Conference on Global Scientific Challenges: Perspectives from Young Scientists

4-6 April 2007
Lindau, Germany

Report and Reflections from the Planning Group

Celebrating 75 years: 1931-2006

ICSU
International Council for Science

Strengthening international science for the benefit of society

ABOUT ICSU

Founded in 1931, the International Council for Science (ICSU) is a non-governmental organization representing a global membership that includes both national scientific bodies (113 members covering 133 countries) and international scientific unions (29 members).

ICSU's extensive membership network constitutes an international forum for scientific research and policy development. In broader terms, because of its representative and diverse membership, the Council is increasingly called upon to speak on behalf of the global scientific community and to act as an advisor in matters ranging from scientific conduct to the environment.

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TABLE OF CONTENTS

INTRODUCTION

From making sustainable development a reality to addressing disease epidemics, the interaction of humankind with its environment lies at the core of a myriad of complex global challenges. Scientific research is a critical resource for addressing these challenges, whether through the development of new technologies or the promotion of better policies. At the same time, the speed of scientific and technological innovation and concerns about the potential misuse of science are creating tensions at the interface between science and society. New approaches are necessary for the planning, conduct, and communication of international research, and a closer partnership needs to be built between science and society as a whole.

"… to juxtapose starkly different objects within the same canvas, just to see how they all get along."

Picasso

In addressing these challenges, the International Council for Science (ICSU) is able to draw upon the expertise of senior scientists around the world to strengthen international science for the benefit of society. A conference held in Lindau aimed to celebrate the 75th anniversary of ICSU by breaking new ground and giving voice to the future generation of young scientists, in so doing also linking them with ICSU's senior scientists. Although key issues such as science for policy and public engagement are regularly addressed on the international agenda, few young scientists contribute their insights and energies to these endeavours, and instead focus almost exclusively on their narrow domain of expertise. Moreover, young scientists seldom have the opportunity to step back and to reflect upon how one can actually reshape and redefine career paths, instead, devoting their energies towards attaining success within existing career structures.

This conference was therefore designed to attract and stimulate the interests of those who we hope will play a leading role in international science over the next decades. Through critical assessment of case studies and experiences, the conference aimed to serve as a space for reflection on the future conduct of science in the context of a rapidly changing world. The conference was organised by a Planning Group, itself comprised of young scientists. The Planning Group started with a totally blank slate and a determination to make this event different from any ordinary scientific conference. Whilst we aimed to bring together young scientists from as many countries as possible, a central question that we started with was how to find a useful ground for discussion among 100-200 people who would share little in common other than the labels of "scientist" and "young". We settled on a set of broad-based conference themes of universal relevance – transdisciplinary cooperation, international collaboration, working with the private sector, and scientific rights and responsibilities. We also aimed to share ideas on addressing the challenges and opportunities for career management by young scientists.

A key task was to determine what kind of profile the ideal participant to this conference should have. Ultimately, participants were nominated and sponsored by the ICSU member organisations and bodies. This selection approach was a strength of the conference because it helped create a truly international and multidisciplinary event, with more than 70 different nationalities and a wide range of scientific disciplines represented. And yet the selection approach was also a weakness because there was no guarantee beforehand that participants would have the breadth to tackle the topics discussed rather than focussing on their own scientific discipline. Scientists, especially young ones, are used to "expert" conferences and there was a concern that we might end up with a gathering of specialists, unable to discuss the global issues.

CONFERENCE SESSIONS

When the conference participants arrived in Lindau, most of them seemed eager and excited, but somewhat bewildered as to what exactly they were participating in. In just the first half-hour, as we each met people from dozens of different countries and scientific disciplines, it became evident what a fascinating event this was going to be.

OPENING SESSION

The idealism and brash confidence of youth is so important to the vitality and creativeness of the scientific community as a whole.

ICSU's President Goverdhan Mehta (India) opened the conference with a wide-ranging exploration of the responsibilities of the scientific community in an era of "spectacular science and technology developments, unparalleled economic growth, and uncontrolled exploitation of the Earth's environment". He called for improvement in the interactions of the scientific community with society. His plea for the rejuvenation of ICSU and of international science is echoed in our hopes for how the younger scientific community will move forward from this conference to implement our ideas.

ICSU's Vice President for Scientific Planning and Review, Khotso Mokhele (South Africa), gave a plenary talk on "Building Bridges within the Scientific Community". He described some of the challenges that funding agencies face in promoting trans-disciplinary science, and how the models used in international collaboration projects are not necessarily adapted to the context within which the work is done, especially for collaborations between the industrialised and the developing world. He offered a frank assessment of the ways in which current models for international collaboration fail to cope with the asymmetries between rich and poor countries, emphasising, however, that asymmetries in resources and infrastructure should not be mistaken for asymmetries in intellectual capacity or creativity. He provided inspiration to the participants by stressing why the idealism and "brash confidence" of youth is so important to the vitality and creativeness of the scientific community as a whole.

INTERNATIONAL CO-OPERATION

"How can we co-ordinate enormously complex international projects? Think of how the conductor leads the orchestra."

Science has always to some extent been a "universal" enterprise. But as the world becomes ever more interdependent, and as rapidly advancing information and communication technologies render national borders increasingly irrelevant, there is a growing necessity for international cooperation in scientific observations, monitoring, research, and assessment. This includes an urgent need for the creation of effective and equitable partnerships between scientists in developing and industrialised countries. This conference session explored opportunities, challenges, and best practices in building international scientific partnerships and programmes.

Ravinder Bhatia (UK) opened the session by discussing the issue of building international networks from the vantage points firstly from within an international governmental organisation, and secondly from a new higher education initiative. He stressed the parallels between the suggested approaches, likening the role of the co-ordinator to that of a conductor leading an orchestra. Hughes

Lantuit (Germany) gave an animated discussion on successes and challenges for the Permafrost Young Researchers Network, cautioning how young scientists sometimes try to become part of networks primarily to promote their career trajectory rather than because of the relevance of these networks to their own work. Pavitray Pillay (South Africa) described the Benguela Environnt Fisheries Interaction and Training Programme as a case study of international co-operation across borders. She raised the issues of balancing environmental conservation needs versus economic development, and sustaining political will and making the programme itself sustainable in the long term. Jianping Li (China) spoke on the concept of a global science family, drawing a parallel between how the "elder" members of the global family as economically developed countries can provide support to the younger generation of developing countries. Gaël Mainguy (France) addressed the challenge of building international networks. He presented the World Academy of Young Scientists (WAYS), a worldwide collaborative network to address local needs of young scientists whilst empowering them globally. The use of its website for information dissemination, local programme creation and global networking has been crucial to the success of WAYS. Jenny Baeseman (USA) described the International Polar Year programme, focusing on how the Association of Polar Early Career Scientists raises the profile of young scientists, and provides internationally and interdisciplinarily focused polar leadership. Mohammad Kolaei (Iran) emphasised that a warning system for the north Indian ocean should be built on the foundation of international cooperation, in accordance with the principle of open, free and unrestricted exchange of data and information. Although Ramani Balasubramanian (India) was unable finally to attend the conference, he has developed important links between youth, science and agricultural development through the work of the Young People Platform in Agricultural Research for Development.

"Should we be trans- disciplinary scientists before being specialists?"

In discussion after the formal presentations, many participants agreed that the networks presented were very effective in reaching the communities they were aiming at. However, the disadvantage was that the networks were web based and internet facilities in developing countries are very slow in performance and expensive. Regional offices would be more effective at sustaining networks, although these of course have commensurate disadvantages including cost. Other participants suggested that there was a lack of communication of what can be truly achieved through international collaboration, especially with developing countries as partners. Funding of international collaboration is still a major issue, and not many funding bodies provide sufficient money and support for the activities which are vital for developing countries to raise the standards of local science. One positive sign is that many scientists trained in the richer countries still prefer to return to their country of origin in order to help the local scientific community.

TRANS-DISCIPLINARY COLLABORATION

The last few decades have seen considerable progress in breaking down the barriers amongst many traditional scientific disciplines (for instance, between physics and chemistry, and between Earth sciences and biology). But the most pressing scientific challenges of the coming decades (global environmental

change, clean energy, and genetic and biomedical engineering, to name just a few) will require more extensive trans-disciplinary interaction and collaboration, especially amongst the physical, social, medical and engineering sciences. In this session we explored new frameworks and approaches being developed for effective trans-disciplinary collaboration, as well as the barriers that currently impede such collaboration.

"How should interdisciplinary projects should be funded and evaluated?"

Karl Gademann (Switzerland) spoke on the molecular language of science, showing that within his field it is already necessary to have a transdisciplinary understanding of science. Kate Heal (UK) discussed the different challenges that we have today in supply of water, disposal of waste water, storm water management, and flooding. To have effective water management strategies, it is necessary to bring together engineers, social scientists, sociologists, political scientists and architects. The main obstacles are limited funding for trans-disciplinary projects, and the lack of communication between scientists from different fields. Mauricio Terrones (Mexico) talked about the importance of having a high international profile in research that aims at bringing a technological revolution in the world, such as nanotechnology. Ghinwa Naja (Lebanon) explained the crucial role trans-disciplinary cooperation plays in making sense of fragmented scientific knowledge. Solutions to key scientific questions generally transcend single disciplinary knowledge. However, scientific structures provide weak or even negative incentives towards such collaboration across disciplines. She illustrated this situation with humour by quoting Russ Mawby, President of the Kellogg Foundation, who said "People have problems and universities have departments – and that's the problem." Similarly, Mihoko Otake (Japan) explained how important trans-disciplinary cooperation was to her scientific research on neural-simulators, and yet how difficult such cooperation was to implement. She presented an approach to "break the invisible walls" separating disciplines and scientists by organising interactive "integrative seminars" which promote the existence of a trans-disciplinary community of scientists around a specific topic. Oliver Mußhoff (Germany) illustrated a prime example of trans-disciplinary collaboration through his work on the assessment of the impacts of climate change on agriculture. Finally, Irasema Ayala (Mexico) outlined the principles of disaster prevention where trans-disciplinarity is a key challenge. She pointed out that there is an increasing narrowing of disciplines, and that isolated efforts to improve trans-disciplinarity are not enough. She pleaded for an "integrating concept" where trans-disciplinarity becomes a core principle for scientific research.

The discussion session revolved around four main issues: publications, funding, assessment, and training. The enormous pressure to publish can deter scientists from engaging in trans-disciplinary research which is perceived as difficult to publish. Authorship of multidisciplinary research articles is also a major issue: who should be the lead author? Should authorship for example simply be listed alphabetically? Moreover, the participants suggested that it is difficult to obtain funding for this kind of research unless it is for climate science (because this is an issue of prominence on the political agenda), or for projects related to human health (which is always considered an important issue). At the same time, evaluation and assessment of scientific output by considering only publications in prestigious journals is an obstacle to promoting trans-disciplinarity. It was proposed that this evaluation process should take into account the impact of the research on solving the problems facing society, although how this can be quantified remains to be determined. Training in order to promote trans-disci-

plinarity was also discussed. In universities, it is important to teach students to think in a interdisciplinary way as part of their training. Yet knowledge of how the job market is still single-discipline orientated will affect the career aspirations of scientists. Moreover, the current system discourages people from working together, for example through co-supervision of Ph.D theses by advisors belonging to different fields. A key question is should we be trans-disciplinary scientists before being specialists? It is easier for people to interact when they are first trained as trans-disciplinary scientists, and they can understand each other better. Another proposition was to specialise first, and then later focus on participating in trans-disciplinary teams. A mixture of both was also proposed. Finally, there seems to be a dichotomy between generations of scientists: today we are more multidisciplinary than previous generations.

PUBLIC ENGAGEMENT

Effective communication between the scientific community and the general public is critically important for providing society with a better understanding of scientific breakthroughs, challenges and controversies. And yet the public must not be treated as a passive receptor of scientific information. It is increasingly recognised that stakeholders from beyond the formal scientific community can play an important role in defining research priorities and in generating new knowledge. The need to sensitise the scientific community to societal concerns is particularly important for new technological developments, which can impact on the interests of many different groups. The influence of the mass media, as a central conduit for public communication, must also be recognised and handled effectively. This session addressed questions such as: How can scientists effectively communicate their messages to society? How can science engage society in such a way that it is foresees and effectively responds to issues of concern? What is the role of participatory processes in public engagement with science and in research per se?

"Science communication is still in its infancy in developing countries."

Rehana Jauhangeer (Mauritius) introduced her discussion on communicating science by quoting Francis Bacon: "Knowledge is power". She emphasised the need to develop a communication strategy which included definition of overall communication goal(s), identification of target audiences, and segmentation of those audiences. Hudson Kalambuka (Kenya) discussed how synthesis and communication of science knowledge is needed to forge links between science and society, particularly in knowledge-based economies. Jesus Olivero-Verbal (Colombia) described how the internet is useful as a tool for sharing scientific knowledge, but this alone is not enough. Spending time amongst non-scientists sends the important message that being of service to this community is important to scientists. He recommended the use local media to promote initiatives and get local people involved. Andrea Mantesso (Brazil) shared her frustrating experiences of explaining science for the general public, underscoring the value of using entertaining stories with specific information to explain complex issues. Finally, Kate Travis (UK) described Science NewWave and the role of science journalism. She clarified that the primary responsibility of the press is not education, as many scientists seem to think. But this is turn puts value on the partnership between scientists and journalists in working together to disseminate scientific information in an accurate, interesting and accessible manner. The key issue raised during the session discussion was that science communica-

tion is still in its infancy in developing countries; this contributes to the lack of support for scientific programmes aimed at the alleviation of human suffering.

SCIENCE FOR POLICY

Scientific expertise is an important element in the creation and reconfiguration of policies at local, national, and international levels. Examples, ranging from domestic pharmaceutical regulations to global conventions on climate change, illustrate the essential role played by scientific knowledge in contemporary policy-making. However, as the nature of the global challenges faced by humankind changes and grows, this entails an ongoing re-examination of the role and methods used for injecting science into the policy-making process. This session addressed questions such as: How can science become more policy-aware and policy-relevant? What new mechanisms need to be developed in order to foster more effective interaction between scientists and policy-makers? What should be the role of the individual scientist in the policy-making process and what forces can hinder the realisation of such a role?

"There are at least four different roles scientists are potentially asked to play in the policy making process: scientific information provider, stakeholder, policy advisor, and political advocate."

Laurie Geller (USA) described the work of the UN Commission for Sustainable Development. She suggested that there are at least four different roles scientists are potentially asked to play in the policy making process: scientific information provider, stakeholder, policy advisor, and political advocate. Although any of these roles may be appropriate within different contexts and at different times, it is vitally important to determine which of these roles you are being asked to play in any given situation. She advised against deliberately confounding these roles, for instance, by taking advantage of your standing as a scientific authority to promote personal views on topics outside your own domain of core expertise. Igor Sirodiev (Moldova) discussed the challenges and opportunities for getting science onto the policy agenda, taking Moldova's ecology policy and its national park as case studies. To foster more effective interaction between scientists and policy-makers, he proposed life-long learning for policy-makers, along with joint interactive seminars and modelling games for solving real or anticipated problems. For him, the ideal role of the individual scientist in the policy-making process is to present their research to policy-makers and society on the one hand and to the scientific community on the other. Juan Pablo Guerra (Mexico) spoke on the role of science in policy making. According to the linear/deficit model, science produces new policy-relevant knowledge; this knowledge is transferred to policy; and a decision is made on what policies to implement. Society then reaps the benefits of scientific knowledge through science-based policy. However, this model has a number of shortcomings, including its inability to account for the existence of numerous different ethical/political frameworks, different groups within society all with different interests, and different sources of expertise and knowledge flows. He proposed that informed decision making should recognise that the policy-making system is not a matter of science but of politics, to which science contributes through the provision of expertise but also through mobilisation of resources (lobbying, education, etc.). Molly Helmuth (USA) spoke on climate risk management in Africa and the work of the International Research Institute for Climate and Society. From her experiences, she confirmed that the successful infusion of science into policy-making and development clearly requires strong partnerships amongst scientists, practitioners and policymakers. This in turn leads to collective ownership,

the communication of a credible message, and collective vision. The process should be demand driven, transparent and open, and sensitive to local contexts. Finally, Alice Abreu (Brazil) spoke on the challenges faced in raising the profile of science for policy in Latin America and the Caribbean. Increased resources must be allocated for research & development. Goals must be set and prioritised at national level. An adequate and highly trained workforce including sufficient scientists and engineers must be developed. There must be recognition of the urgency in which policies must be proposed and implemented. In parallel, a political space must be created which engenders continuity and stability in elaboration of policies and allocation of resources. Underlying all of this has to be social dialogue and ultimately an approach which emphasises the linkages amongst various political, social and economic aspects of the system.

Discussion in the session emphasised how the conduct of science nowadays is intricately linked with science policy, and that in the future, society will create more demand on scientists due to the impact of emerging technologies. As a separate item of discussion, it was highlighted that even where treaties are signed between governments at regional and international levels, there is often a lack of enforcement of these policies at state level.

WORKING WITH THE PRIVATE SECTOR

Traditionally prone to navigate mainly academic waters, young scientists are increasingly offered the possibility to work with the private sector. Indeed, business and industry represent a significant and growing part of the job market for scientists, and there is an increasing emphasis worldwide on public-private partnerships in scientific education, training, research, and technology development. Participation of business and industry in the scientific enterprise can have substantial benefits for both science and society. There are, however, many legitimate concerns about whether private interests might have a detrimental influence on scientific goals and methods. This session addressed questions such as: How can the human and financial resources of the private sector be coupled to academia to address global challenges? How can one ensure academic freedom and openness in private sector research or public-private partnerships? How can one achieve a balance between ownership and intellectual property rights and sharing and equity?

"Often, the better communicator will prevail, not the best arguments."

Delphine Thorel (France), a utility team manager with Veolia Environment, presented her work at the research & development department that focuses on energy related issues such as biomass conversion, solar panel, fuel cell and combustion processes. Through her case study of how ice slurry can be used for district cooling networks, she explained how rewarding it was for her to apply her technical training to generate practical solutions for the future. Adriana Jalba (Romania) is currently at the Université libre de Bruxelles and also works with Procter & Gamble. She compared the recruiting process between industry and academia, suggesting that the private sector is more flexible, tends to focus more on interpersonal skills, and is more results orientated. Her experience highlighted how the company expects results to be generated, measures performance, and offers a dynamic work environment and significant career development opportunities. In contrast, the academic environment primarily

offers creativity and freedom. Robert Stodilka (Canada) gave an overview of the strategy to transform Canada from a resource based economy to a knowledge based economy. The Canadian government has pushed towards more profitability, translational research and advanced training. This strategy is reflected in grant making principles where researchers must find a 55% contribution from a private partner. In this context, successful researchers must learn to rely less on government and university funding, must take research and business risks, and seek non traditional revenues. Alternate funding models now include spin off co-operation though patents, licensing of intellectual property, fees-for-service and contract-based research. Shirshendu Mukherjee (India) introduced the need for additional training programmes even after completion of a Ph.D, drawing on his own experiences of training in international and environmental law. He cautioned that most young scientists are not yet willing to work with or in the private sector. Finally, using his national patent system as an example which has registered 7000 patents but with only 17 coming from universities, Hudson Kalambuka (Kenya) emphasized how a strong institutional and legal context is essential for successful commercialisation of scientific and technical knowledge.

From practical examples and from reports of national strategies, the evolution of research funding towards more private contribution is clear. Such transformation of academia has major impacts on how educational, institutional and legal frameworks need to evolve. At the same time, concerns from the audience were raised that some basic research may be hampered by these new funding strategies.

CLIMATE NEUTRAL SESSION

This session aimed to explain how the CO_2 emissions of the conference were "neutralised" or "offset". An introductory presentation introduced the science of climate change, the basics of CO_2 offsetting mechanisms, and the conference offsetting mechanism of additions to the registration fee to help finance new environmentally friendly technologies. The discussion session was lively, and demonstrated that real examples help scientists from different fields to grasp the difficulty of finding solutions to society's most urgent problems. A few delegates disagreed with the carbon offsetting approach, while other endorsed it. However, everyone agreed that climate change is an important issue, and that global problems with direct consequences on everybody attract interest from across the scientific community. A few days after the conference, we received emails from people asking how to engage in similar carbon offsetting activities themselves. This illustrates that pragmatic (even if not necessarily optimal) solutions can be embraced by young scientists.

SCIENTIFIC FREEDOM AND RESPONSIBILITIES

Scientific activity involves a fundamental tension. On one hand, the pursuit of new knowledge requires the ability to conduct research without external impositions, in an open and unrestrictive environment. On the other hand, there is a need for mechanisms to ensure that the fruits of scientific research do not cause dangerous or detrimental outcomes for society. Whatever legislative or institutional guidelines are in place, personal responsibility lies at the core of this tension. As individuals and members of society, scientists are faced with the need to balance their freedom of research with broader forms of societal responsibility. Maintaining this balance has become increasingly difficult in the past decade, with the rise of new modes of knowledge production and dissemination, and the increasing influence of corporate and other institutional agendas over the direction of scientific research. This session aimed at stimulating thinking and discussion about personal responsibilities in science, and how these influence the conduct of one's own scientific activities.

"The private sector is more flexible, tends to focus more on interpersonal skills, and is more results orientated. In contrast, the academic environment primarily offers creativity and freedom."

Francis Gudyanga (Zimbabwe) introduced the session by reminding delegates of the ICSU mandate of universality of science. Bengt Gustafson (Sweden) spoke on Freedom and Responsibility in the Conduct of Science. Guidance on how we judge whether we are doing good comes out of personal opinions of the scientist concerned, but also importantly through shared dialogue and teaching. At a global level, the North does have a responsibility to provide equipment and return funding to counteract the brain drain of scientific talent and expertise from the South. But at the same time, the South should promote freedom for scientists to conduct their research without external interference. Alex Vlandas (UK) spoke on the social responsibility of scientists and engineers. Scientists should build across the political divide, speaking out on issues of concern to society. Science workshops between scientists and the general public are one way in which scientists can make their knowledge more available. Raed Sharif (Palestine) spoke on the role of young scientists in maximising the value of science in what has been called the information age. There is an opportunity to harness information and communication technologies in knowledge creation. This can be done partly by sharing the results of research through open access journals, which are of particular benefit for the developing world. Dilfuza Egamberdiyeva (Uzbekistan) presented a case study on efforts to mitigate environmental degradation of the Aral Sea, which highlights how is important to remain objective when discussing the advantages and disadvantages of biotechnologies in environmental protection. Jiunn-Wei Chen (China:Taipei) discussed how the freedom and democracy of open access archives will not be granted if this freedom becomes a threat to state authorities. This in turn requires that the scientific community behave in a responsible, self-regulating manner, whereby anonymous postings are quickly discredited, and papers once posted cannot be easily deleted. Moreover, it is easier for whistleblowers to operate in an open system. Because of these advantages, it is hoped that these open access archives can become more common in other scientific fields. Thi Minh Ha Dong (Vietnam) described the responsibility of scientists to show how their research in sustainable development can be integrated into policy-making. A starting point for this is the creation of the Sustainable Development Indicator Set for Vietnam. However, challenges to these activities are low scientific capacity, lack of

"Real examples help scientists from different fields grasp the difficulty of finding solutions to society's most urgent problems. today."

co-ordination of activities, and limited access to information.

The first key element of discussion was to explore the links between the personal freedoms and responsibilities of scientists. It was suggested that freedoms and responsibilities are indeed coupled, but the key issue to be explored through dialogue is to what extent these are coupled. In the nanotechnology field, commercialisation has taken over the research agenda, which scientists should protect against. Moreover, there is a limit to the possibilities for action of individuals, and therefore individual scientists can be more effective if they work together in a co-ordinated manner. Indeed, working in groups is a reminder that responsibilities are derived from community expectations and support. In turn, scientists are expected to increase knowledge, to do good research, and to bring benefits to our societies. If the scientific community does not regulate its own behaviour, an external non-scientific authority will do that for us. A second key issue of discussion was whether we need a code of conduct for doing science, and if so, who should define what is or is not acceptable conduct? Bengt Gustafson suggested that a code of conduct would ultimately be only a guide; complex issues still need to be discussed with other sections of society, industry and government, and these discussions must also address the issue of values. So perhaps a code of conduct is something to be less keen on, especially if it is externally imposed on scientists.

"Scientists should take responsibility for the consequences of their own research."

SCIENTIFIC FREEDOM AND RESPONSIBILITIES

In the final session, three young scientists gave their personal impressions on the conference. It seems that the main objectives of the conference were achieved. The participants had arrived feeling sceptical or even bewildered, and left feeling very enthusiastic. The event culminated in an unforgettable dinner and cruise on Lake Constance, and this was another informal occasion for the participants to network among themselves and to continue the discussions from the conference.

DECIPHERING THE CONFERENCE

This conference will be remembered as a worthy and interesting experiment in trying to gather a varied international sample of young scientists. Given its unconventional and experimental status, the conference was not assigned explicit and formal objectives that could be used to delineate success from failure. In a similar manner, it is perhaps too early to evaluate the wider ranging impacts of this event.

Bearing these factors in mind, most of our impressions of the conference were positive. The participants were a varied group of scientists, reflecting a diversity of gender, discipline, country of birth, and indeed country of current residence. One of the most important aspects of the meeting in Lindau was that for many of the participants, this was the first time they had attended a non-disciplinary conference. For those participants that did not have particular interest in "science and society issues" prior to coming to Lindau, we felt that this event had provided a suitable place and format to sensitise them to these issues.

"Do we need a code of conduct for doing science?"

Participants found the conference topics to be genuinely interesting: and even in such beautiful area and with wonderful weather during the conference, the turnout for all sessions was very high. The topics were broad enough to make it easy for all the participants to find a common ground to build on. Passionate discussions took place on issues as diverse as financial sustainability of research, universality and national interests, and the role of science in decision making processes. Although some participants felt the varied character of this meeting meant it failed to produce a concrete outcome (e.g. technical proceedings or a unified theme), this must not be seen as a failure on the part of the conference, but rather of the manner in which people's expectations were orientated towards a set of "acceptable" results. The key outcome we suggest was not a set of conference proceedings but new mindsets.

Career development issues were clearly of common concern. There was a repeated reference during the workshop to the changing ways in which science is conducted, perhaps related to a generational gap in which the established leading scientists of the present were brought up in contrast to the way in which future leaders are being trained. There seems to be some tension between the generational hierarchy of research teams and the flexible approaches that are often needed to address new challenges. Many delegates spoke of important efforts to build bridges between different disciplines, between different countries, between scientists and society. But at the same time, many other participants spoke of their frustration in taking even the most tentative steps towards such goals. It seems that the scientific community still faces a reality where the only thing that counts is publications in "traditional" journals, and reaching out beyond the laboratory is neither encouraged nor rewarded. And yet the emergence of knowledge based economies should provide tremendous opportunities for career development. Scientists should be given the possibility and encouragement to evolve, with inspiration being drawn from multidisciplinarity, interdisciplinarity and exposure early in their career to other environments.

"For many of the participants, this was the first time they had attended a non-disciplinary conference."

The approach in which the participants engaged in the conference was also positive. This conference confirmed that the young generation of scientists is indeed highly interested in "science and society issues" and can contribute important ideas and opinions to the debates. Moreover, the atypical nature of the event seemed to foster a spirit of openness and reflection that we have rarely seen, even at traditional scientific gatherings. It seemed that for many partici-

pants, the goal was not to impress each other by sharing our knowledge, but to learn from each other by sharing our frustrations and exploring fragments of potential solutions. In this respect, the parallel sessions involving small groups of people proved to be interactive, dynamic and successful, confirming that young scientists are particularly keen to learn and exchange ideas with their peers. We believe that a more traditional environment where seniors would have lectured the youngsters "as usual" would have turned to be less conducive to learning. And, as in most conferences, some of the best discussions and interactions took place outside of the formal proceedings, spilling well beyond the conference halls in particular into a small neighbourhood Latin bar, which surely had one of the most profitable weekends in its history. It was there that the participants had a chance to forge links, contrast their everyday experiences as young professionals, and think together about the challenges of the future.

"The participants were very openminded and shared their experiences and learned from each others not as experts, but as 'young scientists'. It was perhaps something new for them but it was very natural at the same time."

We deeply appreciated the efforts of those speakers for whom English was not their first language. At times during the conference, delegates grouped with colleagues from the same linguistic areas and started discussions in other languages including Spanish and French. Also, a consistent comment heard at the end of the meeting was that given the number of participants, the conference was not long enough to meet and interact with everybody. Many participants enquired whether it would be repeated or was a one off event. Finally, the location chosen was exceptionally beautiful and much appreciated by the participants.

Two negative points deserve to be highlighted. First, with such broad discussion themes and such diverse participants, it was not surprising to find that the presentations within some sessions were too varied and did not sufficiently relate to each other. This could be remedied partly by giving the session chair the authority to liaise with the speakers sufficiently ahead of a session to ensure coherence amongst the contributions. Second, it was also expected that there would be more interactions between the participants during the sessions. However, there were too many presentations and not enough time for discussion. Similar events organised either by ICSU or similar organisations might benefit from experimenting with different formats that facilitate more direct interaction and discussion amongst participants.

CONCLUDING THOUGHTS

The meeting in Lindau was a bold experiment on behalf of ICSU. However unclear the nature of the conference might have been for the participants upon their arrival at Lindau, we believe that most left with a desire to continue these discussions and to translate discussion into action. This was perhaps the most important of all the achievements of the event: getting people to meet, to talk, to keep in contact and to plan how they can work together in the future.

ACKNOWLEDGMENTS

We gratefully thank the Board and Secretariat of ICSU for their vision in giving the younger scientific generation the opportunity to come together in Lindau for this conference.

This conference would not have been possible without the generous support and sponsorship of individual ICSU Members and, on behalf of ICSU and all the participants; we take this opportunity to express our sincere thanks.

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- The Town of Lindau
- L'Oréal for Women in science
- The Veolia Institute

Conference participants returning from the closing cruise-dinner.

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International Council for Science

MISSION STATEMENT

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

- Identify and address major issues of importance to science and society
- Facilitate interaction amongst scientists across all disciplines and from all countries
- Promote the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavour
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

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