-RELATED DISASTERS

by Mr James C. I. Dooge
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Former President of the International Council for Science (ICSU)

It is important to distinguish between the risk of a geophysical hazard and the impact of the resulting disaster. The factor linking the two is the vulnerability which is 'the capacity of an individual or a group to anticipate, cope with, resist and recover from the impact of the natural hazard'. Water-related disasters include not only sudden floods (both river floods and coastal flooding) and prolonged droughts but also the impacts of water-related movements of earth and rock masses and of glaciers.

Statistics on natural disasters indicate the extent of the problems posed by water-related disasters. Floods constitute on the average about 30% of all natural disasters (floods, tropical cyclones, droughts, earthquakes, etc.) and over 30% of the economic loss. Droughts affect a larger number of people than any other type of disaster, possibly 60% of all persons affected by natural disaster. One estimate for the decade of the 1970's put the annual number of people affected as over 24 million for droughts and over 15 million for floods.

Disasters differ widely in regard to the causal hazard, the vulnerability of the local community and the time scale of the disaster impacts. Nevertheless we can identify the following phases in any typical disaster: the anticipatory phase, the alarm phase, the impact phase, the relief phase, and the rehabilitation phase. The reduction of the impact can be accomplished by taking action in good time in planning for coping with all of these phases. This application of the precautionary principle raises a number of key ethical considerations.

A key first stop in coping with natural disasters is the assessment of vulnerability. This involves a number of steps: assessment of the hazard risk, identifying the degree of exposure of individuals, groups and communities, identifying variations in vulnerability arising from socio-economic factors; and clarifying anomalies and interaction between factors. The scope for mitigation of vulnerability involves a number of different areas: hazard assessment and reduction by both structural and non-structural means; preparedness through monitoring, training of those involved, establishment of adequate early warning systems; advanced planning for both immediate post-impact relief and longer-term post disaster rehabilitation. Guidelines in regard to these activities are contained in the 1995 Yokohama Strategy and Plan of Action of the International Decade for Natural Disaster Reduction.

The ethical problems of water-disasters involve the individual in a number of contexts depending on the relationship of each individual to communities of differing sizes. These include person to person relationships, family relationships, neighbourhood relationships, work relationships, and wider community relationships ranging from local government units to all of humanity and the living world. Therefore, in constructing a system of disaster ethics it is necessary to consider the role of the individual, the role of groups (e.g. those based on community or on professional expertise), and the role of governments at all levels (local, national and intergovernmental). Because of natural diversity the project is not an easy one since the aim is one of equity rather than equality which therefore involves a balance between disparate interests, rights and duties.

FRESHWATER RESOURCES AND ETHICAL PROBLEMS IN CHINA

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I. Taking Sustainable Development as the Final Goal

'Our Common Future' was published in 1987 by the UN Committee of World Environment and Development. In 1992, the 'Agenda 21' was approved by the Assembly of Global Environment and Development, in which participated leaders of more than 176 countries. The main theme of the two historical events was sustainable development. Consequently, it is necessary for both the rational development and the utilization of water resources in China to incorporate the concept of sustainable development as their ultimate objective.

However, there are different understandings of sustainable development. Although similar in general, they differ greatly in detail. As far as water resources are concerned: firstly, the development and utilization of water resources should be continuous and sustainable; secondly, the development of water resources should meet the requirements of social and economic development. These two factors are mutually dependent. Without the sustainable development of water resources, there will be no sustainable and stable development of society and the economy, and vice versa, without the support of water resource system, the requirement of social economic development will put strain on the water resource system which might destroy the sustainability of the water resources system.

II. Harmonious Developement of Human Activities, Water Resources and the Environment

It is well known that water is one of the most important environmental factors for human survival. This environmental factor has two attributes. While the positive attribute of water is that it is part of the useful natural

resources which meets the requirements of human production and living, the negative attribute is its association with disasters causing serious threat and harm to human beings such as flooding, water-logging and drought.

Human activity can result in a dual effect on the water resources system: on the one hand, it gains the large benefit of a water supply for the development of cities, industry and agriculture; on the other hand, due to waste water discharge and overdraft of water resources, it brings about a series of water related problems, particularly for groundwater, the decrease of water quantity and the degradation of water quality, which have not only polluted the environment, but also destroyed sustainable water resources development and utilization.

There are many water related problems in China. Generally, they can be summarized into three groups. Firstly, the severe contradiction between water supply and water demand in cities and rural areas. There are more than 300 cities in China suffering from water shortage, and the actual irrigated area accounts for only 40% of the total arable land. The second group belongs to the frequent occurrence of floods, water-logging and drought. The annual loss caused by floods and drought makes up 60-70% of the total loss caused by various natural disasters. Thirdly, it is the serious water pollution. Especially south China, where water is abundant, is subject to water shortage due to water pollution. The three groups of water related problems mentioned above all have close relations with humans, water and the environment. Therefore, the harmonious development of human, water resources and the environment is the most important solution for the sustainable development and utilization of water resources in China.

III. Equal Development of 'Strong' and 'Weak' Water Resources

China is a country with a vast territory. The spatial distribution of its water resources is quite different between the south-eastern and the north-western parts. Additionally, due to the influence of the monsoon climate, the temporal distribution of water resources varies seasonally. The great differences in space and time of its water resources greatly increase the difficulty in regulating and storing water resources in China.

In view of such distribution water resources can be divided mainly into two types. One is the concentrated water resources with the feature of high intensity of water flow rate in a short recovery period for replenishment, such as river water and easily recharged shallow groundwater. The other is the discrete water resources with the feature of

low intensity of water flow rate covering a large area. That is rainwater resources. The former is the object of water conservation engineering projects, and has been the main water resources for cities, industries and agricultural irrigation. The latter is water resources for distributed water demand, including all the areas lacking concentrated water resources, such as the large area of north-western China, thousands of. small isolated islands scattered in three million km^2 of territorial sea, mountainous areas of limestone, large areas of dry climate with high evaporation and the regions subject to areas with high fluorine drinking water. More than 100 million people live in these areas, and it is very urgent to solve their problem of insufficient drinking water.

If the water flow rate of concentrated water resources is measured by unit of m/s, while mm/m is used for the discrete water resources of rainwater, clearly there is a difference of 10^5 in value. So, we call the former 'strong' water and the latter 'weak' water. Although the intensity of 'weak' water is very low, it can be intensified by artificial concentration measures to meet the purpose of water supply. Since the 1980s, rainwater utilization has risen throughout the world, and the International Rainwater Catchment System Association (IRCSA) has been founded. In June 1995, the 7th Conference of the IRCSA was held in China. As for 'weak' water, rainwater utilization is now the main trend for water resources development in the world. It is necessary for China to carry out the equal development of 'strong' and 'weak' water in its 9.6 million km^2 of continental territory and more than 3 million km^2 of territorial seas so as to realize the rational allocation and regulation of its water resources to meet the requirements of the overall development of the economy.

IV. Establishing Regional Reallocation and Regulation of the Nations's Water Resources

The unevenness of China's water resources distribution in time and space is a reason for consideration in the water transfer projects to improve such highly uneven distribution. However, the necessity of a water transfer project must be determined by carefully analysing the characteristics of the water shortage in a region where it is planned to import water (called Water Importing Regions, WIR). The necessity of a water transfer can be more easily determined for the resourcefully water-deficient regions, while a careful determination of the projects must be carried out for water importing regions, where a water shortage not only results from a resource reason, but also from inadequate use of local water. Obviously, there is no reason to import water into a region which is

not a resource-water deficient area. Therefore, an regional reallocation and its rational project scale must be proved according to the problems of the water deficit, including identifying characteristics of water shortage and meeting the socio-economic requirements in both short-term and long-term periods, as well as carefully analysing the balance of supply and demand of regional water resources. For water importing regions, an interbasin water transfer is an important method of water development. A prerequisite for implementing water transfer must be based on a water saving basis. This is the basic principle of any area reallocation of regional water. In most cases of planned water transfer projects in China, importing water is supplementary to the local water system available in WIR. Obviously, the most economical and most rational water transfer project will be achieved on the basis of establishing a water saving system and of fully creating a potential capacity of local water resources in WIR. Thus, the maximum benefit with minimum scale of the water transfer project in terms of high profit and low cost can be achieved accordingly. On one hand, a feasibility analysis is also important and highly necessary for a project: firstly, to determine whether the water exporting region has extra or surplus water available for the water importing regions in terms of the amount of transferable water for diversion; secondly, to solve the problem of a conflict of interest between both the Water Exporting Region (WER) and the Water Importing Region (WIR). In principle, the project should have no significant influence on water use in the water exporting region at present and in the future. In the case of the greater influence on WER resulting from withdrawing water from the WER, alternatively, a compensation approach must be employed to reduce such influence for protecting the benefit of the WER.

South-to-North Water Transfers (SNWT) should be seen as the principal part of the projects for the regional reallocation of China's unevenly distributed water resources. They are mainly subject to solving water shortage problem in the northern and coastal metropolitan areas, where water requirements resulting from population and economic growth exceed the load bearing capacity of local water resources. Therefore, the goal of water projects is mainly towards water supply for urban and industrial sectors associated with agricultural irrigation and improving the environment. To understand such a goal as the condition for transferring water for urban-industry, a study of the full comprehensive utilization of the project should be employed for operation. The three schemes of the South-to-North Water Transfer lines are complementary to each other. Three schemes have their own functions in the nation's eastern, middle

and western economic regions. The schemes are of important significance in meeting the needs of the nation's territorial development in terms of finally solving the extreme unevenness of temporal and spatial distributions of nation's water resources.

The other planned transfer projects beyond the areas of SNWT should have a coordinated plan with the SNWT to constitute an regional reallocation system covering the nation's territory. In order to meet the needs for establishing such regional reallocation systems, to carry out a study of the overall strategic arrangement of interbasin water transfer scheme round the SNWT is highly necessary.

V. Developing the Utilization of Sea Water and Brackish Water

Since the reform and opening policy began in the early 1980s, China has increasingly faced a serious contradiction between supply and demand in water resources, especially, in its coastal economic zones. As for the amount of water deficit, the place where the problem is most serious is not in the arid north-west, north and north-east (so called the 'N' areas), but the south-eastern coastal cities and urbanized areas, which are under humid and rainy conditions. The water deficit in these areas accounts for almost half of the total water deficit of 114 cities suffering from severe water shortage in the country. Therefore, developing sea water utilization is of great significance in all coastal industrialized areas, particularly in meeting, the high consumption of cooling water. Now, some techniques have been relatively successful in solving the corrosive problems in the use of sea water. The cost of sea water used for cooling processes in the industries has been reduced. For instance, one cubic meter of sea water used by an alkali production industry in Qingdao city on the Huanghai (Yellow Sea) shore costs only 0. 17 Yuan (about 0.02 US dollars), making up only 1/4 of the fresh tap water sold by the city's water works. Based on this experience, therefore, sea-water utilization can be employed for solving the problem of high consumption of cooling water in industries in terms of allocating and reallocating (adjusting) these industries' locations distribution along the coastal zones, so that we can make fuller use of sea-water. In addition, there will also be a good prospective for developing desalination of sea-water with progress in technology.

Besides, China has wide areas of brackish water reserved in shallow aquifers as groundwater and in some lakes as surface water. Taking the example of the North China Plain, the brackish water reserved in the plain totals 5,800 million cubic meters or so, which has a salt content between 2-5g/1. This also offers great good potential for water development.

VI. Solve the Water Shortage Problem in Urbanization

According to an estimate of China's urban growth in the mid-21st century, the urban population will increase from less than 300 million at present to about 800 million in the year 2050. In such a case, facing the increasing urbanization and rapid growth of the socio-economy in city areas, research work on water resources must be conducted around urbanization and urbanized industries in the future. At present, there are three major water issues concerning city areas. Firstly, out of 600 cities (total city number in 1995), there are 300 with the problem of a water shortage, of which 114 cities have suffered from a severe shortage. The total amount of water deficit per day of the cities in 1994-1995 was 16 million m^3. The water shortage resulted in great annual loss of industrial output amounting to some 200 billion Chinese Yuan (24 billion US dollars) estimated by a shadow price. Such a water deficit tendency has been increasing, steadily. It is estimated that the city number in the mid-21st century will double to exceed 1,000. How can we solve the problem of the increasing deficit of city water in the process of urbanization? Serious attention must be paid to this and active counter measures taken for mitigating the water deficit in the cities. Secondly, there is a problem of flooding and waterlogging control in city areas. Most important cities and towns in China have been developed and scattered along major rivers. Flood and water logging affected cities account for two-thirds of the total number of the nation's cities. So the prevention standard and capacity against floods and water logging in seven major rivers should be improved to prevent disasters in terms of taking anticipatory measures. Thirdly, it is the water pollution problem. The controlling of waste and polluted water discharged from domestic and industrial sectors is of great importance in both environmental protection and water resources quality protection.

VII. Key Task for Water Ressources Management: Water Saving

Generally speaking, both creating new sources and he conservation of water resources are two of the most important approaches for solving the water shortage problem. However, the management of water resources remains as important as ever. It is a pressing need to get rid of the habit of paying more attention to constructing a new water project than its sound management. Water management involves many aspects, such as policy, legislation (law and regulations) institution, organization, personnel, finance and operation. Water management work on water resources must focus on their rational use. Obviously, the core of the rational use is water saving. So, water saving is the main task for water resources management.

WATER AND HEALTH

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Human health depends on the provision of safe, adequate, accessible and reliable drinking water supplies. Sanitation can reduce the incidence of infectious diseases up to 80% by inhibiting disease generation and interrupting disease transmission.

The International Water Supply and Sanitation Decade, promoted by the United Nations during the 80's, achieved significant improvements in providing adequate services to millions of people in several different countries. In spite of that, today, 1.1 billion people still remain without proper access to safe water supply and 3 billion people have no sanitation services. The goals of the UN decade were not met - rapid population growth and difficult economic situation were unsurpassable obstacles in several developing countries.

Water-related health problems are closely correlated to poverty but not restricted to this single cause. Large investments are needed to correct the situation in most developing countries but some improvement on sanitation conditions can be achieved without capital intensive solutions. Teaching hygiene practices, fostering public participation in water projects and searching for low-cost alternative solutions, when feasible, is also fundamental to achieve better health standards.

Pathogenic contamination of drinking water supplies is a critical problem for developing countries. However, toxic pollution is also a critical problem that may occur both in developing and developed countries.

Water and its close correlation with health indicate the importance of this resource to the sustainable development of our society. Therefore, when considering ethical issues related to water, the role of water in providing better and safer human life is one of the most critical and important topics to be examined.

The most representative ethical questions relating to water use and health are:

- the provision of water in adequate quantity and quality to all populations;
- the promotion of conservation through reduction, reuse and recycling, in order to meet a sustainable level of water use;
- the use for domestic purposes must be given priority over other economic uses of water;
- public participation is a significant factor to achieve successful implementation of water projects.

Equitable service constitutes one of the major challenges in developing countries. Poor populations living in areas without public supply usually depend on extremely expensive and unsafe water from vendors.

When investments are considered, the problem with poor populations is that there is no capacity to pay for such services, although there is willingness to pay. Intangible benefits, such as better health and quality of life, must be included as efficiency indicators in water investments.

To solve both water supply and pollution control problems, creativity is to be used. Lowering costs and improving new technologies are essential to increase coverage of these services.

The fundamental issue that underlines all the questions cited above is the basic human right of having access to safe drinking water. The implementation of this right goes beyond establishing amounts as minimum quantities to be supplied to each person. Such minimum acceptable value varies among different cultures, economies or even climates. The important point is the recognition of the significance of providing such needs, since it can be understood as preventing a major human tragedy, mainly where children are concerned.

On the other extreme, people must recognize that water is a finite resource. It is to be shared and conserved, if such a concept of sustainability is to be achieved.

INTERVENTION OF MR KUNIYOSHI TAKEUCHI

Chairperson of the International
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During the rapid industrialization period of the 1950's and 60's, Japan experienced a number of tragic public issues, including Minamata disease. The cause of this tragedy was the discharging of untreated industrial waste, contaminated by mercury, cadmium, sulphur-dioxide etc., into rivers and the sea. Both the public and government at various levels took up the combat against such occurrences, and by the 1980's such cases had all disappeared. The institutional efforts such as the Water Pollution Control Act of 1970 were most effective. As a side effect, the effluent discharge promoted the use of recycled water in the industrial water use sector.

The Japanese experience of increasing the recycling rate of industrial water was indeed remarkable. It is an illustrative example of the importance of the governmental lead in demand management. In 1965, the average recycling rate in all manufacturing factories with more than 30 workers was 36.3%. 15 years later, in 1980, the rate was doubled to 73.6%. During these 15 years, the industrial products in monetary terms were nearly tripled, implying that the required fresh water supplement per unit industrial product was reduced to one sixth. The current recycling rate has stabilized at around 77% and the total amount of industrial water use has also been stabilized.

Such a remarkable improvement of the recycling rate in the 1960's and 1970's was the results of various factors but the most decisive was groundwater extraction control by the government. In the 1960's, due to over-extraction of groundwater for industrial use, groundwater levels dropped considerably in many cities and sea water intrusion and land subsidence occurred. Under these circumstances, government control of extraction was found necessary. Meanwhile, industrial production was expanding rapidly and could not wait for the public industrial water supply

to be planned and built. Under strong governmental leadership, the factories themselves had to build their own recycling systems to acquire the necessary water. The effluent regulations introduced shortly afterwards also accelerated recycling. Recycling appears to be the most economical and practical solution to meet the increasing demand for industrial water.

ETHICAL NORMS FOR THE INFORMATION SOCIETY

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This is a paper in which I explore, and present for discussion, a number of issues arising out of the theme indicated by its title. Starting with a definitional issue - what do we mean by the 'information society'? - I consider, in order, the relevance of ethics to such a society, taking care to distinguish between those contexts in which this society presents new and unresolved ethical issues and those in which it does not; the extent to which ethical norms actually influence behaviour, and the formation of rules, in contexts where such norms are relevant; and finally, the costs of ignoring ethical considerations where they ought to bulk large in our deliberations and our actions. I make no claim to exhaustiveness of treatment, with respect either to the issues considered, or to the discussion of their implications.

I. Meaning of an 'Information Society'

There is a tendency to define this phrase in terms susceptible to quantification, using either technological criteria such as the number of computers worldwide, the number of people getting connected to the internet every day or even every hour, and the quantity of information stored on connected servers and/or traveling across the internet; or economic criteria, such as the rapid growth and coming predominance of the information industries and/or of people employed in them; or spatial-geographic criteria, such as the increasing number of countries and/or proportion of the world getting connected every day or every hour...

Such definitions, when coupled with the (frequently, unstated) assumption that the ubiquity of information is a good thing, lead to the facile conclusion that the information society signals the arrival of a radically new type of society, representing a new stage in economic and social development, in which all existing relationships will have to be re-configured. This is true of much of the popular writing on the subject, by

journalists, Internet gurus, and the like - what Frank Webster, in his book *Theories of the Information Society*, has called 'gee-whiz writing'. It is also true of much of the academic writing which, though gushing less, also contains many examples of theories assuming or concluding, far more easily than they should, that something radically new is happening. A classic example is Daniel Bell's 1973 book, *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, in which Professor Bell, having observed accurately that there had been a shift from an economy based on the production of goods to one based on the production of services, concluded that this had give birth to a new *type* of economy, in which work was cleaner, more knowledge-based, and more appealing than it had been before.

What these (mostly, popular) writings fail to do is to go beyond description, and *evaluate* the implications of the technological changes, and the ubiquity of information they portend, for individuals, organizations, businesses and governments in their many activities in society. It is not enough simply to observe that, for all these entities, electronic means of storing, disseminating, analyzing and communicating information will soon become their principal, perhaps exclusive, means of handling information; or even to declare that when this is so, they will learn, educate, research, enter into commercial transactions and form social relationships in new and unaccustomed ways that will afford them extraordinary opportunities for personal, economic and social development. The questions that need to be - but mostly have not been - asked are more searching ones: What opportunities and/or possibilities does the information society open up for these entities? In what ways does it restrict them? What dangers does it pose for them? How does it affect their existing relationships, or balances of power? What effect does it have on the *quality* of the information available to them, and therefore on their cultural *milieu*? Only by extracting these implications positively, and evaluating them normatively, is it possible to get some sense of the extent to which the information society is something radically new, and hence requires a re-configuration of accepted ethical imperatives - i.e. of the kinds of individual, institutional, and organizational conduct that are desirable in society.

II. The Relevance of Ethics

At first sight, the conjunction of 'ethics' and 'the information society' might seem to be an odd one - after all, ethics, at least as classically conceived, is an *evaluative* enterprise, concerned with the identification of norms for the evaluation of *individual* conduct, while the information

society, new or not, is simply a *social fact*. What relevance could one possibly have for the other? This apparent disjunction disappears, however, with the realization that the information society is as much in need of rules as its predecessors, and that to the extent that it is a novel social phenemenon, these rules will need to be freshly formulated. In many contexts, new rules will be required for the regulation of individual, institutional, organizational and governmental conduct, and the task of ethics, in these contexts, will be to evaluate proposed rules and supply criteria or norms by which they can be judged. This promises to be a demanding task, the performance of which will require sustained intellectual effort over the years to come. Even great enterprises must begin with small steps, though, and the object of this paper is to clear some of the confusion surrounding this topic by identifying the contexts in which new rules will be required, and proposing a criterion by which such rules as are proposed can be evaluated.

1. The Context of Business Enterprises

Perhaps the most widely-noted implication of the information society is that the compression of space and time in it makes it possible for businesses to operate multi-nationally, and to treat many nations or regions (e.g. the EU, NAFTA, the Pacific Rim, etc.), and soon virtually the whole world, as a single, integrated unit for the purpose of deciding where to locate, whom to hire, where to raise capital, and where, how and by what commercial means to sell. Multinational operation was possible even before the information explosion, but not to this degree, because the slowness of communication made it difficult and expensive, and sometimes impossible, to coordinate the operations of a large number of units that were widely separated physically.

Commentators have pointed to two consequences of this greater ease of multinational operation, both generally viewed as undesirable, and therefore - presumptively, at least - calling for the formulation of new rules:

- loss of regulatory control by national governments, and
- the squeezing out of small enterprises.

The loss of regulatory control is less a consequence of the information society than of national decisions made in order to take full advantage of it. The compression of space and time creates merely the potential for multinational operation, but the full realization of this potential requires that the candidate enterprises be given the freedom to make their operational decisions on the basis of their optimization criteria alone, without regard to the needs or interests of the polity in which they, or their

units, are located. In the absence of such freedom, enterprises would have been unable to take full advantage of the rationalization possibilities opened up by ubiquitous information; recognizing this, many countries that formerly exercised tight regulatory control have chosen, in the last decade, to relax (or even abandon) it, in the interest of integration into the global market economy - they have deregulated domestically, and externally, they have lifted restrictions on trade, investment, capital movements, profit repatriation, acquisition of ownership interests in corporations, use and retention of control over intellectual property, and the terms of joint venture and technology transfer agreements. Recent events in Asia have illustrated dramatically the vulnerability of economies that have chosen this route, and have caused some rethinking about the wisdom of opting (in Edwin Luttwak's phrase) for 'Turbo Capitalism'. This may lead to some reversal of recent trends, and to some re-assertion of national regulatory control; whether it does so or not, however, it's clear that the loss of control that presently exists is caused, not by the information society *per se*, but by the widespread desire to take full advantage of it, and by the (possibly mistaken) belief that the abandonment of national control was the only way to do so.

In like manner, the argument that the information society enables large multinational corporations ('MNCs') to squeeze out small enterprises by exerting unbearable competitive pressure on them does not withstand close examination, because it focuses upon only one of the many costs of production - the cost of coordination. But the ease of communication in the information society reduces other costs, too, many of which are more significant for small enterprises than for large ones - e.g. the costs of advertising, of market research, and of entering into transactions with customers who are widely-scattered geographically. In many industries, these costs are so high as to constitute formidable entry barriers, which would prevent small enterprises competing at all were it not for the instantaneous, low-cost communications permitted by the electronic media; in these industries, the information society is a powerful means of leveling the playing field. And beyond these are the many opportunities that the information technologies have opened up, to small and large enterprises alike, but that the former, because of their size, uncomplicated structure, and an enterprise culture of nimbleness and adaptability, are much better able to take advantage of than the latter - a prominent, and much-discussed, example of this is the kind of 'flexible specialization' that is made possible by the ability to track changing demand patterns and inventories precisely and so to maintain short, customized production

runs. All enterprises may be equal in their ability to take advantage of these opportunities, but small enterprises are undoubtedly more equal than the others.

In the light of these considerations, it appears that, contrary to much that is said in popular writing on the subject, the benefits of the information society are distributed fairly even-handedly between small and large business enterprises. The context of business enterprises is not one, therefore, in which the information society creates new problems of industrial structure, demanding new norms for their solution.

2. The Context of Users and Communicators of Information

This context overlaps with the previous one because users and communicators are often business enterprises - for example, businesses *use* information about potential customers gathered through market research, and *communicate* information about themselves or their products through advertising. But the focus of this discussion will be *non-business* users and communicators, who consume information as end-users, or communicate it by putting up personal web pages or initiating bulletin boards, chat rooms and the like.

(a) The Issue of Access

It is clearly the case that the information society is a good thing for such users and communicators - it greatly extends their ability to use and communicate, and so greatly expands their opportunities for personal and social development. The extent to which this happens, however, depends upon the degree to which they have access to the information society, and this varies greatly between countries, and between groups and individuals within countries. These differences in, and limitations upon, access result from:

- differences in income and wealth, which cause the availability of the necessary infrastructure (e.g. telecommunications networks), and the levels of development of the hardware and software industries, to vary between countries, and the opportunities for education and training to vary between groups and individuals within countries;
- convergence of telecommunications and cable networks, and increasing concentration of the access provision industry worldwide, through mergers and acquisitions;
- a proprietorial regime, greatly extended in recent years in obedience to the wishes of the affected businesses (such as

those in the entertainment industry), whereby large bodies of information, hitherto in the public domain, have been fenced off and subjected to intellectual property rights, such as copyright, trademarks and other source identifiers that have become well-known, and newly-created rights, of a *sui generis* character, in (electronic) databases;

- the dominance of English as the language of cyberspace, which places non-English speakers at a severe disadvantage; and
- political restrictions upon access, imposed by governments that fear the destabilizing effects of unrestricted information flows.

These differences in access threaten to create a divide between the *information rich* and the *information poor*, both as to countries and as to groups and individuals within countries. For those on the wrong side of this divide, the (frequently, severely) limited ability to use and communicate in the new electronic networks is more than just a disadvantage in a utilitarian sense - it's a restriction upon their ability to develop personally and socially by taking full advantage of a new, and increasingly important, dimension of human life. It is the recognition of this implication that underlies the suggestion, advanced insistently of late, that access be regarded as a human right in the information society. Acceptance of this suggestion would underline the need for public and private initiatives to promote access and make it more equally available - e.g. by making investments in infrastructure and education, removing political restrictions upon access, providing incentives for the development of high-quality translation software by private developers, shifting the balance between the private and public domains in information by restricting the scope of private rights and/or by giving broad scope to the exceptions to such rights, etc.

(b) The Issue of Privacy

In the context of users and communicators of information, an issue that is closely related to that of access is that of privacy - i.e. that of the right of individuals (and also of private businesses, though their privacy interests are more usually considered under the rubric of trade secret law) to be free of unreasonable intrusion into their private affairs by public and private actors. While neither the threat to privacy itself, nor the apprehension of it, is a discovery of the information society - Jeremy Bentham's panopticon from the last century, George Orwell's Big Brother from this one, and the more recent writings of scholars such as Anthony Giddens in the United Kingdom and Edward Shils in the United States of

America, all antedate the information society as that term is currently used - both have been given an added edge by the sheer technological sophistication of the surveillance and analytical devices now available. In particular, the ability with these devices to combine and analyze personal data from diverse sources - for example, from police, tax, judicial and financial records - makes available to prying eyes a wealth of information that can be used to the disadvantage of employees, tenants, debtors and citizens generally. The recent controversy over the Pentium III chip just introduced by the Intel Corporation illustrates this point. The chip has the ability to identify the computer in which it is situated and so provide information concerning the preferences, and purchasing and browsing patterns, of its owner - information that (benignly, but intrusively) enables commercial enterprises to target their advertising to particular consumers or groups of consumers, or (in more sinister fashion) makes possible the political surveillance of their activities.

The incentives to misuse private information are too strong for the protection of privacy to be treated as a matter of self-regulation or to be covered by company or trade association codes of good practice. As in the case of access, a combination of public and private efforts is called for: legislation to safeguard privacy must come from governments, while the technical means of protection - such as encryption software, which scrambles information rendering it unintelligible to outsiders - are developed by private business. In view of the pervasive - and legitimate - concern over crime (on the internet or otherwise), the purpose of these efforts would not be to make private data completely inaccessible, but to keep access to a minimum. Laws and administrative practices allowing access would carefully have to define the purpose**s** for which it may be sought, the people to whom it may be granted, and the conditions under which it may be granted. At the international level, a major effort would be required to ensure consistency in the standards adopted by different countries. At present, not enough is being done at either level.

3. The Context of the Quality of the Discourse

Much of the writing about the information society reflects a technological bias, and rarely goes beyond a purely quantitative assessment of the information itself (so many bits...), or of its growth. There is seldom any discussion of the *quality* of this expanded volume of information, and where there is, it tends simply to be assumed that quality has remained unaffected, and that the information society has therefore given us more of a good thing. Commentators with other backgrounds, however, are less impressed by the increasingly complex technology and

by the gee-whizzery of its boosters, and are prone to take a more sceptical view of the content and value of the increased information. In their view, most of this information is transient and ephemeral at best, and seriously misleading in cases where it has been infected by the evil triad of advertising, public relations and 'information management', by businesses or by people in public life. Those who subscribe to the latter view see in this trend a grave threat to the integrity of debate in the 'public sphere' (the phrase is that of the German social philosopher, Jurgen Habermas), and to the reliability of its outcomes, and are led to conclude that the future of democratic institutions is at risk unless determined (and successful!) efforts are made to support and promote institutions (such as public libraries), and groups of people (such as professionals, NGOs), that are imbued by a public service ethos and operate independently of the government and the market. While this may be a gloomy assessment, it is at least leavened by the possibility that the problem is one that is susceptible of rational diagnosis, and maybe even of treatment.

Certainly this leavening, and perhaps even the gloom, are missing from the outlook of the postmodernists who see in the information society an explosion of signs signifying nothing, lacking any anchor in a reality that they represent and by which their accuracy, and quality generally, may be judged. A world of simulations, disconnected from reality and perceived as being such, can be cause for despair, for *ennui*, or for celebration, and while postmodernists may be scattered all along this spectrum, they are united in the conviction that there is nothing to be *done* about it, no rallying cry to be extracted from their philosophy. The only thing to be debated is the validity of the epistemological roots of postmodernism, with their rejection of the Enlightenment project for the progressive understanding of an objective reality, and that is too large a question for this paper (and for this author!) to address.

III. Regarding and Disregarding Ethics

The preceding part of this paper demonstrates that, contrary to popular belief and writing, the information society does not create new problems in every area, calling for the development of new ethical norms, and of rules that are attentive to them - in the context of business enterprises, for example, it creates problems and opportunities for small and large enterprises alike, and gives rise to no new problems of industrial structure. The context in which due regard to ethics is most needed, and is most likely to be productive, is that of the users and communicators of information, because it is here that limitations upon

access to the networks, and the rapid extension of intellectual property rights, pose the greatest threat to the realization of the information society's potential. The driving force in this area has hitherto been private profit maximization, which allocates scarce access opportunities optimally but without regard to distributional inequities, and impels content providers to maximize their rents without regard to what is appropriate for the balanced preservation of their incentives. The private entities advancing these overweening claims, and the trade associations, lobbyists and lawyers representing them, have hitherto had the field to themselves in courts, national legislatures and international organizations, and have prevailed upon these institutions to fashion the rules of the nascent information society in a remarkably one-sided way. The ethical imperative in this context now is to formulate a concept of the *public* interest that takes a balanced view of the needs of the users and communicators of information, and of access and content providers, the world over; and the corresponding practical problem is to identify and develop organizations capable of giving this concept effective voice. These tasks are urgent ones, which we would disregard at our peril.

THE ETHICS OF SPACE POLICY

by Dr Alain Pompidou
Professor at the Université René Descartes
Coordinator of the
COMEST Working Group on 'The Ethics of Outer Space'

I would like to thank Her Excellency Mrs Vigdís Finnbogadóttir, former President of the Republic of Iceland and President of the World Commission on the Ethics of Scientific Knowledge and Technology of UNESCO, for giving me the opportunity to present to the COMEST the goals of the Working Group on 'The Ethics of Outer Space'.

We must first of all acknowledge Mr Federico Mayor's role in understanding that the consequences of the conquest of space have made it necessary to place ethical reflection in an international context. He responded immediately to a request by Antonio Rodotá, Director-General of the European Space Agency and provided the framework for Europe's concerns to be placed in a worldwide context.

Thanks to him, COMEST now has a Working Group on 'The Ethics of Outer Space'.

Why at UNESCO?

Because outer space is part of humankind's common heritage.

Today we have passed from myth to reality.

Icarus burned his wings trying to approach the sun. Since then, the progress of astronomy, that of astrophysics, ballistics and propulsion technology, optics, electronics and software data-processing have enabled man to reach into the heavens, walk on the moon, explore the universe and colonise near-earth space.

Man has thus been able to make orbital stations and satellites for communications, earth observation and the positioning of earth-based mobile communicators. The positioning systems rely on the GPS for the United States, on GLONASS for Russia and will soon be using the GALILEO programme for Europe.

At its first meeting on 28 January 1999, the COMEST Working Group on 'The Ethics of Outer Space' defined four topics of reflection.

1. Manned Flights and Man's Presence in Space

In what way is it worthwhile for human beings to reach space?

More than anyone else, the astronaut should organise his knowledge and share it, for otherwise he will be relegated to the condition of a mere robot or a prop for a technical performance.

The question is what advances are to be expected from experiments carried out in conditions of weightlessness.

2. The Use of Space Technology

This means expanding the field of our knowledge through the exploration of the universe and of other planets such as Mars.

It also means serving utilitarian and commercial ends in order to improve communications between human beings through increasingly powerful satellites.

Finally, it means improving earth observation systems especially for purposes of meteorology and measuring ocean levels as well as to prevent and fight against natural disasters.

The ethics of the use of space technology relate not only to the dilemmas between cost and benefit and between risk and benefit but also to the protection of property rights of information sent via satellite before being picked up on the ground, and also to its availability which implies free access for all to this information.

3. The Protection of our Space Environment

This protection is the condition for the sustainable development of space technology.

There are at present more than 10,000 objects over 10 cm in size in low orbit (altitudes of 200 to 2,000 kilometres) and over one meter in geostationary orbit (altitudes of 36,000 kilometres); more than 35 million objects less than 1 cm in size rotate around the earth at speeds of 10,000 to 30,000 kilometres/hour. These objects thus amount to non-negligible factors of collision.

How can such space pollution of this kind be limited?

The future development of nuclear mini-reactors installed in satellites and space probes requires special attention.

Limiting space debris entails a cost that must be accepted by all in order to avert the risks of distortion by competition: an international legal framework is needed. At the same time, it is necessary to ensure the most efficient possible re-entry of the space station MIR into the Earth's atmosphere and manage the consequences of its return to our planet.

4. The Protection of Personal Freedoms and Cultural Identities

This issue implies taking into account the ethical aspects of:

- electronic monitoring;
- satellite communications;
- satellite positioning systems enabling the localising by satellite of mobile phones in the air, on the ground and at sea.

Thus, it entails ensuring protection of privacy inasmuch as such privacy is not a threat to the community, i.e. where it does not interfere with protection against terrorism, organised crime and paedophilia networks.

As for maintaining cultural diversity, the dissemination of communication tools (Internet and multi-media) is a factor of reduction in expression by human beings, inasmuch as it standardises the modalities of expression.

Proposals must be made to provide for appropriate training at all ages and for all, in the uses of information technology in keeping with respect for socio-cultural specificities.

This is the only way in which a danger can be transformed into new opportunities in a new space of freedom.

What has to be done is to ensure that the tools of communication are truly personalised by upholding creativity.

A society remains modern when it creates. Such a dynamic is more than ever indispensable at the dawn of the 21st century when the different cultures must learn how to live together in inter-cultural dialogue.

5. Conclusion

Access to space, which enables the exploration of the universe and the exploitation of space for communications and earth observation, brings a tenfold increase in our means of action and observation.

It also has a dual aspect, both civilian and military. The work of our Group will specifically exclude military uses from the ambit of its concerns.

This space technology, which is a source of both promise and concern, is mobilising considerable amounts of capital and represents vital issues of power between nations.

Ethical reflection will make it possible to embark on an approach of moral reasoning that places human beings at the centre of the discussion.

The ethics of science and technology implies the following, all at the same time:

- the morality of action;
- thinking about risks;
- the recognition of the other.

It will lead the Working Group to raise three questions on the ethics of space:

- what are the motives involved?
- what is the degree of acceptability not only for public opinion but also with regard to moral rules based on the defence of human rights?

how are we to ensure or restore equity, i.e. equality of access to the use of the products resulting from space technology?

The COMEST Working Group on the Ethics of Space is a preventive body whose work is based on ethical monitoring, warning and watching over the use of space technology.

It will work, eyes open, in a multi-disciplinary context and in co-ordination with international organisations, especially COSPAR, UNISPACE and the COPUOS.

We feel that the role of COMEST is to respond to concern on the part of the public opinion with an objective analysis, that is independent and transparent, and to do so in a context that is often emotional and sustained by the media.

The danger to be skirted here is that of an excessively utilitarian perception that would erase Man's characteristic capacity to dream which is often the driving force behind his inventiveness. As the Director-General pointed out a short while ago, where creativity is concerned, imagination is more powerful than knowledge.

Our Working Group will embark on an analysis of the ethical and societal consequences of progress in relation to space technology.

Its main concern will be to formulate proposals with a view to:

- defining motives;
- protecting the environment of the planet;
- ensuring the protection of intellectual property over scientific instruments as well as commercial products;
- and ensuring the protection of individual liberties freedoms and the cultural identities of the users.

It is in the light of our deliberations, and if necessary and seems realistic, that we shall propose that the World Commission on the Ethics of Scientific Knowledge and Technology of UNESCO draw up guidelines on the ethics of the development and use of space technology.

ANNEXES

1. **Composition of the COMEST**

2. **Biographical Notes on COMEST Members**

3. **List of Participants**

COMPOSITION OF THE WORLD COMMISSION ON THE ETHICS OF SCIENTIFIC KNOWLEDGE AND TECHNOLOGY (COMEST)

I. Members of the Commission

H. E. Mrs Vigdís FINNBOGADÓTTIR
President, Republic of Iceland 1980-1996
CHAIRPERSON OF COMEST

Mrs Faith DUBE (Zimbabwe)
Economy
Journalist at *Inter Press Service*

Mrs Diamela ELTIT (Prof.) (Chile)
Writer
Professor, Department of Fine Arts and Humanities,
Metropolitan Technological University

Mr Jens Erik FENSTAD (Prof.) (Norway)
Mathematics
Professor of Logics, former Vice-Rector of the University of Oslo
President of the Standing Committee for the Physics and Engineering Sciences of the European Science Foundation
Member of the NATO Science Committee and member of the Executive Board of the International Council of Science (ICSU)

Mrs M. R. C. GREENWOOD (Prof.) (United States of America)
Biology and Genetics
Chancellor of the University of California, Santa Cruz
Member of the National Science Board
Chairperson of the Board of Directors of the American Association for the Advancement of Science (AAAS)

Mrs Ágnes HELLER (Prof.) (Hungary)
Philosophy
Professor, Department of Aesthetics of the University Eötvös Loránd, Budapest
Hannah Arendt Professor of Philosophy, The New School Graduate Faculty of Political and Social Science, New York

Mrs Attiya INAYATULLAH (Dr) (Pakistan)
Démographie sociale
Former Chairperson of the Executive Board of UNESCO
President of the International Planned Parenthood Federation (IPPF)

Mr François JACOB (Prof.) (France)
Biology and genetics
Nobel Prize for Medicine and Physiology (1965)
Member of the *Académie française*

Mr Benediktas JUODKA (Prof.) (Lithuania)
Biochemistry
President of the Academy of Sciences of Lithuania

Mr James Peter KIMMINS (Prof.) (Canada)
Forest Ecology
Professor of Forest Ecology at the University of British Columbia

Mr LU Yongxiang (Prof.) (China)
Engineering Sciences
President of the Chinese Society of History of Science and Technology
President of the Chinese Academy of Sciences

Mr Wataru MORI (Dr) (Japan)
Medical Sciences
Former President of the University of Tokyo
Former Chairperson of the Committee on Policy Matters of the Council of the Prime Minister
President of the Japanese Association of Medical Sciences
President of the International Association of Universities (IAU)

Mrs Suzanne MUBARAK (Egypt)
Sociology of Education
First Lady of Egypt
Founder and Chairperson of the Egyptian Society
for Childhood and Development
President of the International Jury of the UNESCO Prize for children
and adolescents at the service of tolerance (1997-1998)

Mr Barry NINHAM (Prof.) (Australia)
Mathematical Physics
Head of the Department of Applied Mathematics Research,
School of Physical Sciences and Engineering,
The Australian National University, Canberra
'Erlander' Swedish National Distinguished Chair of Chemistry

Mr Thomas R. ODHIAMBO (Prof.) (Kenya)
Entomology
Former President of the African Academy of Sciences
Executive Director of the Industrial Technology and Engineering Trust

Mr José SARUKHAN KERMEZ (Prof.) (Mexico)
Biology
Former Rector of the National Autonomous University of Mexico (UNAM)
Senior Professor at the Institute of Ecology, UNAM
Member of the American Academy of Sciences
President of DIVERSITAS

Mrs Dagmar SCHIPANSKI (Prof. Dr. -Ing.habil.) (Germany)
Engineering Sciences
Former Rector of the Technical University of Illmenau
President of the Federal Scientific Council

The Earl of SELBORNE (United Kingdom)
Ecology and Agronomy
Former President of the Joint Nature Conservation Committee
Former President of the Agricultural and Food Research Council
Former President of the Select Committee on Science and
Technology of the House of Lords
Chancellor of the University of Southampton
President of the Royal Geographical Society
President of the Parliamentary Scientific Committee

Members ex officio

Chairperson of the Intergovernmental Oceanographic Commission of UNESCO (IOC)

Chairperson of the Programme on Man and the Biosphere (MAB)

Chairperson of the International social sciences programme on Management of Social Transformations (MOST)

Chairperson of the International Geological Correlation Programme (IGCP)

Chairperson of the International Hydrological Programme (IHP)

International Bioethics Committee of UNESCO (IBC)

- **Chairperson of the IBC**
- **President of the Intergovernmental Committee**

President of the International Council for Philosophy and Humanistic Studies (ICPHS)

Mr Julio LABASTIDA MARTIN DEL CAMPO
Sociology

President of the International Social Science Council (ISSC)

Mr Kurt PAWLIK
Psychology

President of the International Council for Science (ICSU)

Mr Werner ARBER
Biology, Nobel Prize for Medicine and Physiology (1978)

President of the Pugwash Conferences on Science and International Affairs

Sir Michael ATIYAH
Mathematics

BIOGRAPHICAL NOTES ON COMEST MEMBERS

Faith DUBE (Mrs) (Zimbabwe)

Born in 1971. Graduate of the University of Zimbabwe, she continued higher studies in the human sciences at the Universities of Besançon (France), Lisbon (Portugal) and Maputo (Mozambique). She is a journalist with Inter Press Service, Third-world news agency. Undertook research on economic globalization and its implications for human rights in Africa. Since 1991, she has represented the International Association of Students in Economics, Commercial Sciences and Business Management (AIESEC) at many international meetings. She is an expert on problems related to youth and development.

Diamela ELTIT (Mrs) (Chile)

Born in 1949. Writer, and Professor of Spanish in the Humanities Department at the Metropolitan Technical University. She is a graduate of the Catholic University of Chile and has a degree in literature from the University of Chile. She is the author of several novels including *'Lúmperica'* (1983), *'Por la patria'* (1986), *'El Cuarto Mundo'* (1988), *'El Padre moi'* (1989), *'Vaca Sagrada'* (1991), *'El infarto del alma'* (1994), *'Los vigilantes'* (1994), *'Crónica del sufragio femenino en Chil''* (1994) et *'Los trabajadores de la muert'* (1998). Her novels have been translated into French and English and published by Nebraska Press and Lumen Inc. (United States of America), *Editions Christian Bourgeois* and *Editions des femmes* (Paris), and Serpent's Tail (United Kingdom). She has also published numerous essays and articles in national and international journals and revues. She has been awarded distinctions and literary prizes including the José Nuez Martin Prize (Chile). From 1990 to 1994 she held the post of Cultural Attaché at the Chilean Embassy in Mexico.

Jens Erik FENSTAD (Norway)

Born in 1935. He is Professor of Mathematical Logic and former Vice-Rector of the University of Oslo. He is a Member of the Norwegian Academy of Letters and Science and a Founding Member of the Academia Europaea. He is former President of the Norwegian Mathematical Society, former Chairman of the Norwegian Natural Science Research Council, and former President the International Union of History and Philosophy of Science. Currently, he is Chairman of the Standing Committee for the Physical and Engineering Sciences of the European Science Foundation, member of the European Science and Technology Assembly (Brussels), member of the NATO Science Committee, and member of the Executive Board of the International Council for Science (ICSU). He has served on the editorial board of several scientific journals and written and edited many books including 'General Recursion Theory' (1980), 'Non-standard Methods in Stochastic Analysis and Mathematical Physics' (1986) and 'Situations, Language and Logic' (1987). He was awarded the Sierpinski Medal by the University of Warsaw (Poland) in 1988 and was made an Honorary Doctor of Uppsala University (Sweden) in 1998.

Vigdís FINNBOGADOTTIR (Mrs) (Iceland)
Chairperson of the COMEST

Born in 1930. Former President of Iceland, H. E. Mrs Vigdís Finnbogadóttir graduated in English and French literature (theatre) at the Reykjavik College (Iceland). She studied French at the University of Grenoble (France) and literature and drama at the *Sorbonne* University in Paris. She also studied theatre history at Copenhagen (Denmark) and French philology at the University of Uppsala (Sweden). She taught theatre drama and French history at the University of Iceland and presented French lessons and hosted arts programmes for Icelandic television. She was Director of the Reykjavik Theatre Company and later the City Theatre for eight years. She was member and then Chair of the Advisory Committee on Cultural Affairs in Nordic Countries (1976-1980). She was the first woman in the world to be elected Head of State and fulfilled four terms from 1980 to 1996 when she decided not to stand again. During her presidency she devoted herself to the cultivation of the identity and integrity of the nation: its language, culture, and youth. Active in promoting reforestation and land reclamation in the eroded areas of Iceland, she also takes a great interest in the education of children and young people and is founder, member and patron of the 'Save the

Children' Association in Iceland. She was awarded the honorary distinction of *Chancellier des Universités de Paris* (France, 1983) and has received very many honorary doctorates from Universities in Canada, Finland, France, Japan, Sweden, United Kingdom and United States of America. On leaving office she was made an honorary member of the Women's Rights Association in Iceland. She has represented the Nordic countries in various important events called 'Scandinavia Today'. Chair of the newly founded Council of Women World Leaders in 1996, she received special recognition from the Icelandic Language Foundation and in 1997 the Jakob Letterstedts Award for introducing Nordic Cultural Heritage outside its boundaries and the Clara Lachmann-Prize. In 1997 she was awarded the Ceres Gold Medal by the FAO and in 1998 the Selma Lagerlöf's Mårbacka Prize. In 1998 she was nominated Goodwill-Ambassador of Languages at UNESCO.

M. R. C. GREENWOOD (Mrs) (United States of America)

Mrs M.R.C. Greenwood is Chancellor of the University of California, Santa Cruz, a position she has held since July 1, 1996. As chief executive, Chancellor Greenwood oversees a comprehensive teaching and research institution with combined undergraduate and graduate enrolments of approximately 10,600 matriculated students and an annual total budget of approximately $265 million. Dr Greenwood also holds a UCSSC appointment as Professor of Biology. Her research interests are in development cell biology, genetics, physiology and nutrition. Her work over the past 25 years, focusing on the genetic causes of obesity, is recognized world-wide. From November 1993 to May 1995, Dr Greenwood held an appointment as Associate Director for Science at the Office of Science and Technology Policy (OSTP) in the Executive Office of the President of the United States. In that position, she supervised the Science Division, providing authoritative advice in support of the President's objectives and development of science policy. Chancellor Greenwood was elected as President-Elect of the American Association for the Advancement of Science in 1996, and in February 1998 she began her term as President. She is now the Chairman of the AAAS Board of Directors. President Clinton appointed her, and the U.S. Senate confirmed her, as a member of the National Science Board. In 1992 she was elected to the Institute of Medicine of the National Academy of Sciences. She is also President of the American Society for Clinical Nutrition.

Ágnes HELLER (Mrs) (Hungary)

Born in 1929. A survivor of the Holocaust, she studied philosophy at the University of Budapest under the guidance of George Lukács and became Assistant Professor in the Department of Philosophy. For her participation, with George Lukács, in the Hungarian revolution of 1956, she was expelled from the University and banned from publication for several years. In 1968, she protested against the invasion of Czechoslovakia. In 1973, by a special resolution entitled 'Budapest School of Philosophers', she was banned from all possibility of teaching and research and was forced to leave Hungary in 1977. She subsequently taught sociology at the University of La Trobe (Melbourne, Australia). She moved to New York in 1986 and is now 'Hannah Arendt' Professor of Philosophy at the New School for Social Research. She also teaches in the Department of Aesthetics at the University Eötvös Loránd (Budapest) and in the Department of Philosophy of the University Józef Attila (Szeged). The author of numerous works, translated into several languages, of which the major titles are 'Aristotle's Ethics and the Antique Ethos', 'Renaissance Man', 'The Theory of Needs in Marx', 'The Power of Shame', 'General Ethics, A Philosophy of Morals and Ethics of Personality'. She received an honorary degree from La Trobe University, (Australia) in 1966 and from the University of Buenos Aires (Argentina) in 1997. She has received many distinctions including the Lessing Prize (Hamburg, 1981), the Széchenyi National Prize (Hungary) and the Hannah Arendt Prize (Bremen, Germany, 1995).

Attiya INAYATULLAH (Mrs) (Pakistan)

She holds a doctorate in social demography and has received global recognition as an activist in the field of human development. Her specific field of interest is on issues pertaining to women. Among the high level government, international and civic responsibilities she has held are that of Member of Parliament, Minister of State of the Government of Pakistan for Women's Development and Adviser to the President of Pakistan on Family Planning. She has been Chairperson of UNESCO's Executive Board and chaired the working group on 'Women's Health, Bioethics and Human Rights' of the International Committee on Bioethics of UNESCO. She is currently President of the International Planned Parenthood Federation (IPPF), member of UNESCO's International Advisory Panel 'Towards a Culture of Peace' and the International Panel on 'Democracy and Development'. She was awarded the United Nations Ceres Gold Medal on the occasion of the First World Population Year and in 1994 the Human Rights Gold Medal by the Human Rights Society of Pakistan. She has participated in major international conferences on genetics, ethics, and human values in reproductive health.

François JACOB (France)

Born in 1920. Doctor of Medicine and Doctor of Science of the Faculty of Medicine and of the Faculty of Science of Paris. Joined the Free French Forces in London in June 1940 and took part in the campaigns in Fezzan, Libya, Tripolitania, Tunisia and France where he was badly wounded, in Normandy, in August 1944. He was made a *Compagnon de la Libération* and was awarded the *Grand-Croix de la Légion d'honneur*. Joined the *Institut Pasteur* in 1950, became Professor in this Institute, in 1960, and was elected Professor of Cellular Genetics at the *College de France* in 1964. His work has been mainly on microbiology and genetics, on the mechanisms ensuring transfer of information as well as the regulatory circuits which, in the bacterian cell, adjust the activity and the synthesis of macromolecules. He participated in particular in introducing new ideas (messenger RNA, regulator genes, operon, allostery and replicon) and to the study of the first stages of embryonic development in mice. He was awarded the Nobel Prize for Physiology or Medicine in 1965. He is a Member of the *Académie française* (1966) and of the *Académie des Sciences*, Paris (1976) as well as of many Academies in other countries. He is Honorary Doctor of numerous Universities. Author of many scientific books and works including *'La logique du vivant, une histoire de l'hérédité'* (Gallimard, 1970), *'Le jeu des possibles, essai sur la diversité du vivant'* (Fayard, 1981), *'La statue intérieure'* (Editions Odile Jacob, 1987), *'La souris, la mouche et l'homme'* (Editions Odile Jacob, 1987).

Benediktas JUODKA (Lithuania)

Born in 1943. Graduated from the University of Vilnius (Lithuania) and Doctor of Bio-organic Chemistry and Molecular Biology of the State University of Moscow (Russian Federation), he is presently President of the Academy of Sciences of Lithuania. After teaching biochemistry, biophysics and molecular biology at the University of Vilnius, he was made head of the Department of Biochemistry and Biophysics of the University of Vilnius of which he is Vice-Rector for Research. He has been a member of the Academy of Sciences of Lithuania since 1987 and was made a member of the Academy of Sciences of Latvia in 1994. In 1995 he was awarded the National Science Prize of Lithuania. He has received several distinctions from German and European institutions. He is the author of numerous monographs and other scientific publications.

James Peter KIMMINS (Canada)

Born in 1942. He graduated from the University of Wales, did post-graduate studies at the University of California, Berkeley and obtained a

Doctorate in Forest Ecology at Yale University (United States of America). He has taught since 1969 and is presently Professor of Forest Ecology at the University of British Columbia (Canada). Author of works on forestry ecology including a standard textbook used world-wide, 'Forest Ecology: the Ecological Foundation for Sustainable Management' and a lay-person's guide to environmental issues in forestry 'Balancing Act: Environmental Issues in Forestry' (UBC Press, 1997). He developed ecosystem management simulation models and educational software in the same field. He is a consultant to the Governments of British Columbia and Saskatchewan (Canada) and Tasmania (Australia) as well as to environmental groups and the forestry industry. He received a gold medal for scientific achievement from the International Union of Forest Research Organizations and the Canadian Institute of Forestry.

Lu Yongxiang (China)

Born in 1942. Graduate of the University of Zhejiang (China), Doctor of Engineering Sciences RWTH (Germany) and the Hong Kong University of Science and Technology, he obtained a Research Fellowship at the University of Aachen (Germany). Since 1964 he has had teaching posts, and became Director of the Institute for Fluid Power Transmission and Control and Vice-President of the Zhejiang University. President of the Academy of Sciences of China since 1997, he is a member of numerous national academic commissions and international scientific associations. He is Vice-President of the Chinese Mechanical Engineering Society and President of the Chinese Society for the History of Science and Technology. Honorary Doctor of the University of Hong Kong, he has been awarded many scientific distinctions in both Germany and China. Author of numerous publications mainly on electro-hydraulics and mechanical engineering that have appeared in China and abroad, he also holds 20 patents for inventions registered in China, Europe and the United States of America.

Wataru Mori (Japan)

Born in 1926. He received his M.D. and D.Sc. (med.) degrees from the University of Tokyo. From 1956 to 1959 he was at Yale University (United States of America) and he spent a year at Cambridge University (United Kingdom) from 1966 to 1967. Professor Emeritus and Former President of the University of Tokyo, he was one of two permanent Members of the Prime Minister's Council. He was Chairman of the Committee on Policy Matters which functions as the Council's Executive Committee. The

Council is the senior advisory body in Japan on matters of science and technology and is chaired by the Prime Minister. He was President of the University of Tokyo after serving as Professor and Chairman of the Department of Pathology and then as Dean of the Faculty of Medicine. His major field of study has been liver pathology and he has maintained an active interest in the pineal hormone melatonin discovered by a group, to which he belonged, headed by Professor A. B. Lerner at Yale University. Secretary-General of the Japanese Pathological Society from 1983 to 1989, he has been President of the Japanese Association of Medical Sciences since 1983 and he is also the present President of the International Association of Universities (IAU). He is Member of the Japan Academy, Foreign Member of the Institute of Medicine, National Academy of Sciences of the United States of America (NAS), Honorary Fellow of the Royal College of Pathologists of the United Kingdom and Foreign Member of the American Philosophical Society.

Suzanne MUBARAK (Mrs) (Egypt)

Born in Menya, Egypt. Graduate in political sciences and sociology of education from the American University of Cairo (Egypt), she is Doctor *honoris causa* of Westminster College (New Wilmington, United States of America). She led the Egyptian Delegation in a number of international organizations such as WHO, UNICEF and the United Nations University, as well as at numerous international conferences, in particular those held with a view to the drafting the United Nations Convention on the Rights of the Child, the International Conference of the board on Books for Young People (IBBY) (1990), the World Summit for Children (New York, 1990), the Special High-Level United Nations Council in charge of Studying Ways and Means to Prevent Natural Disasters, New York (1993) and the Fourth International Conference on Women (Beijing 1995). Founder and Chairperson of the Integrated Care Society and the Egyptian Association for Childhood and Development, Mrs Mubarak is the initiator of the unified law on children, adopted in 1996, which is a codification of all relevant issues in national law regarding the Egyptian child. Extremely active in the area of books for young people, she was the Chairperson of the International Jury of the 'UNESCO Prize for Children's and Young People's Literature in the Service of Tolerance' (1997-1998), furthermore, in 1991 Mrs Mubarak launched a vast reading for all campaign. She is the recipient of numerous international awards, amongst which the Maurice Pate Prize awarded by UNICEF in 1989, the Enrique de la Mata Peace Prize (1992) and the Health for All Gold Medal awarded by WHO (1994).

Barry W. NINHAM (Australia)

Doctor of Mathematical Physics of the University of Maryland (United States of America), he has been Head of the Department of Applied Mathematics in the Institute of Advanced Studies of the Australian National University (Canberra) since 1970. Known world-wide for his work on colloid and surface science, the discipline that underlies industrial processing and modern biology, chemical engineering and physical chemistry, he has many former students among university professors around the world. He is the author of many papers and books in various scientific fields. He has an Honorary Doctorate from the KTH (Stockholm). He received the Inaugural Lecture Award of the Japan Chemical Society in 1995, and occupied the National Chair of Chemical Engineering in Sweden in 1996. He is presently in Sweden where he holds the Erlander Swedish National Distinguished Chair of Chemistry.

Thomas Risley ODHIAMBO (Kenya)

Born in 1931. He is Doctor in Insect Physiology at the University of Cambridge (United Kingdom), his particular interests are education, basic and medical sciences, and technology and he is a member, director or founder of several Kenyan organisations in which he continues to have an active role in directing or management (in particular: the Industrial Technology and Engineering Trust, the Foundation for the Promotion of Children's Science Publications in Africa, the Research and Development Forum for Science-Led Development in Africa, the International Centre of Insects Physiology and Ecology). In the framework of his academic activities, he was the Founding Chairman of the Kenyan Commission for Higher Education and Founding Dean of the Faculty of Agriculture of the University of Nairobi. Currently, he is also President of the University of Tropical Medicine and Technology Trust. Member of numerous learned societies, he has also been President of the African Academy of Sciences. He holds many academic and scientific distinctions including the Albert Einstein Gold Medal awarded by UNESCO in 1991. Author of many publications including six scientific books aimed at young people whose developing awareness is one of his continuing interests.

José SARUKHAN KERMEZ (Mexico)

Born in 1940. He has a degree in Biology from the National Autonomous University of Mexico (UNAM), he obtained a Masters Degree in Agricultural Botany (Mexico) and a Doctorate in Ecology at the University of Wales. He was Director of UNAM and Vice-Chancellor for Science. He

was elected Rector by the Governing Council of UNAM. He is presently Professor at the Institute of Ecology of UNAM. He was President of the Botanical Society of Mexico, of the Mexican Academy of Sciences, of the Tropical Biology Association, of the Latin American Union of Universities (UDUAL), and Vice-President of the Conservation international. He is presently President of DIVERSITAS, an international non governmental organization sponsored jointly by UNESCO and the International Council for Science (ICSU), responsible for co-ordination and development of biodiversity in the world. Designated by the President, he is also National Coordinator of the Mexican National Commission for Biodiversity. He is a member of the Academy of Sciences of the United States of America. His main academic work is concerned with botanical ecology, ecology of temperate and tropical ecosystems, the role of training in higher education and science in development. He has published numerous scientific articles and works. He holds several Honorary Doctor degrees.

Dagmar SCHIPANSKI (Mrs) (Germany)

Born in 1943. After studying at the Technical University of Magdeburg (Germany), she obtained a Doctorate in Solid State Electronics at the Technical High School of Ilmenau where she taught and became Dean of the Faculty of Electronics and Informatics. Among her academic activities, she was a member of the 'Teaching and Study' Commission of the Conference of German University Rectors, member of the founding commission of the University of Erfurt, member of the selection committee of the Lise-Meitner Prize, member of the Scientific Council of Germany from 1992, and member of the selection committee of the German Academic Exchange Service, and Vice-Rector then Rector of the Technical University of Ilmenau. Appointed, in 1995, to the National Council of Science, Technology and Innovation and to the selection committee of the Research Award of the Minister of Science, Research and Culture of Thuringe, in 1996 she was elected President of the Federal Scientific Council. Member of several non-profit making institutions or organizations in the field of science, she is the author of numerous publications and holder of 9 invention patents. She was awarded the Officer's Cross of the Order of Merit of Germany.

The Earl of SELBORNE (United Kingdom)

Fellow of the Royal Society and Fellow of the Institute of Biology and the Royal Agricultural Society, Lord Selborne was President of the Joint Nature Conservation Committee of the United Kingdom from 1991 to 1997

and Chairman of the United Kingdom Agricultural and Food Research Council from 1983 to 1989. He was also Chairman of the House of Lords Select Committee on Science and Technology from 1993 to 1997. He is currently President of the Royal Geographic Society (with the Institute of British Geographers). He is also Chancellor of the University of Southampton (United Kingdom), President of the Parliamentary and Scientific Committee and Managing Director of the Blackmoor Estate Ltd, a farming company in Hampshire (United Kingdom) with major enterprises in dairying, and arable and fruit crops. He has honorary degrees from the Universities of Bristol and Cranfield.

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