Science and Technology in Society (STS) *forum*

"Lights and Shadows of Science and Technology"

Fifth Annual Meeting
October 5-7, 2008
Kyoto International Conference Center (ICC Kyoto)

Summary of Proceedings





Science and Technology in Society (STS) *forum* (NPO)
Sanno Grand Building 419, 2-14-2 Nagatacho, Chiyoda-ku, Tokyo 100-0014, Japan
Tel:+81-3-3519-3351 Fax:+81-3-3519-3352 Website: www.stsforum.org

Sunday, October 5, 2008

10:30-11:30	**100**	Opening Plenary Session: “Science and Technology and the Future of Humankind”		1
13:20-14:50	**101**	Plenary Session: “Crucial Issues and Development of Science and Technology”		1
14:50-15:50	**102**	Plenary Session: “How is ICT affecting Humankind?”		2
16:30-18:30	**103**	First Series of Concurrent Sessions:		
		A1	“Climate Change: Socioeconomic and Security Impacts”	3
		B1	“Infectious Diseases”	4
		C1	“New Materials - What Can They Do for a Sustainable Society?”	5
		D1	“Science and Engineering Education”	6
		E1	“International Collaboration in Science and Technology”	6
		F1	“Collaboration among Universities / Research Institutes / Industries	7
		G1	“Business Innovation through ICT - How ICT Affects Business”	8
19:30-21:00	**104**	Official Dinner: “Lights and Shadows of Science and Technology”		9

Monday, October 6, 2008

08:30-09:50	**200**	Plenary Session: “Science and Technology in the Service of Health”		9
10:20-12:20	**201**	Second Series of Concurrent Sessions:		
		A2	“Harmony with Nature - Nuclear Energy Alternative”	10
		B2	“New Development in the Genome Era”	11
		C2	“What Can ICT Do for Education?”	12
		D2	“Role of Universities - What is Needed of Universities in the 21st Century?”	13
		E2	“Research Collaboration between Developed and Developing Countries”	14
		F2	“Interface and Dialogue between Humanities and Natural Sciences”	15
		G2	“Role of Venture Capital in the Developed and Developing World”	15
12:20-14:05	**202**	Working Lunch: “Dialogue between Political Leaders and Scientists”		16
14:20-16:20	**203**	Third Series of Concurrent Sessions:		
		A3	“Harmony with Nature - Managing Water Resources”	17
		B3	“GMOs for Food, Fiber and Fuel”	18
		C3	“What Can ICT Do for Health?”	18
		D3	“Proposals from Young Scientists”	19
		E3	“Brain Drain, Brain Gain and Brain Circulation”	20
		F3	“Role of Media in Science and Technology”	21
		G3	“International Reconciliation of IPR”	22
16:50-18:00	**204**	Plenary Session: “Biofuels and their Potential Effect on Food Production and the Environment”		22

Tuesday, October 7, 2008

08:30-09:25	**300**	Plenary Session: Summaries from Concurrent Sessions	23
10:45-11:45	**302**	Plenary Session: “Role of Science and Technology in the 21st Century”	25
11:45-12:30	**303**	Closing Plenary Session: “Returning to Harmony with Nature - What Can We Do?”	26

In this summary, all the names, job titles and functions reflect those current as of the date of the forum; personal titles have been omitted.

Sunday, October 5, 2008

10:30-11:30 OPENING PLENARY SESSION

100 "Science and Technology and the Future of Humankind"

Chair:
Omi, Koji, Member, House of Representatives; Chairman and Founder, STS *forum*, JP

Speakers:
- **Noda**, Seiko, State Minister in charge of Science and Technology and Consumer Affairs, JP, on behalf of Taro Aso, Prime Minister of Japan
- **Furukawa**, Kazuo, Representative Executive Officer, President, CEO and Director, Hitachi Ltd.; Vice Chairman, Nippon Keidanren (Japan Business Federation), JP
- **Garmendia Mendizábal**, Cristina, Minister of Science and Innovation, ES
- **Kindler**, Jeff, Chairman and CEO, Pfizer Inc, US
- **Lu**, Yongxiang, President, Chinese Academy of Sciences (CAS), CN
- **Molina**, Mario, Professor, Department of Chemistry and Biochemistry, University of California, San Diego (UCSD), (Nobel Laureate in Chemistry, 1995), MX

Koji Omi opened the Fifth Annual Meeting of the STS *forum*. He said that although advances in science and technology have brought tremendous benefits to our daily lives, they have also brought problems such as global warming, ethical concerns in biosciences and information security issues in ICT. These are the "lights and shadows of science and technology," he explained. Scientific progress influences us all, and it is not just an issue for scientists and engineers, but for policymakers, business leaders and the media as well. The problems that result cannot be solved by one or two countries alone, international cooperation and system harmonization are essential. Thus the STS *forum* is a crucial platform for people of different backgrounds to discuss these issues, to seek a common direction and to strengthen human networking.

Seiko Noda spoke on behalf of the Prime Minister of Japan. She said Japan will promote research and development of technologies such as induced pluripotent stem cell treatment and alternative energy, and will combine science and diplomacy to resolve issues such as global warming and infectious diseases. The STS *forum* provides an opportunity for scientists and political leaders to discuss problems created by science and technology. She hopes to bridge the gap between scientists and the general public.

Jeff Kindler said advances in technology are the key to solving global economic problems. New medicines are being developed, but good health and prevention are also necessary investments. Fewer workers are contributing to the economy today. As populations age, prolonged health and productivity will be necessary. The public and private sectors must continue to develop as partners. The appropriate application of science is necessary for the benefit of humanity.

Lu Yongxiang said the number of young people from developing countries involved in science and technology is expected to increase greatly. Science and technology will combine research and innovation in IP licensing and knowledge-sharing. Renewable, safe and clean energy, green manufacturing, safe drinking water, security, disaster prevention, and health are critical issues. Access to new ICT technology must be widened. The benefits of science and technology must be shared.

Cristina Garmendia Mendizábal warned that the benefits of science and technology are not reaching most of the population. In spite of advances, social and economic problems are increasing because of unequal access. The IT revolution has changed our way of life, but there is a gap between developed and developing countries in the number of Internet users. Biomedical research has improved quality of life, but equal access to health care is necessary. Clinical trials should consider differences in nationality and racial identity. Gender gaps are present in both scientific and economic achievements in high-tech fields.

Kazuo Furukawa spoke about the importance of science and technology in the creation of new 21st century industries that aim to achieve a century of human affluence by preserving the Earth's environment and providing a healthy society. He also mentioned the role of science and technology in industries' initiatives to tackle the many global issues facing humankind today. "Fusion" will be a key word in the process: fusion of knowledge between institutions; the needs of society and individuals, and between policies and systemic reform on a global scale.

Mario Molina emphasized that the atmosphere has a finite capacity to absorb the by-products of human activity. The cost of the damage caused by climate change will be much greater than the cost of preventing it. Use of renewable energy sources and increased energy efficiency are necessary. Government leaders must act now. We have a responsibility to leave an acceptable environment for future generations. He concluded: "An earlier speaker said that science and technology open the doors to both heaven and hell. I hope we can open the doors to heaven a little wider."

13:20-14:50 PLENARY SESSION

101 "Crucial Issues and Development of Science and Technology"

Chair:
Yoshikawa, Hiroyuki, President, National Institute of Advanced Industrial Science and Technology (AIST), JP

Speakers:
- **Bréchignac**, Catherine, President, French National Center for Scientific Research (CNRS); President-Elect, International Council of Science (ICSU), FR
- **Gaidar**, Yegor, Director, The Institute for the Economy in Transition (IET), RU
- **Johnson**, Ray, Senior Vice President and Chief Technology Officer, Lockheed Martin Corporation, US
- **Ogata**, Sadako, President, Japan International Cooperation Agency (JICA), JP

- **Okamoto**, Kazuo, Vice Chairman and Representative Director, Toyota Motor Corporation, JP
- **Rahman**, Atta-ur-, Federal Minister and Chairman of the Higher Education Commission (HEC), Government of Pakistan, PK
- **Zehnder**, Alexander, Scientific Director, Alberta Water Research Institute; former President of the ETH Board, Swiss Federal Institute of Technology (ETH) Zurich, CH

Hiroyuki Yoshikawa said the STS *forum* brings together people from different countries, disciplines and backgrounds to talk about problems facing the world. Discussions and the development of science and technology are needed to halt climate change, reduce poverty and disease, and find new energy resources. Uncertain security, local disputes and financial instability cause problems. There is no "wonder drug" to solve such problems. Discussions are needed between different groups so ideas can be exchanged, leading to solutions.

Atta-ur-Rahman said that Pakistan has a population of 160 million of which 54% are young. The higher education system is focused on quality, access and relevance to both national and international demands. Pakistan has launched a number of exciting initiatives: 3,000 of the brightest students are sent abroad for PhD level studies; the world's largest Fulbright scholarship program has been launched; the typical pay of a professor has been increased to about five times that of a government minister; students and institutions have free access to over 23,000 academic journals and 45,000 textbooks. Pakistan hopes to leapfrog old problems to compete in modern international research.

Sadako Ogata said that the investment of human resources in science and technology has significant impact on both accelerating and sustaining development. With development a key goal for African countries, African leaders and the Japan International Cooperation Agency (JICA) are looking toward Asia to create their own version of the Asian economic miracle. JICA has many technical cooperation projects (concerning science and technology development) in Asia, the Middle East and Africa. As rapid growth sometimes leads to a rise in inequality, programs have to be made that benefit the country as a whole.

Yegor Gaidar discussed Russian science and technology development since the end of the Soviet Union. Russia wants to become an economy based more on knowledge and innovations rather than energy commodities. The Soviet Union featured world-class schools, which Russia now hopes to harness for making useful technology. To invigorate the system, younger workers, especially graduates, are entering the workforce. More and more Russian students are staying in Russia than going overseas.

Catherine Bréchignac said systematic development is the biggest problem that faces the world today. The increase in urbanization and climate change will put a massive strain on available resources. We must go beyond the Kyoto Protocol, and work to continue to adapt and develop technology. Solutions will come through networking at all levels.

Alexander Zehnder said while world population is growing, the quantity of water is constant. Water consumption has increased six-fold over the last century and current use of resources is leading to scarcity. Climate change is likely to cause further water shortages in areas of high population density. Only a few countries can expect risk-free water supplies, and to avoid political abuse of these imbalances, we need the UN Millennium Goals and for governments to guarantee a free market for food products.

Ray Johnson highlighted ubiquitous global communication, the genomics revolution, global talent development, and nanotechnology as four important technology trends and discussed their impact on a global society. The Internet is creating a human terrain that is replacing geographic terrain, genomic-based developments promise cures for diseases as well as having positive impacts on food production, science and math education on a global scale is creating opportunities for both developed and developing nations, and nanotechnology is enabling incredible new materials. The convergence of technologies offers opportunities for invention and innovation that hold the promise of bringing solutions to the world's most challenging problems.

Kazuo Okamoto discussed the future of the automobile industry in light of climate change and rising oil prices. While petroleum facilitated the growth of the automobile industry in the 20th century, we need alternatives if we are to continue our automobile-based lifestyle. Currently, no single alternative energy source is viable. Hybrid engines, which offer greater efficiency and re-use energy by combining different power sources, may be one solution.

14:50-15:50 PLENARY SESSION

102 "How is ICT Affecting Humankind?"

Chair:
Thomson, Robert, Managing Editor, The Wall Street Journal; Editor-in-Chief, Dow Jones & Company, AU

Speakers:
- **Gopalakrishnan**, S. Kris, CEO and Managing Director, Infosys Technologies Limited, IN
- **Hanazawa**, Takashi, Director and Senior Vice President, Director of Research and Development Planning Department, Nippon Telegraph and Telephone Corporation (NTT), JP
- **Kleiber**, Michał, President, Polish Academy of Sciences, PL
- **Sasaki**, Hajime, Chairman of the Board, NEC Corporation, JP
- **Swope**, William, Vice President and General Manager, Corporate Affairs Group, Intel Corporation, US

Robert Thomson opened with an overview of the current serious state of the U.S. financial system and the global situation in general. What he called the greatest upheaval in eight decades is detrimental to investment in science and technology in particular, and societies in general. Two modern trends, digitization and globalization, may be simultaneously contributors and solutions to the crisis. As the democratization of information expands worldwide, he asked, how can it be

sustained, what are the social costs, and are current goals too idealistic or not idealistic enough?

S. Kris Gopalakrishnan explained that computers have developed ever-higher levels of complexity, miniaturization and performance, allowing current models to perform tasks and complex calculations at tremendous speeds. The Internet also facilitates a system of interconnectedness and collaboration among people across borders, spurring the creation of new companies like Amazon and providing many other opportunities. In India, 94% of the public has access to mobile technology, which has empowered many by creating or sustaining employment in sectors such as farming and fishing. Communication has resulted in improved productivity and work redistribution. Tasks are also getting redistributed around the world at lower costs, which helps developing economies like India.

Hajime Sasaki reflected on the 30 years following the start of the convergence of Computing and Communications (C&C), during which the speed of communications and power of computers have increased enormously. Advanced computer simulations like those projecting climate change can profoundly affect humankind. New sensing systems are also improving the lives of patients, senior citizens, and others. He raised the issue of the rise in cyber attacks, particularly bot-infected computers, saying that dependable ICT systems should combat such threats. He concluded that C&C will contribute to creating a society in which ICT satisfies people's needs and coexists with humans.

Michał Kleiber stated that virtually every country faces a sense of urgency in meeting the economic challenges of the 20th century, brought about by globalization and technology. He mentioned areas in which IT has made a significant impact, including security and educational inclusion. He said that much like electricity, not only does ICT enable us to do sophisticated things, but its applicability extends into many other areas such as health, cross-border communication and education. The future will usher in new and improved access to more sophisticated network systems and content-rich mobile intelligent devices.

William Swope focused on the positive contributions of ICT to society in the areas of education, healthcare, and the environment. He stated that he is committed to making ICT a positive force in society. He noted that computing power (in particular processor efficiency) has grown exponentially, that connectivity is reaching more people than ever, and that computer prices have decreased substantially. He commented that ICT can make anything more efficient and expressed the hope that wider acceptance of ICT will be able to positively influence government policy.

Takashi Hanazawa presented a vision of the future of communication services based on recent advances. The Internet is now an indispensable part of our daily lives. Personal business and social activities, digital networks, the growth of blogs and video posting all indicate a new era dominated by ICT. He said that this has created an ubiquitous world; a new world order. Security mechanisms, legal regulation and education related to standards, local customs must be put in place to ensure maximum benefit from ICT.

16:30-18:30 FIRST SERIES OF CONCURRENT SESSIONS

103-A1 "Climate Change: Socioeconomic and Security Impacts"

Chair:
McBean, Gordon, Chair of Board and CEO, Canadian Foundation for Climate and Atmospheric Sciences, CA

Speakers:
- **Adachi**, Toshio, Representative Director and Executive Vice President, Sharp Corporation, JP
- **Bernard**, Rob, Chief Environmental Strategist, Microsoft Corporation, US
- **Da Silva**, Wilson, Editor-in-Chief, Cosmos Magazine, AU
- **Kennel**, Charles, Professor, Scripps Institution of Oceanography, University of California, San Diego (UCSD), US
- **Masuda**, Yukio, Corporate Advisor, Mitsubishi Corporation, JP
- **von Deessen**, Ulrich, Climate Protection Officer and President, Competence Center Environment, Health and Safety, BASF SE, DE

Today, climate change has become an issue that impacts the security of mankind. It is said that by 2050 there will be 9 billion people in the world and due to climate change even scarcer resources. Up to half the world's population will be at risk of being impacted. How can we reduce the human impact on the climate system and reduce the impact of the climate on human beings?

We now realize that we cannot only think about mitigating climate change but must adapt to it as well. We need to recognize the interaction between natural disasters and climate change. We also urgently need an international framework for assessing the impact of regional climate change in order to raise awareness among individuals and local decision-makers.

Impacts of climate change on the third world must be addressed. For example, agriculture and fishing communities will be strongly affected by temperature rises, melting ice packs and drought. We must create improved scientific models to help us drive policies and new scientific tools like genetically modified plants that better utilize water. New schemes would also help, such as a pricing structure for carbon sequestration that encourages countries to save their rainforests or the use of mandatory targets for emissions with carbon credits allocated based on population, favoring nations like China and India.

Climate change mitigation by individuals, governments and companies was one theme of the discussion. Global warming is a complicated issue and the notion of emission trading as a practical solution needs to be carefully examined. It is noted that a carbon credit scheme for individuals would allow you to trade your carbon credits through a carbon credit bank. We should reduce unnecessary air conditioning or heating use, improve insulation and take other small steps.

The public knows that global warming is real and caused by human activity but they are paralyzed by the enormity

of the problem. People need to know that by making small changes in their lives and houses they can reduce energy consumption drastically. If we use existing technology to reduce energy waste and improve energy storage we can cut energy consumption by half by 2020. Buildings are a source of 40% of emissions, so energy-efficient new buildings must be complemented by building renovation. Another idea is a system in which you can download electrons for your car and then plug back in to a grid to return unused energy in a local, mobile and bidirectional system.

Many corporations are cutting CO_2 reductions through energy use reduction and waste reduction. A careful examination of production processes and product portfolios is needed. It is important to implement existing technologies, such as teleconferencing, to reduce transport-related emissions, as well as innovate with more efficient rechargeable batteries and alternative energy sources. And since one-third of the energy produced in the world is lost in transport and storage, companies need to focus on ways to reduce this kind of carbon leakage.

Incremental change cannot achieve what is needed, however, so our industrial structure must change as well. This will involve such things as new urban design, a complete switch from fossil fuels, carbon catch and sequestration, and the use of biomass to extract CO_2 from the atmosphere. The implementation of such schemes will determine whether the temperature rises by a terrible but manageable 2 degrees or a disastrous 5 degrees, which would transform our world completely.

It was noted that many of the participants discussed ways to reduce emissions, increase energy efficiency and distribute benefits more equitably between developing and developed nations. What is needed is a global social network so we can identify others around the world with the solutions to our environmental problems.

Many companies are investing in environmental technologies, but we need more predictability in terms of governmental law and regulations. We need leadership and an understanding of what climate change means to us as individuals, so we can make the right decisions.

103-B1 "Infectious Diseases"

Chair:
Yeo, Philip, Senior Science and Technology Advisor, Ministry of Trade and Industry, SG

Speakers:
- **Hacker**, Jörg, President, Robert Koch-Institut, DE
- **Herrling**, Paul, Head of Corporate Research, Novartis International AG, CH
- **Imura**, Hiroo, President, Foundation for Biomedical Research and Innovation (FBRI), JP
- **Matano**, Tetsuro, Professor, Division of Microbial Infection, Institute of Medical Science, International Research Center for Infectious Diseases, The University of Tokyo, JP
- **Poovorawan**, Yong, Professor, Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, TH
- **Sun**, Xiaodong, Director, Office of Public Health Emergency Response & Preparedness, Shanghai Municipal Center for Disease Control & Prevention, CN

Rapporteur:
Karpati, Melinda, CEO and Chairman, AmVac AG, CH

This panel session centered on discussion of the global threat that infectious diseases pose. Highly contagious diseases such as avian flu and SARS have spread to several countries throughout the world and have been the cause of fatalities, raising concerns about worldwide pandemics. Infectious diseases both threaten life and place a strain on the resources of any society.

Several emerging diseases in the 21st century have crossed from animals to humans, including encephalitis, HIV and avian influenza (H5N1). The outbreaks can be prevented through worldwide collaboration and monitoring. It is necessary to develop networks of investigation for diseases such as SARS. There is also a need to improve diagnostic methods to help control and prevent diseases. In developing as well as developed nations, the incidence rate of infectious disease can be greatly reduced if modern disease prevention and universal Internet-based hospital surveillance systems are implemented.

Close international collaboration is indispensible for controlling both endemics and epidemics. The United States-Japan Cooperative Medical Science Program has helped address specific infectious diseases and meets twice a year to review its activities and discuss future directions of research. Meanwhile, Japan's development of counterpart research centers in partner Asian and African countries is an example of effective multilateral cooperation. High levels of international collaboration are important for combating infectious diseases.

The rate of death from infectious disease is approximately 30%, but with diseases such as malaria there is a stark contrast in fatality rates between developed and developing countries. HIV and other diseases, however, are problems in both developed and developing countries.

New technologies allow the analysis of the genomes of infectious agents, gene mutations and protein modification, but it takes a significant amount of time to produce drugs and vaccines based on such technologies. Diagnostics using these technologies are also necessary and effective methods for detecting new pathogens.

There is a necessity to share these technologies worldwide and provide education for implementing new techniques and surveillance systems in both developed and developing countries.

The importance of AIDS vaccine development is evident from the increasing number of infected individuals. A pandemic increases the risk of the appearance of drug resistant viruses and a global strategy for prevention is required. A first-generation prophylactic AIDS vaccine would inhibit further

transmission to infected individuals while second-generation vaccines would help prevent AIDS progression. New concepts are necessary for effective disease control.

The creation of institutes to target neglected diseases such as tuberculosis and malaria are necessary for infectious disease research. 95% of all pharmaceuticals come from commercial organizations, so huge sums of money with no guarantee of returns cannot be invested into these diseases. Big foundations should form Public-Private Partnerships (PPPs) to promote research in these areas.

Since both pharmaceutical and biotechnology companies cannot invest funds when no return is expected or there is a high rate of failure, a cost-effective approach is necessary to promote such pipelines. Funds should be pooled from both developed and developing countries specifically for R&D. These dedicated monies would then be allocated by an international group of scientific and medical experts to research projects showing promising results.

Improving the success rate in drug development does not seem probable but there is room for improvement in regards to intellectual property. While intellectual property rights are important for encouraging innovation, disease vaccines should be made available to everyone. Sample sharing is necessary to help set up good control systems.

Extending patent rights seems to have been an effective model for giving incentives for research into neglected diseases in the United States, but these same models have shown to be ineffective in the European market. Meanwhile, socio-political agendas can block the sharing of information between countries, as has occurred in the cases of HIV and other diseases.

103-C1 "New Materials – What Can They Do for a Sustainable Society?"

Chair:
Kitazawa, Koichi, President, Japan Science and Technology Agency (JST), JP

Speakers:
- **Brandstetter**, Franz, Senior Technology Consultant, former President, Polymer Research, BASF SE, DE
- **Eastham**, Tony, Acting Vice President for Research and Development, Hong Kong University of Science and Technology (HKUST), CA
- **Hosono**, Hideo, Professor, Materials and Structures Laboratory, Tokyo Institute of Technology, JP
- **Schlapbach**, Louis, CEO, Swiss Federal Laboratories for Materials Testing and Research (EMPA), CH
- **Yasui**, Itaru, Vice Rector Emeritus, United Nations University, JP

Materials research is essential for the development of new technologies, especially those related to the production and use of energy. Such research will help address environmental problems related to climate change and sustainability. There was broad consensus that one challenge for the field to overcome is that research often takes decades to go from concept to market.

Materials research can directly address issues of the energy efficiency of buildings, vehicles and devices. CO_2 emissions can be reduced greatly by adding advanced materials to existing materials. For example, the amount of water used to make concrete is much more than is required for the chemical reaction. The extra water needed can be drastically reduced by adding just a small amount of a polymeric material.

The thermal properties of buildings can be improved to lower the energy requirements for their heating or cooling. Important materials for this task include polystyrene, concrete, phase-change materials, and glass combined with advanced coatings. Also, if all current air conditioning units were changed to heat-pump types, energy consumption would be cut by two-thirds. Although cooling of buildings remains energy intensive, heat loss from buildings can be overcome by the use of insulation. The challenge is to convince the homeowner, for whom it may take years to recoup installation costs. Many types of new materials are needed in order to achieve the doubling of a building's energy efficiency, necessary for reducing CO_2 emissions.

We need to use the wind and the massive amount of exhaust heat that we produce to make our electricity. Solar energy and photovoltaics were promoted as possibilities for generating clean energy. The limitation of the requirement for local daylight could possibly be alleviated by connecting power grids over long distances using superconducting cables. In recent years, the number of potential materials for fabricating superconductors has increased dramatically and the frontiers of basic research in this area have also expanded greatly. There was consensus on the importance of superconductivity, but its viability was debated.

One participant suggested that nanotechnology has broad consumer applications, but whether they make a contribution to power efficiency or sustainability was debated. We should also turn our attention to reusable and recyclable materials. Participants repeatedly mentioned consumption and renewability as areas of importance; in our rush to develop and commercialize new materials, we must not forget the environment.
Efficient rail transport needs to be promoted, but improved efficiency for cars is vital. Either a breakthrough in electricity storage or a viable means of using hydrogen for fuel will likely be necessary. One view of the future was hybrid cars with exchangeable batteries. However, electric cars will likely require more electricity than we produce and there was concern over hazardous waste.

It was lamented that energy policy is driven by political considerations and by public acceptance of specific energy technologies. Advancements in ICT will require breakthroughs in materials for computing and communications hardware. Medical applications of materials, such as replacements for organic materials and research on designing microbe-resistant surfaces, were briefly discussed.

The panelists discussed fuel cells, which are not yet commercially viable, but may eventually have application. Steel production volume and scrap was also touched upon

- it could be possible to source nearly all of Japan's steel production from scrap.

While there are wonderful materials discoveries to be made, not many industries will support long-term research. It is particularly difficult for young researchers to produce results on short time scales in order to receive funding. It is important for institutions to identify talented researchers and support them over longer timeframes, although panelists agreed that this remains a challenge.

103-D1 "Science and Engineering Education"

Chair:
Peacock, Jim, Fellow, Commonwealth Scientific and Industrial Research Organisation (CSIRO); former Chief Scientist, Department of Education, Science and Training (DEST), Australian Government, AU

Speakers:
- **Cox**, Stephen, Executive Secretary, The Royal Society of U.K., UK
- **Ding**, Lei, President, Shanghai General Motors Corporation Limited, CN
- **Krieger**, Eduardo, Head, Hypertension Unit, InCor - Heart Institute/USP; former President, Brazilian Academy of Sciences, BR
- **Mazur**, Eric, Balkanski Professor, Harvard University, US
- **Ponting**, Arlene, CEO, Science Alberta Foundation, CA
- **Schaal,** Barbara, Vice President, National Academy of Sciences (NAS), US

Getting more people interested in science, technology and engineering is a goal for educators worldwide. While it is obviously important to get more university students to enroll in technical courses and thus increase the number of science and engineering graduates, the panel agreed that a lot of interest in science must be stimulated at primary/K-12 educational levels. Various initiatives and methods for this were discussed, and new developments in technology which may benefit education were mentioned.

Many of the panel members discussed programs implemented in their home countries which aim to get people in the sciences and in industry to go into schools and work with children. These schemes create partnerships between teachers and professionals. The panelists cited some encouraging results and all agreed that the schemes were beneficial. Although facilitating some of these programs might be difficult in terms of finding time and incentives for professionals, the consensus was that this was worth working towards. It was suggested that this kind of activity gives children an idea of real-life applications, answering their need to know why they should learn about science.

The discussion moved onto methods of pedagogy. Many speakers said that interactive learning is a far more effective method than just lecturing. While lecturing was described as 'only transfer of information,' interactive learning was suggested to foster superior cognitive and social skills and give students a chance for input and involvement in their own studies. Several speakers reported on achieving improved results and a more positive atmosphere for learning.

Many participants noted advances in technology which are being used in education, especially involving the Internet. Now that information is readily available to children, students and researchers alike the skill to develop is how to find important information, rather than remembering it. This fed into the discussion on interactive learning, where such skills form an integral part of the learning process. However, with the availability of so much course material and resources on the Internet, some asked whether qualifications might become more widely available throughout the world. This led to the point that, especially in science, the skills learned through the interactive and social experience with other people cannot yet be replaced by Internet technologies. However, current popular web technologies, such as social networking, games and so on, were praised as ways to encourage children to learn and to aid the educational process.

While much of the initial talk was about getting children interested in science and the role of universities, many speakers reiterated the importance of making the public scientifically literate. This was a key point of the session. One example given was the critical role that parents play in shaping their children's opinions: if parents are not interested in science, children are likely to be discouraged. Although it was pointed out that this does work two ways and children can encourage interest from their parents, the consensus was that bringing more science to the public is necessary. In furthering this goal, methods of interactive learning and group work were said to have had the best results in generating understanding of science among the general public. Such methods have also been tremendously effective at closing the gender gap, which was raised as another issue that must be addressed to increase understanding of science. That teachers are critical in all of this, and must never be neglected, was the final and overriding message of the session.

103-E1 "International Collaboration in Science and Technology"

Chair:
Aymar, Robert, Director General, European Organization for Nuclear Research (CERN), FR

Speakers:
- **Ikeda**, Kaname, Director General, International Fusion Energy Organization (ITER), JP
- **Klocke**, Fritz, President, International Academy for Production Engineering (CIRP), DE
- **Talwani**, Manik, President and CEO, Integrated Ocean Drilling Program Management International (IODP-MI), US
- **Taylor**, Martin, President and CEO, Ocean Networks Canada (ONC), CA

Three possible models might be helpful for facilitating international collaboration in physics and also possibly applied sciences. The first involves individual interests stimulating research collaboration between institutes and laboratories. Issues such as staffing and material costs would need to be worked out. In a second model, different groups

conceive and develop products. While this would allow some scope for dealing with problems that partners face, issues related to intellectual property rights and investment details would need to be addressed. Another model is equipartition involving long-tem participation on a global scale with each partner sharing the responsibilities and benefits. Sometimes investments are grant-based, so some arrangements would need to be formalized in treaties and intellectual property rights protected.

Europe's long-term vision helps to strengthen international collaboration, as seen in projects like the International Fusion Energy project with seven partners: Japan, the European Union, Russia, the United States, India, China and South Korea. The project requires substantial resources, which further reinforces the need for each partner to bring their own expertise.

Each partner in a collaborative venture should assume an important role in the project. Plans to establish facilities such as nuclear power plants must be carefully thought out with strict adherence to safety standards. Also, in order to ensure the continuity of these projects they must attract young people from the community.

Another speaker spoke about the importance of production engineering in dealing with the strategic issue of energy sustainability. He said that companies have to examine local markets and community needs before attempting to work out global solutions. He suggested different models to run research projects, namely, cooperation based on individual interests and joint projects, involving collaboration among industries that share research interests. The speaker suggested that a bottom-up approach that depends on the impact of individual partners is a useful approach to collaboration.

Another participant wondered why some strategic orientation leads to collaboration and some does not. For example, oceanography should be a field with a lot of international collaboration, but unfortunately, this is not the case. He identified certain factors such as funding and national identity issues that affect international collaboration.

There is a large international collaborative effort in ocean drilling among 20 EU countries, China, India, Australia, New Zealand and possibly Russia. The project's high cost, large societal benefits and broad scientific curiosity were all reasons for the international collaboration. Two other impressive examples of international collaboration, according to one participant, are CERN in Europe and the Venus project. The latter aids understanding of the biological, chemical and physical parameters of the ocean and has encouraged the development of what he called "transformative technology."

Seven imperatives were listed: considered to be fundamental to any collaborative effort.

1. Excellence: the need to maintain high professional standards of operation
2. Intellectual capital, involving the best minds
3. Economic imperative
4. Infrastructure imperative
5. Analytical imperative
6. Educational imperative: Opportunities for highly qualified people. Making sure that the information that results from the collaboration is important to the future of science
7. Global imperative

Building research communities is a huge challenge. It is not easy to get organizations to share their intellectual property, or to get agencies to be proactive or to overcome national rules which impede development, but it is essential to successful collaboration.

One participant said that governments need to play a role in collaboration at the operational level. He said that some issues never reach the government level, which leads to difficulties in winning political support. He inquired: "How we can actually begin the process of putting together international networks that lead to success in joint technology platforms and bringing participants together on issues such as mobile technology communications, small enterprises and Internet security?"

Finally, participants also discussed alternative energies and ways of providing developing countries with crucial technologies.

103-F1 "Collaboration among Universities/ Research Institutes/ Industries"

Chair:
Wince-Smith, Deborah, President, Council on Competitiveness, US

Speakers:
- **Feczko**, Joseph, Senior Vice President and Chief Medical Officer, Pfizer Inc, US
- **Gomez Restrepo**, Hernando, President, Council of Competitiveness, CO
- **Lau**, Lawrence, Vice Chancellor and President, Chinese University of Hong Kong (CUHK), HK
- **Matsushige**, Kazumi, Professor, Kyoto University, JP
- **Profumo**, Francesco, Rector, Polytechnic University of Torino, IT
- **Rietschel**, Ernst, President, Leibniz Association (WGL), DE
- **Russell**, Alan, Chairman and Director, McGowan Institute for Regenerative Medicine, University of Pittsburgh, UK
- **Tan**, Chorh Chuan, Acting President, National University of Singapore, SG

Finding the perfect formula for collaboration among universities, research institutes and industries is a very important issue for technological development. The panel explained different ways that this partnership can be developed to be beneficial to all the parties involved. If these collaborations are effective, it can speed up the time taken from the initial scientific breakthrough to the final product.

The main idea was for the creation of a three-way partnership among government, universities and industry. The key may be allowing everyone in the partnership to keep working to their strengths, and to improve the interface between the groups. This way, the core purpose of the institutions can be maintained, but the diffusion of knowledge and ideas can be

improved. An example is the cluster model, where universities formulate a research idea that will attract the best scientists and the government and industries interested in the idea fund the project. Some of the research that results would be donated to the cluster, improving the flow of ideas. Such an approach would bring scientists and industries together in a situation where spin-off projects could make money and advance research. Another model involves bringing companies from different areas of interest together with a university to form a group, so that ideas can be shared between all parties without conflict and the university can provide the research that the companies really need.

Almost all models suggest that the government is very important in this process of formulating policies that promote research and development. If a government can provide funding for an idea to be formalized, then industry will be in a position to take it further. For this to work effectively, governments need to release any claim to the intellectual property, making the further development of a product more enticing to industry. This chain of funding will increase the money available at a basic level, so a country is in a position to attract and retain scientific talent.

The issue is different in developing countries; where companies often look outside their own country for research partnerships. This results in low productivity and countries do not effectively use their resources. To encourage these partnerships, governments need to organize research fairs, where companies can meet universities and find out what their own country has to offer. An improvement in research investment means more money stays in the economy and improves the level of research talent in the country.

Though there are many ideas for improvement, one problem was that of ownership of intellectual property rights for research discoveries, which determines who will benefit most from the research. If you clearly define at the start of the collaboration who will own what, problems may not arise later, but this can be more difficult when working on a multinational level.

Many problems stem from a lack of communication, which results in a lack of trust. A solution is to bring universities closer to industry. Methods to promote this include sending scientists out into industry, where they are often very successful, which develops stronger ties between universities and companies. Another successful solution is bringing companies onto the university campus. This blends public and private research, increases a university's capacity for research and provides money and an exchange of ideas to promote research. In the end, personal relations matter; if people like each other, they will work better together. To create a partnership that allows people to grow, you need to get the right people together.

In these collaborations, "value is created at the interfaces." If roles in a partnership are clearly defined and all parties know what they are expected to put in and what they can expect to get out, this will help people work together. Formation of effective partnerships can help scientific developments move into society and benefit everyone.

103-G1 "Business Innovation through ICT – How ICT Affects Business"

Chair:
Higashi, Tetsuro, Chairman and CEO, Tokyo Electron Limited, JP

Speakers:
- **Balasubramanian**, Bharat, Vice President, Group Research and Advanced Engineering, E/E, IT & Processes, Daimler AG, DE
- **Chami**, Ahmed, Minister of Industry, Trade and New Technologies, MA
- **Ito**, Chiaki, Member of the Board and Vice Chairman, Fujitsu Limited, JP
- **Ito**, Joichi, CEO, Creative Commons, JP
- **Sahin**, Kenan, President, TIAX LLC, US

Rapporteur:
Saracco, Roberto, Director, Future Centre and Scientific Communications, Telecom Italia SpA, IT

The discussion began with examples of the advantages of ICT. Rapid urbanization of population leads to poverty, crime, environmental destruction and prevents efficient use of energy. ICT distributes jobs geographically and by doing so eases the pressures of urbanization, such as its burden on the environment, and increases standards of living.

Within the field of ICT, the semiconductor industry has fused with the nanotech and biotech industries to bring improvements in medicine, education, and to the environment. Industries, such as the automobile sector and energy generation, for example, have also benefited from ICT. Although the ICT industry is responsible for 2 percent of carbon emissions, it can have an overall positive effect by reducing emissions in the remaining 98 percent of non-ICT industries. Specifically, ICT reduces the need for buildings and physical facilities which account for 40 percent of CO_2 emissions. ICT can also reduce environmental problems by changing business models and promoting smarter management of supply and demand.

ICT has fostered new kinds of innovation. Traditionally, innovation has come from large companies and governments with heavy amounts of R&D funding. In contrast, the ICT sector features many small firms with low overheads. Transaction costs are low because the Internet allows efficient competition, and the cost of failure is low.

ICT does have problems, though, including a lack of quality standards, since speed-to market is prioritized over quality. Databases exist but don't interoperate. Eighty percent of information is spam. There is no way to validate who is sending information under what name, and identity theft is not being addressed effectively, partially due to the complex nature of the problem and the number of computers involved.

Another problem mentioned was that of the quality of Internet content. We are transitioning from a world of peer-reviewed papers to one where information is free-for-all but often unverified. Often the quality of information on the web cannot be trusted. Institutions such as newspapers and academic journals that hire experts might be put out of

business by bloggers. The Internet is building isolated micro-cultures. People only look at information that supports their preconceived beliefs, and consequently democracy is being threatened. On the bright side, some bloggers are gaining a sense of responsibility.

Societies depend on the Internet despite its chaotic structure. There needs to be some government control, and this will be a major issue in the future. However, it is difficult to control such a complex system. This point led to concerns being raised about privacy. Democracy is endangered when governments and corporations become tempted to use and gain control over data.

The session concluded with a statement that IT and communication allows many players to participate and therefore promotes rapid development. Governments will have to play some kind of role in getting all the people involved to behave responsibly. If car manufacturers were completely ethical, they would not build cars that can be driven faster than 30 kph. However, there is pressure to sell cars, so investment is made in making cars safer for people who are not using them safely. Similarly, ICT is not related to ethics or sustainability per se, but is an independent, uncoordinated effort.

19:30-21:00 OFFICIAL DINNER

104 "Lights and Shadows of Science and Technology"

Moderator:
Hayashi, Yasuo, Chairman and CEO, Japan External Trade Organization (JETRO), JP

Speakers:
- **Her Royal Highness, Princess Sumaya El-Hassan**, President, Royal Scientific Society of Jordan (RSS), JO
- **Holliday Jr.**, Charles, Chairman and CEO, DuPont (E.I. du Pont de Nemours and Company), US

Yasuo Hayashi welcomed participants by stating that when discussing issues such as climate change, energy conservation, health, diseases and food problems a long-term vision is required. For the world to achieve sustainable economic growth we must address these issues, and the role played by science and technology is increasingly important. Water will be another increasingly critical issue, and he identified Japanese water practices in the Edo period, 200 years ago, as a model for modern practice. For the ancient Japanese the principles of reduce, reuse and recycle were in force and they did not waste a drop of water. Water is closely related to hygiene and disease control, and it is very meaningful that the STS *forum* is devoting an entire session to this topic. He next discussed mobile telephones, one ICT development that has made it possible to work from any spot on the Earth. He expressed concern that future developments in ICT may further widen the gap between developed and developing countries. Making ICT equipment more eco-friendly is also a challenge.

Charles Holliday Jr. shared his thoughts on current critical issues viewed through the lens of DuPont's corporate experiences. DuPont believes that there is a "new reality;" a realization that the Earth has limited resources. Everything we remove from the planet is at a higher price level than it was 18 months ago, he said. This places demands on science and also means that everyone needs to act differently. He suggested that vehicles like the one-person Segway may in the future become automobiles for the entire family, as long as the government takes the necessary steps. He predicted that the banking system would recover in less than two years. Science, he insisted, can be a big piece of the answer to our current problems.

Princess Sumaya El-Hassan said that Jordan and the Middle East are in a "terrible new reality" for which everyone must take responsibility. Those in science, commerce and politics need to recognize the need to globalize care and invest in knowledge that is committed to understanding local experience. There is considerable untapped human potential in this part of the world – we must extend our efforts to ensure better lives than we currently endure. Individuals must be directly involved in their own development, she added. The Princess explained that in the Middle East the desert is a major source of alternative energy and commerce. There needs to be transparency, trust and cooperation across borders to meet community, cultural and environmental needs, or the region will drift towards chaos and war. She identified non-governmental organizations (NGOs) as being key to bringing real change, and she noted that genuine interest to make the world a better place exists in places like the STS *forum*. Industry and academia are also engines of change, teaching students how to be more entrepreneurial.

Monday, October 6, 2008

08:30-09:50 PLENARY SESSION

200 "Science and Technology in the Service of Health"

Chair:
Yamada, Tadataka, President, Global Health Program, Bill & Melinda Gates Foundation, US

Speaker:
- **Brennan**, David, CEO, AstraZeneca Plc, UK
- **Hasegawa**, Yasuchika, President, Takeda Pharmaceutical Company Limited, JP
- **Kosgei**, Sally, Minister of Higher Education, Science and Technology, KE
- **Lim**, Chuan Poh, Chairman, Agency for Science, Technology and Research, (A*STAR), SG
- **von Eschenbach**, Andrew, Commissioner, U.S. Food and Drug Administration (FDA), US

Tadataka Yamada said that the purpose of the STS *forum* was not for scientists to talk about science for the sake of science but to seek ways for science to serve society. He considers the inequity in healthcare between developed and developing countries to be a moral tragedy and a cause of economic and political instability. He quoted Bill Gates as saying that "humanity's greatest advances are not in its

discoveries but in how they are applied to reduce inequity." Collaboration between private and public sectors is necessary to bring money and ideas to solve these problems.

David Brennan alluded to the lights turned on by science and technology and the shadows cast by industry. There is a rise in the incidence of diabetes and obesity along with a number of unmet medical needs, including cancer, stroke, dementia and HIV. Only large corporations can release the potential of medicine to improve peoples' lives. The average citizen's life span has increased from 45 to 60 years due to improvements in diet, living conditions and medicine. Successful partnerships in Japan, France and throughout the world to fight disease will also spark new innovations.

Yasuchika Hasegawa said that many diseases in developing countries are treatable by available drugs, and that infection can be reduced by clean water, sanitation and education. Poverty and starvation hamper efforts to invest in infrastructure and education and provide drugs that are needed. Research institutes focusing on tropical diseases should leverage the experience and knowledge of pharmaceutical companies. Encouraging the worldwide use of vouchers encourages development of medicines for diseases in developing countries. A tiered drug pricing system can be used to provide affordable drugs to countries according to their means. We need to empower developing countries to ensure human dignity and better quality of life for all.

Lim Chuan Poh described his government's success in providing high quality and affordable healthcare through scientific and technological innovation and policy. Singapore tripled its number of researchers and has achieved great growth in a short time. The government introduced an integrated approach to R&D at the highest administrative level by creating a small committee of responsive ministers with control of a budget. Increased collaboration between researchers and technicians resulted in unpredicted benefits such as applications for rehabilitation of stroke patients. He stressed the importance of investigative research and maintaining a balance between top-down governmental and bottom-up researcher-based approaches.

Andrew von Eschenbach said general, macroscopic medicine is being replaced by personalized, predictive, preventive and participatory medicine based on a genetic and molecular understanding of health and disease. Regulatory agencies must create a new regulatory framework to become a bridge, instead of a barrier, for transferring the benefits of medicine to people. These agencies should not focus on national interests but should integrate with other countries. The Federal Drug Administration will soon adopt a "beyond borders initiative" to strengthen confidentiality agreements with other countries. He added that regulatory agencies need to communicate their motives to the public to reduce their fear of biotechnology.

Sally Kosgei stated, "If you are hungry, any opportunistic disease can affect you." Poverty and health issues decrease life expectancy and productivity as the gap between rich and poor increases. Research, science and technology are powerful tools for enabling a long, healthy life and are necessary for achieving the three health-related Millennium Development Goals. The World Health Organization estimates that annually, 600,000 women die from problems related to pregnancy and childbirth. The organization helps save lives by increasing access to healthcare for African women. It is necessary for North-South and South-South partnerships to be formed in research, science and technology to bring important changes to the lives of African people.

10:20-12:20 SECOND SERIES OF CONCURRENT SESSIONS

201-A2 "Harmony with Nature – Nuclear Energy Alternative"

Chair:
Orbach, Raymond, Under Secretary for Science, U.S. Department of Energy (DOE), US

Speakers
- **Arima**, Akito, Chairman, Japan Science Foundation, JP
- **Batterham**, Robin, President, Australian Academy of Technological Sciences and Engineering (ATSE), AU
- **Debreuille**, Marie-Françoise, Vice President, Research and Innovation, AREVA Group, FR
- **Gottfried**, Kurt, Co-founder and Chair, Union of Concerned Scientists (UCS), US
- **Laval**, Guy, Foreign Secretary, Academy of Sciences of France, FR
- **Maekawa**, Osamu, Chief Technology Executive, Toshiba Corporation Power Systems Company, JP
- **Muto**, Sakae, Managing Director, The Tokyo Electric Power Company Inc., JP
- **Otheguy**, Héctor, CEO, INVAP, AR

Table Rapporteur
Pradel, Philippe, Director, Nuclear Energy Division, French Atomic Energy Commission (CEA), FR

We are on the cusp of a transformation in the way we produce and consume energy. The world is addicted to cheap energy but with fossil fuel prices spiraling upwards and worries about global climate change, energy has become a front-page concern. This is a good time for a reexamination of the promise and perils of nuclear energy, along with such issues as its sustainability, spent fuel reprocessing, plant safety and nonproliferation.

Most of the participants agreed that nuclear power will be an indispensable part of a nation's energy portfolio for at least the next few decades, until new, non-carbon or low-carbon-based energy sources like nuclear fusion come on-line. Nuclear energy is cost competitive with most other alternatives, even when a lifecycle comparison is considered, and it is virtually emission-free. The experience of nuclear plants in Japan, which experienced little damage from last year's strong earthquake, demonstrated the improved safety of modern plant design. Uranium supplies are stable for many decades and less subject to price swings than fossil fuels.

There was broad support expressed for rapid expansion of nuclear plants as a means of mitigating climate change, and some disappointment that nuclear energy was not included

in the Kyoto Protocol mechanisms. Standardized licensing process across countries and greater cooperation with and funding for the International Atomic Energy Authority (IAEA) will help the nuclear industry expand cost-effectively and safely.

Promising new technologies such as sodium-powered fast reactors, new reprocessing techniques and deep storage technologies are now being developed. Nuclear fusion is a very promising energy source that is thought to be cleaner, safer and more sustainable than current nuclear fuels, but it suffers from a long timeline from development to implementation.

Until now most nuclear plants have been located in the top 16 industrialized nations, but developing nations like China and India are rapidly investing in new plants. Nations like Brazil and Mexico have shown that developing nations can safely operate nuclear plants. Countries acceding to the non-proliferation treaty agree to nuclear safeguards in exchange for receiving help in developing their own nuclear energy. New technologies can monitor and control applications of this technology.

Some participants raised very real concerns about nuclear energy, including the issues of the stability of uranium supplies, nuclear safety, waste management, public acceptance, aging facilities and workforce. Containment of nuclear materials must be successful in the event of plant damage from accidents, whether natural, accidental or manmade. The safety culture of the nuclear industry must be good enough, even for older plants.

Public understanding and support must be gained, and the industry can learn from others in public awareness campaigns. Although environmentalists and labor leaders are more sympathetic to nuclear energy these days, the industry must still do more to engage with the public and not be defensive. The public doesn't believe what is told to them about nuclear power, and only 30 percent have the scientific education required to understand the main issues. Radioactivity creates fear, and many think there is no solution to nuclear waste problems. They should know, for example, that reprocessing can potentially recover up to 95% of the remaining uranium and plutonium in spent nuclear fuel.

Nuclear non-proliferation was a major concern. Nuclear terrorism poses great threat, but governments have not shown the political will to deal with the threat with the urgency required. Stopping proliferation often takes second place to other interests even though we know of secret stockpiles and attempted purchases of plutonium from former Soviet stockpiles. Weapons-grade uranium can be made using civilian output as feedstock. We need to take a long view of nuclear dangers – nuclear facilities will be with us for a long time, and nuclear know-how will spread.

201-B2 "New Development in the Genome Era"

Chair:
Hayashizaki, Yoshihide, Director, Omics Sciences Center, RIKEN, JP

Speakers:
- **Colwell**, Rita, Distinguished University Professor, Center for Bioinformatics and Computational Biology, University of Maryland and Johns Hopkins University, US
- **Conde**, Jorge, President and CEO, Knome Inc., US
- **Landis**, Story, Director, National Institute of Neurological Disorders and Stroke, National Institutes of Health (NIH), US
- **Lindpaintner**, Klaus, Head, Roche Genetics, Molecular Medicine Laboratories, F. Hoffmann-La Roche Ltd., AT
- **Ugrumov**, Mikhail, Counselor of the Presidium of the Russian Academy of Sciences on Foreign Affairs, Russian Academy of Sciences, RU
- **Winter**, Alan, President and CEO, Genome British Columbia, CA

This session analyzed the impact of next-generation genome sequencing technology on modern science and healthcare. The recent increases in sequencer throughput have resulted in a significant drop in the price and time required to sequence a genome. This promises to change research, healthcare and other aspects of science.

Society has great expectations for next-generation sequencing technology. The possibility of DNA as a predictor for diseases such as Alzheimer's, certain behavioral patterns, the production of replacement organs and the determination of risk for certain diseases is promising. The answers to problems related to aging, food, pandemics and bio-fuels will come from a molecular-level of biology. While genomics allows us to understand biology at a fundamental level, the human genome itself does not reveal everything.

The ethical and legal aspects must be faced. Controversies surrounding stem cell research, establishing a standard of care, regulating procedures and how to deal with privacy and confidentiality are all issues that need to be tackled. As genetic information can reveal private information and have a psychological impact, fair methods of dealing with genome sequencing must be developed.

The movement of technology has resulted in cheap and efficient methods of sequencing the genome, having rapidly fallen from millions to thousands of dollars. When the cost of sequencing a genome falls to a certain level, consumers will become increasingly interested in genetic technology for personal use. Some companies have begun to offer sequencing services to individuals and this development brings up many issues. Customers want to know about indications of preventable diseases that may show up in their gene information while some wish to remain uninformed about the possibility of developing certain incurable illnesses. However, dangers lurk in the possibility of the misuse of genetic information in employment, selective healthcare and other areas.

Concerns that it is too early to properly interpret the instances

of rare variance found during genetic sequencing were raised. Using epidemiology to find phenotypic expressions of rare variance takes time and requires extremely large sample numbers. Expectations must be managed appropriately. Nothing specific can be drawn from genetic information besides risk factors. Creating tested products for gene analysis that deliver true value will take time.

Application of these technologies can be used to improve the diagnosis of neurodegenerative diseases which are characterized by the appearance of symptoms some 20-30 years after the sporadic degeneration of certain neurons. Advancing sequencing technologies could be used to look at gene mutations associated with neurodegenerative disease such as Parkinson's disease.

Current genomics can already study private mutations or copy number variations that may exist in individuals by utilizing amazing sequencing capacities. Yet, as a caution, as the speed of sequencing increases and its cost decreases, accuracy will need to be assured. Understanding why genetic defects cause disease involves complicated biology and creating therapeutics is difficult despite the availability of genetic information.

Sequencing can provide a powerful and immediate tool for identifying pathogenic viruses. The current method of diagnosis for pathogens takes a very long time but it is desirable for physicians to be able to determine the type of infection you have as soon as possible. There are a lot of scientific surprises resulting from the ability to identify pathogens such as cholera, small pox and anthrax. It will take time to analyze bacterial genomes as there are many existing mutations but this information is a valuable tool for treating infectious diseases more rapidly and effectively.

The drastic fall in sequencing prices will result in new promising applications for gene sequencing technologies. However, unreasonable public expectations that widespread personal applications of genomics are available must be avoided. Curiosity is the biggest driving factor for those who are interested in these technologies for personal use and diagnosis. As the complexity of the genome goes beyond a one-gene one-enzyme connection, efforts should be made to inform the public about genomics by educating science writers.

201-C2 "What Can ICT do for Education?"

Chair:
Bregman, Mark, Executive Vice President and Chief Technical Officer, Symantec Corporation, US

Speakers:
- **Adly**, Noha, Director, Information and Communication Technology Department and International School of Information Science (ISIS), Bibliotheca Alexandrina, EG
- **Kulikov**, Gregory, Executive Vice President, TransTeleCom, RU
- **Leslie**, Ian, Pro-Vice Chancellor (Research), University of Cambridge, UK
- **Martin**, David, Executive Chairman, SMART Technologies, CA
- **Murai**, Jun, Vice President, Keio University, JP
- **Schoenberger**, Chana, Associate Editor, Forbes Magazine, US
- **Siriruchatapong**, Pansak, Executive Director, National Electronics and Computer Technology Center (NECTEC), TH

The participants expressed overwhelming support for applying technology to education and research. Many examples of possibilities were given, especially as a tool to benefit and complement existing frameworks. One concern was the education of teachers, especially those who are not technology natives. A recent phenomenon is students knowing how to use the technology before learning about it in school. Students often know more about technology before their teachers. Access to technology can be a source of frustration to students in the developed world, when they realize that they have better access to technology in their own homes than in their schools.

However, this is not true in the developing world, where technology access is clustered at institutions. Current education centers could become technology deployment centers. Technology is changing the teaching environment and teachers are moving away from being lecturers and toward being facilitators. New methods of teaching must be developed to accompany new technology, such as real-time evaluation of students, in which students perform activities while teachers provide feedback on how the students are responding. Other examples include changing from lecturing to interactively exploring material with students.

Teachers must be better trained to foster "learning to learn," and allow each individual to progress at their own pace. Technology has enabled take-home textbook content to become take-home multimedia content, which can complement classroom technology. Search technology should likewise be a complement to libraries and traditional sources.

Many existing and innovative solutions were offered for addressing the wide technology gap between the developed and developing worlds. The biggest differences are the educational divides between cities, schools and areas.

A popular application of ICT is distance learning, especially for rural schools. However, a high bandwidth connection is required for video broadcast, which is prohibitively expensive for many countries. For schools that don't have reliable broadband access, there could be systems which can run on- or off-line. Wimax is a possible solution for getting 90% of information online for 5% of the cost. To set up an IT system in a remote area, one could run it like a business - identifying the local educational process and understanding the customers.

Benefits of ICT use include students developing connections and friendships outside of their hometowns and helping teachers communicate with parents. Access to scientific journals, currently impossible, could become a reality.
Education is an important part of the process of creating innovation and fostering international competitiveness. In the coming years in India, there may be wage parity with IT workers in the US. Many organizations are looking to the next

markets and worker resource areas, such as Africa.

Not only accessing, but internalizing knowledge remains important, and the new "cut-and-paste" culture is becoming a major barrier to learning. Also at the university level, not enough young researchers are practicing true research that doesn't just feed on accessed information.

In years past, there was standard coursework on library navigation, which should be extended to technological information. Not all references can come from Wikipedia, which was debated as an educational tool. Children should be taught about ethical issues surrounding the use of technology. To combat plagiarism, there are technological solutions, such as a term-paper database service to check against existing papers.

Obstacles to the increased use of technological information are language barriers, resistance to change, and copyright. English is the language of choice, and machine translation is not yet practical. We all need to work on overcoming these hurdles. The issue of copyright is also a major challenge. The existing educational use exception does allow for online materials, so new frameworks and perhaps new laws are needed to allow educational collaboration in the online space. Finally, new methods must be cheap, effective and sustainable.

201-D2 "Role of Universities – What is Needed of Universities in the 21st Century?"

Chair:
Anzai, Yuichiro, President, Keio University, JP

Speakers:
- **Eichler**, Ralph, President, Swiss Federal Institute of Technology (ETH) Zurich, CH
- **Ghubash**, Rafia, President, Arabian Gulf University (AGU), AE
- **Kovačević**, Branko, Rector, University of Belgrade, RS
- **Lenzen**, Dieter, President, Free University of Berlin, DE
- **Seabra Santos**, Fernando, Rector, University of Coimbra (UC), PT
- **Suh**, Nam Pyo, President, Korea Advanced Institute of Science and Technology (KAIST), KR

Table Rapporteur
Minami, Masago, Senior Writer, Yomiuri Shimbun, JP

The discussion recognized that universities play a key role in helping address global issues such as climate change, health, security and poverty. Globalization and the market for research expanding across national borders were noted as pivotal changes for modern universities. The social responsibility of universities to supply government and industry with knowledge was underlined, as was the need for interdisciplinary teaching and conducting research for solutions to modern problems. However, it was generally agreed that traditional disciplines of education must not be abandoned - the need for students to have broad, relevant, skill-based educations was also emphasized.

The difficulty of balancing interdisciplinary research with the acquisition of knowledge necessary to understand technical subjects came up throughout the session. Working with different fields may be the only way to innovate and successfully tackle today's emerging problems, but faculty heads should not eliminate the boundaries of core subjects. Some universities are now choosing to implement much more radical programs - the push by Massachusetts Institute of Technology (MIT) to make research integral to all of its courses, and Melbourne University's move towards more modular education were given as examples.

Also recurrent was the subject of funding for universities and the sources for this funding. As universities have expanded, their position in society has changed. It was agreed that more funding is always good, but more important is the university's autonomy. Therefore, the source of funding should be considered. Most stated that private funding allowed the greatest freedom for university research, but as part of the global marketplace, a combination of funding sources is now standard.

Globalization was seen as a phenomenon in which universities are playing a major role, while also being profoundly affected by it. Universities are accepting more and more migrants as both faculty and students, which has accelerated international cooperation. Industries seeking the best research partners now select top global universities, bypassing national borders.

This led to a discussion about what skills a university of the 21st century should teach. Panelists agreed that teaching was the main responsibility of universities. Graduates should now be viewed as 'global citizens' and need to be able to compete in a global setting. It was suggested that degrees be standardized across the world and that universities work together to make degrees more transferable across borders; the European system was cited as an example. Courses which encourage learning of more of the skills needed for creativity, design or synthesis were said to be desirable now, with such skills being taught as part of courses at all levels. This should give students a wider skill base, which is of benefit to both interdisciplinary academic research and will also produce more employable, skilled individuals for industry.

A discussion of the relationship between universities, industry and wider society was central to this session. It was agreed that an atmosphere where universities can contribute to the wider world should be encouraged. Schemes which encourage competition and provide motivation for academics through practical problems from industry were recommended either through government schemes or from industrial projects. It was suggested that in motivating healthy research, some mix of "fear, greed and aspiration" is optimal.

201-E2 "Research Collaboration between Developed and Developing Countries"

Chair:
Juma, Calestous, Professor, Practice of International Development, Belfer Center for Science and International Affairs, Harvard University, KE

Speakers:
- **El Nazer**, Hani, President, National Research Center (NRC), EG
- **Forssberg**, Hans, Vice President, Karolinska Institutet, SE
- **Fujii**, Nobutaka, Executive Vice President, Kyoto University, JP
- **Hassan**, Mohamed, Executive Director, the Academy of Sciences for the Developing World (TWAS), SD
- **Kojima**, Seiji, Ambassador for Science and Technology Cooperation, Ministry of Foreign Affairs (MOFA), JP
- **Rubinstein**, Ellis, President and CEO, New York Academy of Sciences, US
- **Rwamasirabo**, Emile, Ambassador, Embassy of the Republic of Rwanda, RW
- **Singer**, Peter, Professor of Medicine, University of Toronto, CA

There is a need to enhance the ability of developing countries to be competitive in the global environment. Global competitiveness will help developing countries in tackling persistent problems associated with nutrition, health, education and water. The Hundred Dollar Laptop program was one practical example given of an effort to enhance the ability of developing countries to contribute to the global fund of knowledge.

It was also suggested that software development in developing countries is another way of increasing their capacity to tailor their knowledge base to fit their own developmental agendas.
Participants agreed that science and technology is crucial to any national development effort. Through science and technology, developing countries are better equipped to deal with issues such as global terrorism, natural disasters and diseases. However, for this to happen there must be better infrastructure to build sound partnerships in science and technology. One participant remarked it is the United Nations' responsibility to take the leading role in fostering this kind of scientific collaboration. He proposed the creation of a new UN umbrella organization called the World Science and Technology Organization (WSTO).

One participant said that as there is a strong association between poverty and health, there is a concomitant ethical imperative to place the focus on helping developing countries in dealing with diseases. He proposed that universities in developed and developing countries should be partners in these collaborative efforts. The idea of university twinning was given as one possible starting point.

Another speaker endorsed the idea of inter-university partnerships across the developed and developing world. International science and technology centers have created new patterns of collaboration that benefit developing countries. More advanced developing countries, like China, Brazil and India, should share their expertise with other developing countries.

There was general consensus that science could and should contribute to poverty reduction and economic development. Regarding the economic disparity between developed and developing countries, there is a need for more collaboration at the national agency level in formulating a comprehensive policy which promotes projects that ensure maximum delivery of benefits to people in the developing world.

It was also suggested that there is an obvious problem when aid organizers are not working in partnership with each other. He described an effort called "Scientists without Borders," which brings existing and potential aid organizers together through the web. This is a global alliance, like *Wikipedia*, that puts project leaders and individual organizers from developed and developing countries in contact with each other.

One speaker noted that while the Internet is invaluable in gaining access to information vital to development, several places, like East Africa, do not yet have this access. He mentioned, however, that there are currently initiatives to build better internet network infrastructure in the region.

Another participant gave examples of programs run by the Canadian government to aid development. He highlighted the Development Innovation Fund which finances the development of vaccines that do not need refrigeration.

An attendee said that there needs to be more regional cooperation among countries, so they are better able to respond to common challenges. The website www.iphandbook.com was offered as an online source of practical information on developing science and technology projects. Developing countries need to have specific priorities to organize donors. This needs-driven approach would ensure that resources are channeled into the most critical areas.

Closing remarks centered on integrating scientific research into national development agendas. The development of human capital was said to be the best way to increase developing countries' capacities to contribute to global knowledge. Support for young scientists and research institutions, access to publications and the development of educational infrastructure to train people locally, were some of the practical examples highlighted.

201-F2 "Interface and Dialogue between Humanities and Natural Sciences"

Chair:
Yaari, Menahem, President, Israel Academy of Sciences and Humanities, IL

Speakers:
- **Dutkiewicz**, Rafał, Mayor, City of Wrocław, PO
- **Haiduc**, Ionel, President, Romanian Academy, RO
- **Hasse Ferreira**, Joel, Member, European Parliament, PT
- **Kuroda**, Reiko, Professor, Graduate School of Arts and Sciences, The University of Tokyo, JP
- **Niiniluoto**, Ilkka, Chancellor, University of Helsinki, FI
- **Otieno Malo**, Joseph, President, Kenya National Academy of Sciences (KNAS), KE

In the world today, the need to bridge the gap between natural science and humanities is more apparent than ever. As new information is identified by science, for example relating to climate change, it then falls on the humanities and social sciences to identify the impact that these discoveries will have, and what policies need to be enacted as a result. Without this interface, further scientific developments will be hard to integrate into society.

There are many areas in which the link between natural science, social science and humanities must be improved. In large urban areas, there is general interaction between these three disciplines, but without joint action, the implementation and development of new plans is slow. The environment is another area in which these three groups need to come together; society will be affected by any decision made and must understand what is happening. In order for people to make sacrifices, they have to understand the reasons why.

There are many barriers which impede this interaction. Some of the strongest are built into the education establishment, where specialization forces students to choose an area of study from a young age. Once students have been separated into different areas, it is then very difficult to integrate them. With some notable exceptions, in most areas of humanities or natural science there is no chance to study outside of one's own field. As a result, two scientists may not understand each other's terminology, which means that laymen would always struggle. Scientists need to let in other scientists, and then humanities to improve the flow of information.

In the case of many cutting edge scientific discoveries it can be very difficult to diffuse knowledge into the public domain. The scientist is not necessarily at fault; pressure to publish papers and obtain funding and grants make it very difficult to find time to disseminate findings to a wider community. The job lies with journalists, but journalists without scientific training often unintentionally misrepresent scientific discoveries. It is very important that the people who are moving information into the public domain have a level of scientific training that allows them to understand the scientific discovery. This also applies to politicians – if they have an interest in science, then they can implement scientific policy that they understand and believe in.

Communication is very important for moving science into society. One example given related to science in developing countries, but is equally applicable to many other countries with strong historical or cultural identities. When scientific policies were implemented, many tribes, with different cultures and languages, would immediately reject them as they do not match with cultural beliefs. This happened because there was no explanation and communication between the two groups. In this situation, social scientists and humanitarians need to be involved in projects, so they can explain the benefits and the reason why scientists believe something has to be done. Without this interaction with society, important scientific work will not reach its full potential.

There were a number of possible solutions discussed in this session, one of which was implementing courses at universities relating to science communication. These courses would allow both science students and students with backgrounds in the humanities to learn about different ways of interdisciplinary communication. Such courses could also train those that may not end up in science careers to work to promote greater understanding of science. This would help society have its say in important decisions about the environment, nuclear power, privacy of genetic information and other issues that impact peoples' lives.

201-G2 "Role of Venture Capital in the Developed and Developing World"

Chair:
Hara, George, Group Chairman and CEO, DEFTA Partners; Ambassador, UN ECOSOC, JP

Speakers:
- **Hsu**, Charles, President, eMemory Technology Inc., Chinese Taipei
- **Massingue**, Venâncio, Minister of Science and Technology (MCT), MZ
- **Moon**, Chulso, CEO, Cangen Biotechnologies; Adjunct Professorship of Otolaryngology and Oncology, Johns Hopkins Medical Institute, KR
- **Patel**, Ketan, CEO, Greater Pacific Capital, UK
- **Vargas Guerrero**, Rodolfo, Chief Technology Officer, XVD Technology Holdings (USA) Inc., MX

First, it was stated that the original purpose of venture capital was to sow the seeds of new businesses and industries and to foster their growth. However, this purpose has degenerated into making big money without benefiting the public.

Several stages of development were described through which venture businesses typically progress. For the first few years there is a risk stage in which millions of dollars of investment annually produce zero revenues. After about the fourth year of remaining in this stage, financers tend to write off the company as a failure. However, some of today's most highly successful businesses initially required huge investments while yielding no returns for the first three years.

Examples were given of countries that have successfully used government policy to promote venture businesses. These countries tended to progress through several stages. First, the government stimulated innovation by providing incentives

for investors to invest in high-tech ventures together with the government. As these companies began to succeed and make initial public offerings (IPOs), more investors began to invest in the new industries. During this period, the countries experienced great industrial growth and became world leaders in the new industries. However, big companies then began to start business ventures in these new lucrative technologies and became competitors to the small companies. Consequently, the market became saturated and growth declined or ceased in these industries.

The claim that the venture capital market is a failure was addressed. The participants thought that if problems such as global warning are so big, then there must be ways to make a profit by solving them. One reason that it is difficult to fund such ventures is that it is unclear whether there is a market for the products. For example, it is difficult to invest in agricultural biotech ventures in Europe because it is unclear whether a market exists for such ventures. In contrast, there is a very clear roadmap for biofuel development in the US, so there is sure to be funding for it.
Some concern was expressed that start-up companies may become addicted to government funding and learn tricks to get funds without actually creating a successful business. However, examples were given of countries that successfully avoided this problem. For example, an organization in one country received all of its funding from government for a certain allowed period, and then was required to get half of its funding from other sectors, and ultimately ended its dependence on government funding.

A major problem identified by the participants was that fund-managers measure performance of a company by its internal regular returns. Consequently, short-time return plays an important role in venture capital industries even though it is more efficient in the long run to invest a lot of money at the beginning. Technology-based venture companies have to make big investments for future R&D. It is too risky for them to borrow money from banks because they have to return it. Once venture businesses go public, they become investments for activists who demand that capital be distributed as dividends instead of reinvested for R&D. To counteract activists, venture companies should accumulate money internally before having an IPO.

Participants recognized that this is a difficult time for venture capitalists. The whole banking system became risk-averse overnight because of the current economic crisis. This situation makes it even more difficult for venture business to get financing.

Some participants suggested that their governments should provide funding to solve these problems. They thought their countries should provide fiscal incentives and tax breaks to investors who invest in venture businesses. This strategy would encourage investment in the future of the country instead of in money games, such as subprime loans.

12:20-14:05 WORKING LUNCH

202 “Dialogue between Political Leaders and Scientists”

Chair:
Goldin, Daniel, Chairman and CEO, Intellisis Corporation, US

Speakers:
- **Barañao**, Lino, Minister of Science, Technology and Productive Innovation, AR
- **Cohen**, Jay, Under Secretary for Science and Technology, U.S. Department of Homeland Security, US
- **Kumar**, Ashok, Chair, Parliamentary Office of Science and Technology (POST), Houses of Parliament, UK
- **Mlynek**, Jürgen, President, Helmholtz Association of National Research Centres, DE
- **Rowland**, F. Sherwood, Donald Bren Research Professor of Chemistry and Earth System Science, University of California, Irvine (UCI), US (Nobel Laureate in Chemistry 1995)
- **Schiesser**, Fritz, President of the ETH Board, Swiss Federal Institute of Technology (ETH), CH

Daniel Goldin said that his generation has experienced mainly the “light aspects” of science and technology, but his grandchildren will have to deal with the many “shadows.” We are living in a time full of potential for significant climactic disaster. Low cost energy is not actually low cost or clean, and while humans can quickly travel around the world, so too can infectious disease. He said that the three shadows in ICT are inadequate security, privacy and reliability. Scientists should work harder to educate political leaders.

Lino Barañao explained that dialogue between scientists and political leaders is a new phenomenon in Argentina. Previously, relationships between scientists and politicians were strained, as science budgets stayed low in both good economic times and bad, but political support is now increasing. All politicians in Argentina today believe that science and technology are required for economic development and state policy, but adequate human resources, technology-based enterprises and new venture capital are missing.

Jay Cohen told the audience that terrorism knows no bounds. Fortunately, solutions to terror threats and other issues also know no bounds. Good ideas come from everywhere, so international engagement and cooperation is critical. The U.S. is an optimistic society. So too is the STS *forum*, which seeks to balance challenges and solutions. The idea of the force of enlightenment is a common thread. Only federal governments have the resources, staying power and wherewithal to facilitate discoveries and the knowledge to change the world and solve problems.

Ashok Kumar described dialogue between the science and technology community and the British parliament as healthy and successful. Exchanges about climate change, fossil fuels, and other scientific topics are occasionally fierce. Politicians speak one language and scientists another. The Parliamentary Office of Science and Technology (POST), where he is employed, tries to bring both sides together.

POST attempts to take difficult, complex subjects and explain them to politicians so they can understand and apply them in their debates. It is an independent advisory body which has gained the respect of all political parties.

Jürgen Mlynek said that when students asked Einstein why he asks the same questions every year, he explained that it was because every year the answers to the questions are different. Mlynek believes it is our duty as scientists to make this clear to the public and to politicians. Innovations come from curiosity-driven research. Politicians are not interested in science, or if they are, it is only if there are political or business gains. It is up to scientists to make science more political and business-oriented.

F. Sherwood Rowland started his session by reminding the audience that this is the 21st anniversary of the Montreal Protocol, which is now often cited as the most successful global environmental treaty ever put into effect. In 1974, the year that Rowland and his partner Mario Molina first published the scientific work for which they later shared the Nobel Prize, they had to decide whether to engage actively with the media and the political world. “We chose to talk to people and become enmeshed in politics and science.”

Fritz Schiesser claimed that a dialogue in science and technology is essential to tackle the challenges we are facing. Scientists and politicians are competitive but in different ways. Scientists are competitive in funding, while politicians compete in order to be elected and re-elected. In order to establish a successful dialogue, scientists need to understand politics, without giving up the principles of science. They must also pursue outreach activities to enlighten the public to help them understand how science works. An enlightened public equals enlightened voters.

14:20-16:20 THIRD SERIES OF CONCURRENT SESSIONS

203-A3 “Harmony with Nature – Managing Water Resources”

Chair:
Khoo, Teng Chye, Chief Executive, Public Utilities Board (PUB), SG

Speakers:
- **Braga**, Benedito, Director, Brazilian National Water Agency (ANA), BR
- **Conzelmann**, Claus, Vice President for Safety, Health and Environment, Nestlé S.A., DE
- **Guinot**, François, President, National Academy of Technologies of France (NATF), FR
- **Kada**, Yukiko, Governor, Shiga Prefecture, JP
- **Szöllösi-Nagy**, András, Deputy Assistant Director General, Natural Sciences Sector, UNESCO, HU

Seven hundred million people have no access to safe, affordable water and 2.5 billion lack access to safe sanitation. This global water scarcity crisis was referred to as “global drying” by one participant. Although climate change will have a tremendous impact on water resources, through increased rainfall or droughts, among other effects the greatest driver of the water crisis is population growth. More than three billion people will be added to the current 6.4 billion people in the world in the next 50 years, with most of the population growth occurring in the developing world. Trends like urbanization and migration will make water management even more difficult.

Like oil, water is precious, although, unlike oil, water is considered a renewable resource. This assumption was challenged by one participant, though, as he noted that in many areas water scarcity is causing depletion of deep underground aquifers and that this fossil water is not easily renewed.

Simple, cost-effective, self-sustaining solutions to water problems must be found. Fortunately, many already exist. Participants suggested increasing the number of surface or subterranean reservoirs and groundwater and the expanded use of traditional techniques such as gravity-powered rather than petroleum-powered water pumps. They also spoke of managing demand through pricing policies. Farmers, who are often subsidized for water use, must understand the true economic value of water in order to encourage conservation and reduce waste. Since up to half of all irrigation water is lost, the productivity of water employed in agriculture must be improved.

There has been some progress in securing safe drinking water around the world, but increasing numbers of people lack sanitation. The increase in reservoirs and irrigation has changed the flow conditions of rivers. We have the tools for management but lack trained personnel, so we must invest in education of water professionals.

Cities face unique problems in water management, including limited land for water storage. Some techniques that may be effective are the reuse of water using advanced membrane technology and the desalination of sea water. Public water conservation campaigns and taxes help raise awareness of water conservation.

There was a discussion about whether water should be considered a public good or an economic good. While minimal needs must be met, some participants suggested that pricing water accurately would actually benefit the poor, who already pay dearly for water. To understand the economic value of water we must consider virtual water assessment, in looking at all the water consumed to produce goods. One beef steak, for example, represents 2000 liters of water. For many foods or consumer products, most of the water is used at the production site, far from where final consumption occurs. Large factories use lots of water but are often located in water-scarce areas and use raw materials that have used lots of water, so even reducing water use doesn’t affect greater waste in agricultural sectors where raw materials derive. Farmers do not know the true economic or environmental cost of water because of government subsidies for water use.

Consumers need to make the right choices. Carbon labels tell consumers how much CO_2 equivalent is required to make a product, but it was suggested that a virtual water label also be added to products so that they understand how much water was consumed as well.

Some participants suggested that we do have enough water to meet global needs. Accessing that water is both a technological and economic issue, depending on whether an area is largely urban or rural and the country's level of development.

Water problems in the developed world tend to get solved when a crisis arises and political will is felt but this is not true for developing nations. Developing nations need funding and assistance to deal with building the needed infrastructure and management systems they will need in coming years. Funding that will allow developing nations to comply with Millennium development goals must be found.

203-B3 "GMOs for Food, Fiber and Fuel"

Chairs:
- **El-Beltagy**, Adel, Chair, Global Forum on Agricultural Research (GFAR), EG
- **Fedoroff**, Nina, Science and Technology Adviser to the Secretary of State, U.S. Department of State, US

Speakers:
- **Datta**, Asis, Professor of Eminence, National Institute for Plant Genome Research (NIPGR) New Delhi, IN
- **Fischhoff**, David, Vice President, Technology Strategy and Development, Monsanto Company, US
- **Holmgren**, Peter, Director, Environment, Climate Change and Bioenergy Division, Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations (FAO), SE
- **Oishi**, Michio, Director, Kazusa DNA Research Institute, JP
- **Van Montagu**, Marc, President, European Federation of Biotechnology (EFB); Chairman, Institute for Plant Biotechnology for Developing Countries (IPBO), BE

Agriculture plays a significant role in most countries. In developing countries it can involve over 50% of the population and successful agriculture programs are necessary for employment and prosperity. The world food crisis and continuing social upheaval will cause poverty and cause us to fall short of our Millennium Development Goals. New scientific tools are needed to tackle increasing problems of poverty and hunger. The use of genomics and genetic engineering could become extremely important in the near future.
Participants in the session believed that while the use of genetically modified organisms (GMOs) is the most prominent solution to food shortage, strong public sentiment is preventing the full exploration of the possibilities, especially outside the United States. Opposition to the production of GMOs leaves scientists with few options. We must allow more access to information about DNA and biotechnology and continue research in this area. There will come a day when GMOs are necessary for the world.

The agriculture and energy sectors are closely intertwined. Bio-fuels (all carriers of energy in biomass) compose 13% of the world's total energy consumption – the energy equivalent of 4 gigatons of oil. 1.9% of this energy comes from liquid bio-fuels, including bio-ethanol and bio-diesel. The possibility of using these fuels as resources is currently a topic of intense debate. Bio-fuel production has both advantages and risks, but a clear picture of its effects on green house emissions and water resources has yet to be developed.

Scientists have to be ready to give more information about the usefulness of GM-crops with viral and bacterial resistance. In the case of corn, over 400 genes contributing resistance have been patented and crops with increased nitrogen fixation abilities are already available. Certain speakers were adamant that blocking the use of GMO technology due to misinformation and lack of funds must be discontinued.

It was agreed that we must create confidence in the use of GM-crops and dispel false beliefs. People say that they want a world free of GMOs and there is a lack of support at the political level. It is urgent that scientists speak up now to bring to the attention of society the benefits of GMOs. Scientists must be prepared to provide information to dispel false claims against GMOs and make the public understand that "the whole world is one big genetic laboratory."

While some countries carefully introduce GM-crops, others block farmers from the choice between the use of GM and non-GM crops. Access to scientific information is too limited. Our politicians don't receive accurate information, and non-governmental organizations (NGOs) raise large amounts of money to counteract the production GM-crops. The public is fascinated by the use of technology in electronic items, but they do not know about its potential in agriculture. A recently released study in Europe has shown that GM-crops are safe, but the EU has not published this report or held any press conference.

It will be a difficult challenge to convince the general public of the safety and benefits of GMOs. In one African nation, a census revealed that printed media reach only 15% of the population – radio media was more widespread, but not used to promote GMOs. Neither the African public nor private sectors are commonly involved in the development of GMO technologies. Most citizens' trust lies with the public policies of the government and there are many obstacles to gaining the public's trust of GMOs. Working in connection with the international community to promote funding for research in these areas would be invaluable to making African countries more receptive to these necessary technologies.

203-C3 "What can ICT do for Health?"

Chair:
Campbell, Donald, Senior Strategy Advisor, Davis LLP, CA

Speakers:
- **Chang**, Morris, Chairman, Taiwan Semiconductor Manufacturing Co. Ltd., US
- **Gage**, John, Partner, Kleiner Perkins Caufield & Byers, US
- **Graydon**, Oliver, Editor-in-Chief, Nature Photonics, UK
- **Harbour**, Malcolm, Member, European Parliament for the West Midlands, UK
- **Hegarty**, John, Provost, University of Dublin, Trinity College, IE

- **Kitano**, Hiroaki, Director, The Systems Biology Institute (SBI), JP
- **Sangin**, Amirzai, Minister of Communications and Information Technology, AF
- **Sutherland**, Garnette, Professor of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, CA

ICT now plays a role in almost all aspects of our daily life, especially healthcare. At the intersection of ICT and health, many great strides have been taken and many possibilities exist for future breakthroughs. It can be said that ICT has contributed to the rising cost of healthcare, but it will likely also be part of an effective healthcare solution.

In developed countries, populations are aging, and as a result, healthcare costs are rising exponentially. An important recent study reported that 20% of persons over 65 are dependents. Technological solutions, such as monitoring systems and assistance devices, will be needed to care for these persons, either at home, which is the cheaper alternative, or in care facilities.

The use of sophisticated imaging and standardized records can help minimize the need for surgery and tissue sample procedures and achieve more targeted treatments for specific subsets of patients. Electronic hospital records also offer improvements in safety, accuracy, convenience and environmental impact. They can speed treatment for critically urgent situations, such as stroke, following imaging and diagnosis.

We can look forward to a much more informed consumer in terms of both ICT and healthcare. One US study reported that 75% of Americans use the Internet for health advice, and Google has become the number two resource for health information. Patients want control and security for their medical information, but need to maintain its availability to family and care-givers when necessary. They also want more accurate information and more effective treatments on ever shorter timeframes.

ICT can be of great help to developing countries where it can make a big difference. Unfortunately, ICT infrastructure is the least developed in these countries. The needs of developing countries can be markedly different from those of developed nations. In remote areas of developed countries, broadband ICT availability can help bring doctors to patients and vice-versa. However, in many developing nations, basic ICT, such as cell phones and slow-speed Internet, remain luxuries. Even this low-tech ICT can be a major contribution to healthcare. Access to electronic books, journals and basic communication makes a major difference to medical research in the developing world. It was noted that the majority of simple problems in rural areas could be treated without transport to a hospital if communication technology were available. However, electrical power generation alone remains a large obstacle in many remote areas.

Numerous technological advances were discussed, including optical sensors, higher-speed networks, mass data storage, and better communication between healthcare workers, including first-responders and those involved in subsequent treatment. Likewise, in high-tech healthcare, advances have been made against malaria and other diseases, and breakthroughs have even been made in stem cell research. Panelists discussed one cutting-edge area of drug research, synergistic effects of combinations of drugs, which has produced several useful drugs; some drugs unrelated to certain diseases are effective against those diseases when used in combination. Computational science was suggested as a future technology for predicting possibilities and reducing the risks and difficulty of exploratory clinical trials.

ICT is of great importance for securing acceptance and motivation for action on health issues. Attendees expressed concern that the most successful products are not always the most technologically advanced, but often the cheapest ones. The STS forum could be influential in speaking out against barriers to ICT advancement.

Overall, there was a general consensus that ICT has a great role to play in both the developed and developing world, in terms of medical progress.

203-D3 "Proposals from Young Scientists"

Chair:
Schürer, Wolfgang, Chairman, Foundation Lindau Nobelprizewinners Meetings at Lake Constance, CH

The overriding themes of this session were how to create an environment where young scientists can work on problems which particularly concern them and what are the opportunities for getting more young people positions in science. General issues such as social responsibility, increased funding for "blue sky" research and encouraging innovation from young scientists were raised. Additionally, reforming academia to further motivate scientists was suggested. It was agreed that quality of research should be fostered in young scientists, rather than purely encouraging a high quantity of publications.

The session was divided into the following five sub-topics:

Fostering young researchers
This starts with communities and schools and children should be exposed to science early. However, science does not stop when people leave school. Meanwhile, scientists from developing countries should have more facilities, infrastructure and recognition to continue research when they return from institutions overseas. This creates more local role-models in science and sets science up as a viable career path. Government commitment is needed for this, along with a greater number of scientists in government - in both developed and developing countries.

Schemes to develop the creative ideas of young researchers
The crucial idea discussed was creating a positive environment for young researchers. The ideas discussed had much in common with the previous topic, as it was pointed out that such an environment is necessary for both fostering young researchers and developing their ideas. It is extremely desirable for young scientists to be able to concentrate on their research, rather than worry about their career and job

security. This environment should be sustainable and feature evaluation methods and criteria for research projects which allow for interdisciplinary work.

Establishing networks among young researchers
Now that we have very good, ubiquitous networks, how can we use these to aid research and help young scientists? Participation with Internet-based collaboration tends to be more active and lacks some passive elements of face-to-face networks. Encouraging the use of the Internet is usually easy among young scientists, but using it across generations presents more of a challenge. Technologies also afford much faster publication of research results and this generates extreme competition. An environment with healthy competition where young scientists feel free to share new ideas is something worth pursuing and will require more trust between young scientists.

Mutual and international exchange between academic, industrial and governmental sectors
Technology licensing is now an issue that is international and encompasses both developed and developing nations. Public outreach is necessary and more groundwork is needed in schools, governments, banks and the wider scope of society. The issue of retaining good researchers in academia, as much talent is lost to the private sector, and the specific case of developing countries being unable to keep talent were discussed. Some examples given were universities from developed countries building branches in developing countries. This kind of local distribution of institutions can lead to research specific to regions.

Next great challenges for Science and Technology
A profound issue raised in this talk was that of risk assessment. In the past century, many new technologies were developed for very worthy causes, but had unexpected side-effects. The development of chlorofluorocarbons (CFCs) was cited as one such example. Meanwhile, the recent financial crisis was described as possibly a case where innovation had overtaken risk assessment and balanced thinking. With the proportion of old people now outweighing that of young people in many countries, it was asked if young scientists might be "endangered." Points raised earlier in other topics came up again, clarifying the opinion that inspiration for young scientists needs to be introduced early.

203-E3 "Brain Drain, Brain Gain and Brain Circulation"

Chair:
Zhang, Jie, President, Shanghai JiaoTong University, CN

Speakers:
- **Bououny**, Lazhar, Minister of Higher Education, Scientific Research and Technology, TN
- **El-Hassan**, Princess Sumaya, President, Royal Scientific Society of Jordan (RSS), JO
- **Kabganian,** Mansour, Deputy Minister, Ministry of Science, Research and Technology, IR
- **Omer**, Ibrahim, Minister of Science and Technology, SD
- **Winnacker**, Ernst-Ludwig, Secretary General, European Research Council (ERC), DE
- **Wintermantel**, Margret, President, German Rectors' Conference, DE

The session examined ways in which "brain drain" affects developing countries. One negative impact that was highlighted is that brain drain decreases the capacity of a developing country to meet its own local needs and makes it difficult for it to compete on a global scale.

The push and pull factors that lead to migration and brain drain were also discussed. Low income, poor social conditions and ethnic problems were identified as important push factors. Developed countries, on the other hand, are attractive for exactly the opposite reasons. Additionally, one participant spoke about the policy of some European Union countries to actively recruit highly skilled scientists from the developing world and from other European countries. This is seen as a necessary step in maintaining a competitive edge in the global economy. It was reported that Europe aims to become the most competitive and dynamic knowledge-based economy by 2010. The success of this goal will depend on an influx of highly trained migrants. Some participants further argued that in a globalized world, the concept of brain drain is inappropriate. They suggested that the term "brain circulation" better describes the flow of talent between sending and receiving countries.

On the transition from brain drain to brain gain, it was reported that Chinese universities have begun putting programs in place to repatriate scientists who have gone abroad to pursue their studies. These scientists are considered to have added value and a government initiative has been set up to recruit them and utilize their knowledge in addressing the local needs of their home country. Thus countries facing brain drain will need to develop strategies to cope with the loss of their skilled people while at the same time finding ways to integrate them into the development efforts in their home country.

One such strategy that was suggested is for developing countries to take steps to prioritize their resources in such a way that education is not disproportionately underfunded. Lack of responsible resource allocation is identified as a prevalent problem in a number of developing countries. Some of these counties expend a huge portion of their national budgets on militarization while neglecting critical areas like health and education. One example that was given was those developing countries which still have not fully committed themselves to

educating their women and harnessing their potential to play a significant role in the development of their economies.

One participant argued that efforts by developing countries to prevent brain drain might be futile. Instead, it was suggested that they should concentrate their energies on developing alternatives that can attract private investment.

Some countries like Japan suffer from a phenomenon that one participant called "brain stagnation" in which young people are not interested in pursuing their studies abroad and as result lose out on the new perspectives and skills that they could gain from other countries. This has the potential to reduce the capacity of the Japanese workforce to compete globally.

It was concluded that a borderless world makes it easy for people to migrate to other countries. However, international collaboration can help to lessen the impact of brain drain on vulnerable economies. One way in which collaboration could do this is by setting up national or regional diaspora organizations that encourage scientists to play an active role in the development of their home countries.

203-F3 "Role of Media in Science and Technology"

Chair:
Kurokawa, Kiyoshi, Special Advisor to the Cabinet; Professor, National Graduate Institute for Policy Studies, JP

Speakers:
- **Jain**, Jinendra K., Chairman, Jain TV Group, IN
- **Jasny**, Barbara, Deputy Editor for Commentary, Science, American Association for the Advancement of Science (AAAS), US
- **Kamanga**, Daniel, Director of Communications and Public Acceptance, Africa Harvest Biotech Foundation International (AHBFI), KE
- **Osterwalder**, Konrad, Rector, United Nations University; Under-Secretary-General of the United Nations, CH
- **Park**, Penny, Supervising Producer Discovery Specials, Discovery Channel Canada, CA
- **Power**, Christopher, Assistant Managing Editor – International, BusinessWeek, US

Table Rapporteur:
Bergman, Catherine, Author and Journalist, CA

While the general public does not need to have a deep knowledge of every area of current research, it needs to have some understanding of the science behind the issues that face the world today. This session focused on how the media could be used to diffuse this important knowledge to the public.

It can be difficult for a journalist to write an accurate science article. With great pressure to meet deadlines, it can be difficult to do sufficient background reading and check all facts and sources. An editor is looking for a story that will sell, if the science article is not sensationalist, it is unlikely to be approved. This pressure means that a story about a scientific discovery is less likely to be written. With this situation, it is a struggle for scientific research to make it into the public domain.

Misinformation is a big problem with the scientific articles that do appear in the main stream media. Scientists often feel the meaning of their research is distorted, a recent example being the Large Hadron Collider, where one person with a sensationalist viewpoint managed to make it into the press with views that did not match those of the scientific community. Press coverage like this spreads a false view of scientific work, and also breeds fear and mistrust within the scientific community. It is imperative that accurate information can be given to the public to reverse this trend.

An important first step for science, when using the media to broadcast findings, is careful selection of the correct choice of medium. This choice will depend on the country you are in and the audience you want to reach. The media is market-orientated; it has to provide the stories people want, which puts the onus on the scientist to present not just their findings, but also a story that will interest the public. Programs following scientific endeavors can present findings and humanize the research process, helping the public understand what scientists are doing.

A different approach has to be taken in developing countries, where there are higher levels of illiteracy and in many areas people do not own televisions. For these people, knowledge about agriculture and having general access to educational materials is very important. Radio is one means to provide this; in Africa most people will listen to the radio everyday, providing a medium for scientific knowledge to be dispersed.

The media cannot be expected to give science more coverage; as businesses they have the right to choose the material they cover. They need to satisfy their market and if the market does not crave scientific knowledge, they should not be obliged to provide it. It instead falls to the government, through education policies, and scientists, through finding ways to sell their science as a story, to create a culture of science. Once a culture of science has been created, the market will then be there for the media to satisfy, leading to increased science coverage.

Science and journalism are two very different cultures, and a way to provide a bridge between the two is needed. Centers like the Science Media Centre in the UK can provide this bridge. They provide weekly briefings for editors, a contact point for journalists when they have to write a science story; and experts that can explain the science to the journalist. This way, scientific ideas can be presented as journalistic stories, without technical jargon, allowing an accurate article to be made. Another bridge could come through training for scientists to communicate with journalists, making communication easier. This greater communication can be turned into personal bonds, massively improving relationships, resulting in science being brought into mainstream media.

203-G3 "International Reconciliation of IPR"

Chair:
Yu, Geoffrey, Senior Specialist Advisor, Ministry of Foreign Affairs, SG

Speakers:
- **Akimoto**, Hiroshi, Counsel of Intellectual Property, Japan Pharmaceutical Manufacturers Association (JPMA), JP
- **Hennessey**, William, Professor of Law, Franklin Pierce Law Center, US
- **Koezuka**, Masahiro, former Commissioner, Japan Patent Office; Advisor, Mitsui Sumitomo Insurance Co. Ltd., JP
- **Li**, Yonghong, Director General, Electricity Examination Department, State Intellectual Property Office of P.R. China, CN
- **Oosterlinck**, René, Director, Galileo Programme and Navigation related activities, European Space Agency (ESA), BE
- **Stein**, Christian, CEO, Ascenion GmbH, DE
- **Takagi**, Yo, Executive Director, Office of Strategic Planning and Policy Development and the WIPO Worldwide Academy (WWA), World Intellectual Property Organization (WIPO), JP

The session opened with a statement that political and ideological differences have distracted attention from important issues, such as the discrepancy between developed and developing countries. The purpose of the session was to bring back substantive rather than political-ideological debate, because IPR is based on necessary cooperation between states.

Patent offices need to harmonize national IP systems to catch up with the increased workload caused by increased filings, and to reduce redundancy of applications in multiple countries. This harmonization can be achieved by collaboration between patent offices of various countries to function as one "virtual global patent office." Patent offices need to respond to the differences between innovation modes in areas such as IT and pharmaceuticals. Patent offices also need to address global disputes and assess the negative impacts of opportunistic activities by improving predictability in the acquisition and utilization of IPR. Clear and transparent rules combined with effective use of IT and the facilitation of IPR transfer and licensing are required. Finally, a pro-innovation global IP infrastructure needs to be established.

It was noted that only a small percentage of patents are owned in developing countries. Consequently, such countries are skeptical about the IP system, because they don't understand how it could benefit them. Their skepticism must be eliminated and they must be encouraged to protect their own patents. Also, developing countries don't know which IP model to follow as there is no established model among developed countries.

Participants discussed the significance of free and open source software (FOSS) for IPR. The old industrial model was based on the concept of individual or company ownership of property, but the basis of IT innovation is sharing. Pressure from the IT collaborative model has caused phenomena such as patent pools and collective trademarks. The question was posed as to whether FOSS would work as well for other industries as well as it has for IT. India was cited as an example of a country that has applied the FOSS model to the pharmaceuticals industry. Participants discussed whether FOSS would work as well in the pharmaceuticals industries as it has in IT, and concluded that there are some important differences between the two fields. IT products combine many technologies, but pharmaceutical products are single substances. Therefore, open source innovation would be difficult to apply to the pharmaceutical field. However, open source innovation could be useful for basic research tools used in pharmaceutical fields.

Concern was expressed about the harmful effects of patent "trolls," who opportunistically enforce their patents against alleged infringers. An example of a successful solution to an IP problem was offered: A US law changed the term of patents from seventeen years after its grant date to twenty years after its filing date. This law reduced the number of "submarine patents," those which were granted long after the application date and remain unknown to the public during that period.

An infrastructure is necessary to foster cooperation and technology transfer between academia and industry. Universities must be allowed to participate in the commercial successes of their products. A line needs to be drawn between competitive and precompetitive research, so that the latter can be pooled. Since the role of universities and researchers is to disseminate information, they should not use "blocking patents," which prevent patentees from using their inventions without licenses from another patent. Grace periods should also be introduced.

Linguistic issues were mentioned as examples of the effects of globalization on IPR. Disclosures are required to be written in English, but applicants from some countries think they should be translated into their languages. The importance of IPR for startup companies was also mentioned. Innovation can be promoted by prioritizing startup companies over large companies for grants of revenue.

16:50 – 18:00 PLENARY SESSION

204 "Biofuels and their Potential Effect on Food Production and the Environment"

Chair:
Serageldin, Ismail, Director, Library of Alexandria, EG

Speakers:
- **Desmarescaux**, Philippe, Chairman, Scientific Foundation of Lyon, FR
- **Riisgaard**, Steen, President and CEO, Novozymes A/S; Chairman, EuropaBio, DK
- **Rosegrant**, Mark, Director, Environment and Production Technology Division, International Food Policy Research Institute (IFPRI), US
- **Taha**, Elzubair, Minister of Agriculture, SD
- **Wambugu**, Florence, CEO, Africa Harvest Biotech Foundation International, KE

Ismail Serageldin described carbon emissions, volatile markets and competition against food production as issues to overcome if biofuels are to be truly viable. Subsidies have been enacted in a number of countries and in the U.S., one-quarter of the corn crop now goes to produce ethanol. However, with population increase and economic growth leading to much greater demand for food, there may not be room for biofuel production. With rising food prices leading to riots in some areas, the decision to cultivate biofuels is not simple. "It is wrong to burn the food of the poor to fuel the cars of the rich." he suggested, especially when many alternatives may be explored.

Mark Rosegrant explained that although biofuels have triggered high food prices, many other factors contribute to the price rises. Low rainfall, export bans and increases in demand are greater factors and, as an estimate, biofuels have only accounted for around 30% of these price rises. He recommended that ethanol blending and similar policies should be removed. Also, with high and rising gasoline prices, biofuels are comparatively economical. Even after the current problems of food and oil are solved, biofuels will be part of the long-term equation. Production of second generation biomass also creates competition for land, so there are no easy solutions.

Elzubair Taha stated that food security is paramount. Arguments over the details and causes of food price rises are causing many rifts in the world. These problems are shared between us and are likely to get worse. Sudan has much fertile land and can support massive crop production, and is opting for harvesting food rather than producing car fuel. This choice is like a 'tug of war,' but new agribusinesses may promote cooperation. As the problems are common, we must identify who, rather than what, is the villain.

Steen Riisgaard said the next generation of cellulose-based biofuels will be developed on an industrial scale within two years. The confluence of expensive energy and improved technology, along with funding from the U.S. Department of Energy, has made this possible. The new biofuels will be produced in China, which has been providing first-generation biofuels on the local level, in Brazil, a pioneer in sugar cane-based biofuels with a developed market, and in the U.S., where new automotive fuel standards mandate biofuel use. Europe will lag 5-10 years behind, due to a lack of political will. Unwavering political leadership and a road map are what are needed to convince companies to invest with confidence.

Florence Wambugu explained that early this year food prices rose by more than 50 percent for all commodities, while energy prices also spiked, leading to dire suffering for many. Also behind the food crisis, she said, was an increase in meat consumption, a growing population, and biofuel production. Yet placing blame on biofuels would be counterproductive. Biofuels have potential benefits for African communities, she said, citing examples of fuel conversion of indigenous plants, like Jatropha, that grow well in semi-arid conditions. She urged Africans to turn a perfect storm of events into a perfect opportunity for fostering a green revolution in Africa.

Philippe Desmarescaux said that we need to consider global and environmental impacts of our behavior. We must change our lifestyle and eating habits, accepting that livestock farming requires more land and cereal than is sustainable. We must balance our use of arable land with needs for food, fuel, fiber and feed, and preserve the environment for the benefit of all. Science and technology can help us do this by improving energy yields and developing new plant varieties that need little water or are able to use more arable land in saline or drought areas.

Tuesday, October 7, 2008

08:30 – 09:25 PLENARY SESSION

300 "Summaries from Concurrent Sessions"

Chair:
Helal, Hany, Minister of Higher Education and Scientific Research, EG

Speakers:
- [A] **Schellnhuber**, Hans, Director, Potsdam Institute for Climate Impact Research (PIK), DE
- [B] **Bhumiratana**, Sakarindr, President, National Science and Technology Development Agency (NSTDA), TH
- [C] **Carty**, Arthur, Executive Director, University of Waterloo Institute for Nanotechnology, CA
- [D] **Shirai**, Katsuhiko, President, Waseda University, JP
- [E] **Córdova**, France, President, Purdue University, US
- [F] **Lee**, Yuan Tseh, President Emeritus, Distinguished Research Fellow, Academia Sinica, Chinese Taipei (Nobel Laureate in Chemistry 1986)
- [G] **Brown**, Gavin, Inaugural Director, Royal Institution of Australia, AU

Hany Helal introduced the speakers, who each summarized the proceedings of one of the seven tracks of concurrent sessions. He later concluded the session by calling upon the audience to think globally, act locally, network among scientists and other stakeholders, simplify science and promote public education, save energy, and improve connectivity and access to information for developing nations.

Hans Schellnhuber described the three sessions of the A track. The first session looked at socioeconomic and security aspects of climate change. Global warming might generate violent conflicts and cause widespread human dislocations, and the necessary cuts in CO_2 emissions require system change as well as individual behavioral change. The participants warned that strong political leadership is needed to achieve a satisfactory outcome for Copenhagen next year. He concluded that even under ideal circumstances, we can only limit global warming to about 2 degrees, so we will need far-reaching adaptation measures. He thus suggested that next year's meeting deal with integrated regional assessments.

The second session covered nuclear energy. It was felt that nuclear fission should be part of a country's energy portfolio under certain conditions like good governance but there remain crucial problems with proliferation and public acceptance. We need international control regimes and dialogue about the risks related to society. If nuclear succeeds it must do so by economically competing with other no-carbon energies.

The final session concerned the global water crisis, which threatens natural and social security. We need incentives to conserve water and appropriate pricing and incentives for innovation in water management. Early warning systems for storms and membrane technology for water filtration are important, while improved agricultural efficiency is imperative. He warned that a large-scale water disaster is looming, due to climate-change-generated glaciers melting on the Tibetan plateau and shifting monsoon patterns that may ultimately disrupt the lives of up to 2 billion.

Sakarindr Bhumiratana said that the continuing worldwide problems of infectious disease require a timely, appropriate and coordinated global response, including detection and notification of new pathogens and drug resistance. Engineering new drugs and vaccines are important parts of the solution but generally take time to develop. Prevention worldwide will require the consolidation of efforts like research, doctor training and technology transfer to areas of greatest need. Prevention and treatment of polio in particular remains a major challenge. Governmental and private assistance is still needed in areas that offer little opportunity for profit. Additionally, worldwide coordination and consideration of intellectual property regulations are recommended.

He noted progress in genome science, with recent rapid acceleration especially in sequencing, and predicted continuing progress and falling costs. The challenge will be to convert the research to the clinical regime as there remains a gap between the promise and the realization. Important applications include diagnostics and prevention of neurological disease. Genetic techniques will be very important for public health, and there have been significant contributions made by the private sector.

GMOs are the most prominent method for expanding food production, but strong public opposition is preventing widespread use outside the U.S. This leaves scientists with few options for addressing world food problems. We must improve the education of the public and create confidence in the use of GM crops. Biofuels, with their recent rapid increase, are an area of ongoing discussion in light of world food needs.

Arthur Carty explained that ICT has strong influences on materials science, education and healthcare. Materials are the building blocks of our society: bronze, steel, plastics, and now nano materials have brought about innovation and have great promise in the future. Materials science will in particular drive the development of innovative technologies including areas such as photovoltaics, high-speed communications and computing, and polymer and composite materials. Also, applications in high temperature superconductivity remain a long-sought future goal, with many new possibilities. The use of ICT in teaching and learning includes the role of teachers, parents, and students. New learning formats, the use of computers, and online communication and communities must cater to the needs of students who are today's "digital natives." Teachers are becoming facilitators and parents are being incorporated in the learning process. Students must become more active participants in their education.

The use of broadband can be a vital link for rural areas, especially in the developing world, and even narrowband connections can be important. Connections can, for example, link high school students with universities and their students. International links can be especially fruitful, though some barriers remain, such as language, with a universal language such as English not widespread in remote areas. In healthcare, aging populations are a major concern, and ICT can help drive improvements to healthcare, including that for the elderly. New technologies include advanced medical imaging, electronic records, robotic surgery and more rapid treatments. Developing countries also face difficulties which can be addressed by ICT, providing medical care to remote areas, and access to medicine, research, knowledge and assistance to developing nations.

Katsuhiko Shirai discussed Track D. He spoke of the necessity to interest more people in science and provide opportunities for study for the young, citing examples of bringing researchers into the schools and forming partnerships between teachers and professionals. Interactive education can be an effective way to disseminate science.

The next session covered the role of universities. Universities are key sources of ideas and markets for research. To carry out their social responsibility to supply society with knowledge, universities should promote interdisciplinary education while not abandoning the strengths of a traditional education. Universities are increasingly globalized, and so they must enable their graduates to compete in the global marketplace. International standardization of degrees would be one positive step.

The third session featured ten promising young researchers, who presented meaningful proposals for improving the scientific environment around the world. Mr. Helal called one of the ten young scientists to the stage to share the findings of these promising young researchers in their session. The researcher reemphasized the importance of networking and mentoring, supporting research in developing nations, and building a science-friendly society and schools. He added that young scientists need the chance and the funding to take risks and generate paradigm-shifting ideas. The other young scientists then joined him on the stage for an introduction to the audience.

France Córdova discussed Track E on international scientific collaboration. In the first session, participants shared differing models for international partnership and identified some common features, such as the promise of revolutionary results, the need for powerful new tools such as platforms in space and robust analytical tools, the potential for societal benefit, agreed upon models for sharing research and, most importantly, visionary leadership.

The second session covered research collaboration between developed and developing nations. Developing countries need to build capabilities and infrastructure, enhanced by funding from both governments and private investment. Open courseware and the Internet can help facilitate this kind of collaboration and identify new opportunities for government, universities and research centers to work together.

The problems of brain-drain and brain-gain were the topic of the third session. With globalization leading to increased human migration, developing nations must implement creative solutions to retain and draw home their promising talent. More investment in research and science facilities and government-private sector collaboration was advised. Emigrants would benefit from links with their global diasporas.

Lee Yuan Tseh explained that the key to partnerships between universities, research institutes and industry was to allow each partner to work to their strengths and maintain interaction. He said that it was agreed that government must provide support and leadership, and efforts must be coordinated between institutions within countries, especially in developed countries with more resources. On the other hand, developing countries often look outside their borders for support and more forums for fostering collaboration within their own countries are needed.

The area of intellectual property and giving proper credit for ideas is still lacking clear solutions. Contributions of the humanities to science issues and cooperation among the disciplines are very important for both the sciences and the humanities. Adequate funding for collaboration continues to be an area that must be stressed. He said that in particular, more focus should be given to providing scientists a broader view of science in society. The media has an important influence in science as it disseminates information quickly, but deadline culture and research culture are often at odds; journalists often find it difficult to sufficiently research background on a story in a short period of time, and scientists cannot always communicate their findings in a compelling fashion.

In the developing world, literacy is low, and dissemination methods are fewer. Tools such as radio are useful for spreading science information. Media and science are very different, and a bridge is needed to make experts available to journalists and training for scientists to communicate effectively to non-specialists. Improved science education is also important to ensure that correct and formal science education is compelling and pervasive.

Gavin Brown said that there was overwhelming optimism among participants for applications of ICT in business. Numerous advances have been made, such as remote collaborations, safety in the auto industry and crash prevention and mitigation. Today even remote farmers are often ICT enabled. The Internet especially has experienced many innovative advances, such as open source development, collaboration of technologies, and security mechanisms. He noted concerns such as dependence on the Internet and the massive impact of a failure, as well as the difficulty of organizing and retrieving universally accurate information.

Venture capital can make important contributions to nations' development, but we need to do more in financing emerging small businesses. Green innovation is especially important.

Lastly, he said that internationalization of an IP regime is a critical need. We need simple and consistent rules and an end to the current glut of patent filings. To improve IPR, he recommended more collaboration, grace periods and use-it-or-lose-it clauses. In short, institutions should behave more ethically.

10:45 – 11:45 PLENARY SESSION

302 "Role of Science and Technology in the 21st Century"

Chair:
Komiyama, Hiroshi, President, The University of Tokyo, JP

Speakers:
- **Bement Jr.**, Arden, Director, National Science Foundation (NSF), US
- **Hwang**, Chang-Gyu, President, Corporate CTO, Samsung Electronics Co. Ltd., KR
- **Markides**, Karin, President, Chalmers University of Technology, SE
- **Noyori**, Ryoji, President, RIKEN, JP (Nobel Laureate in Chemistry 2001)
- **Sibal**, Kapil, Minister of Science, Technology and Earth Sciences, IN
- **Thumann**, Jürgen, President, Federation of German Industries (BDI), DE

Hiroshi Komiyama, citing the learning from the first G8 University Summit held earlier this year, mentioned that it is no longer adequate for universities to generate and then feed knowledge into society; they need to play a more active role by acting as a driving engine for shaping society and by developing university campuses as a model for a sustainable society. In order to achieve their new roles, universities need to take the lead in establishing the "Network of Networks", connecting existing networks on a global scale.

Ryoji Noyori spoke about what needs to be done for future generations. Despite warnings as early as 1985 about the societal implications of the population explosion, no great improvements have been made. The promotion of economic growth has brought about deterioration in society. A flaw in the way quality in life is measured has brought about a focus on the materialistic, instead of the spiritual. This imbalance must be readdressed. A return to humanity is essential to battle the limitless greed of modern society.

Arden Bement Jr. said three vital national and international needs can benefit from scientific progress: energy, environment, and economy. The understanding of each of these individual systems has improved, but the inherent complexity of their interaction complicates efforts to build sound policies for the three in combination. Advances in information and communication tools are critical to improved analysis of complex coupled systems, which in turn will lead to advances in forecasting, better response strategies, and enhanced tools for science-informed decision making. These are grand challenges worthy of the global scientific enterprise.

Kapil Sibal said we are being threatened with formidable and unprecedented global challenges in health, food, energy, security and the environment. Science can provide solutions, but we need to better understand the innate value of nature and people living together in a global village. Cooperation between different sectors such as genomics, ICT, nanotechnology and synthetic biology can bring new hope. Solutions must be simple and affordable to be of practical benefit to the poor

people of the world.

Jürgen Thumann explained that to tackle global challenges like climate change and meeting the needs of energy, food and water supply as well as education and healthcare, we need innovation and technology. The Federation of German Industry (BDI) has presented a strategy for future growth and employment. This BDI Manifesto supports the government's efforts to boost 17 different areas of technology and recommends among other things to create education markets and expand research markets. Thumann emphasized that the BDI is dedicated to promoting cooperation between science and industry on an international level and strongly advocates the development of a global roadmap. It is through international conferences like the STS *forum* that we can face the challenges of the 21st century together.

Chang-Gyu Hwang said that we should develop a more futuristic approach to scientific research by devising a mechanism for creating opportunities for future generations of scientists. Consumer and global products define the IT industry and as such future lifestyles should embrace three main concepts: customized entertainment, intelligent living and shared feelings. Companies cannot work alone and so in addition to support from academia and governments, they must have a global outlook that embraces different people, technologies and industries.

Karin Markides stated that developing countries could strengthen their own economies if they build technology now with help from clusters of universities, research institutes, the public sector, and industry. However, funding stakeholders are needed and action must be taken now as the gap between the "haves" and "have-nots" widens. If tests and pilot schemes, developed through an understanding of local needs, can be implemented in developing countries, then greener, safer, more robust and more efficient transport systems of the future can be created, improving the economic capacity of the developing world.

11:45– 12:30 CLOSING PLENARY SESSION

303 "Returning to Harmony with Nature – What Can We Do?"

Chair:
McKinnell, Henry, Chairman, Accordia Global Health Foundation, US

Speakers:
- **His Imperial Highness, The Crown Prince of Japan**
- **Friedman**, Jerome, Institute Professor and Professor of Physics Emeritus, Physics Department, Massachusetts Institute of Technology (MIT), US (Nobel Laureate in Physics 1990)
- **Omi**, Koji, Member, House of Representatives; Chairman and Founder, STS *forum*, JP
- **Schavan**, Annette, Federal Minister of Education and Research, DE
- **Swaminathan**, Monkombu, Chairman of the Board of Trustees, M. S. Swaminathan Research Foundation, IN

His Imperial Highness, The Crown Prince expressed his appreciation of the animated discussions that took place during the STS *forum*. While humankind has benefitted greatly from the remarkable developments in life science, communication technology and other fields, questions are raised as to whether development is in harmony with the laws of nature. Moreover, we should ask if the fruits of these innovations are equally shared. It is not easy to give clear-cut answers, but the cost of not seeking these answers is too high. Humankind should mobilize its utmost wisdom to ensure that science and technology can provide a bright future for planet Earth.

Henry McKinnell began by describing the beauty of Kyoto as a city built by skilled artisans, architects and designers hundreds of years ago. However, will the legacy of current generations be appreciated in the future? We may be the first generation to leave the world in a worse state than we found it in. Nonetheless, if we improve people's understanding of science, we can get the support necessary to redress this. He ended by asking how can we ensure that ten years from now we can look back at STS *forum* and say that it made change for the better.

Annette Schavan said that science derives its strength from the diversity of scientists and their approaches. We should work together closely in order to find viable scientific answers to the challenges of the 21st century. While industrial nations often use energy recklessly and live in excessive affluence, people in other parts of the world have neither access to energy nor a decent healthcare system. There is need for a continuous dialogue of the entire international communities and sustainable solutions. Our golden rule ought to be that our actions remain compatible with the permanence of human life.

Jerome Friedman warns that we must seal global pacts to reach our environmental goals and prevent the devastating consequences of global warming. It is forecasted that atmospheric levels of CO_2 could reach 550 ppm by mid-century. If this increase is allowed to continue, climatologists warn that we will cross a point of no return, resulting in reduced crop yields in many parts of the world; reduced supplies of drinking water; more severe storms; droughts and forest fires of increasing intensity; an increase of infectious diseases; lethal heat waves; coastal flooding and large scale species extinction. Industrialized nations, most responsible for the amount of greenhouse gases in the atmosphere, must bear the biggest responsibility for leadership. The world's nations must replace the Kyoto protocol in 2009, establishing long term goals as well as interim goals that would require prompt investment in reducing greenhouse gases.

Monkombu Swaminathan asked what we can do for the Earth at a local level. Sustainable development should become the new human ethic and to build a good common future, we need a better common present. Education is essential to this, but a 'nature deficit disorder' is hindering our progress. We need children to understand and experience their natural environment. Integrated use of technology is already aiding human life, but now we need integrated and sustainable use of nature and technology. As a final thought, he quoted Gandhi: "How can we be non-violent to nature, if we are violent to each other?"

Koji Omi said that the opinions and profound insights offered highlight the significance of holding the STS *forum*. We have agreed that rapid progress in energy efficiency and clean energy, nuclear power under strict safety and non-proliferation, international standards for privacy protection and the development of a new international framework to replace the Kyoto protocol are necessary. This forum has deepened our ties of friendship and expanded our human network. Developing countries and developed countries must utilize all their knowledge and resources. Joint activities should be encouraged in order to mobilize the human resources of developing countries. The STS *forum* is not a mere conference, but a movement of world leaders to ensure the future of mankind.

The Science and Technology in Society (STS) *forum*, inaugurated in November 2004, holds an annual meeting starting on the first Sunday of October every year, in Kyoto, Japan. The meeting is aimed at creating a global human network based on trust and providing a framework for open discussions regarding the further progress of science and technology for the benefit of humankind, while controlling ethical, safety and environmental issues resulting from their application: “The Lights and Shadows of Science and Technology.” In seeking to ensure further progress in science and technology throughout the 21st century, it is necessary to keep possible risks under proper control based on shared values, and to establish a common base for promoting science and technology.

Because international efforts as well as concerted efforts between different areas to address these problems are essential, the forum gathers top leaders from different constituencies: policymakers, business executives, scientists and researchers, media - from all over the world.