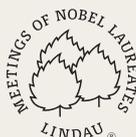




19TH FORUM DEDICATED TO CHEMISTRY – PLATFORM FOR THE
DIALOGUE BETWEEN SCIENTIFIC GENERATIONS
59TH MEETING OF NOBEL LAUREATES AT LINDAU
RETROSPECTS AND PROSPECTS 2009

Kuratorium für
die Tagungen
der Nobelpreisträger
in Lindau
Council for the Lindau
Nobel Laureate Meetings



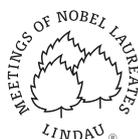
Stiftung Lindauer
Nobelpreisträgertreffen
am Bodensee
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Count Lennart Bernadotte and Albert Schweitzer, Nobel Peace Prize Winner in 1952, at the 1954 Lindau Meeting.

The originators of the Lindau Meetings (from left): F.K. Hein, Count L. Bernadotte, and G. Parade during the first meeting in 1951.

Countess Bettina Bernadotte,
President of the Council for the Lindau Nobel Laureate Meetings:

The Centenary of Count Lennart Bernadotte

The 'Mission Education' of the Council and Foundation for the Nobel Laureate Meetings has a tradition of nearly 60 years, a tradition shaped right from the beginning by Count Lennart Bernadotte (1909–2004). Early on, he recognised that the meetings provided an international platform – with the aim to educate, to inspire and to connect scientific generations. Count Lennart Bernadotte was born 100 years ago. It is with gratitude and great respect that the Council and Foundation commemorate the 'spiritus rector' of the Lindau Meetings.

My late father Lennart Bernadotte believed in the potential of science to transcend boundaries. At a time in which Germany, in the wake of the Second World War, was isolated not only politically but also economically, he hosted a meeting of Nobel Laureates at Lake Constance – exactly 50 years after his grandfather, who later became Swedish King Gustaf V, presented the first Nobel Prizes in Stockholm.

With a series of projects, the Council and the Foundation work to live up to this 'Mission Education' in order to educate, to inspire and to connect. In this, they remain faithful to the original intention of their founders. The annual Nobel Laureate Meetings at Lindau are the heart of these initiatives. This year, Laureates in chemistry met for a week at Lake Constance with top talents from all over the world. Lectures and panel discussions covered the topics of climate change and sustainability, the biochemistry of the living cell, the analysis of surface reactions and new strategies in synthesis.

The final day of the meeting featured not only a panel discussion on "Sustainability and Climate Change" in co-operation with the Intergovernmental Panel on Climate Change (IPCC), winner of the Nobel Peace Prize in 2007, but was also the opening day of the 'Discoveries' exhibition on Mainau Island – and here, too, the issue at hand was sustainability. Various solutions science has developed towards a sustained approach to the resource of water were shown in 20 pavilions. Thanks to this exhibition, the dialogue begun in Lindau was opened up to the general public – generating enthusiasm in a novel way for the achievements of science and research.



The mediatheque, featuring lectures by Nobel Laureates spanning six decades, accomplishes this same objective. It offers a unique window into the history of science as narrated by Nobel Laureates.

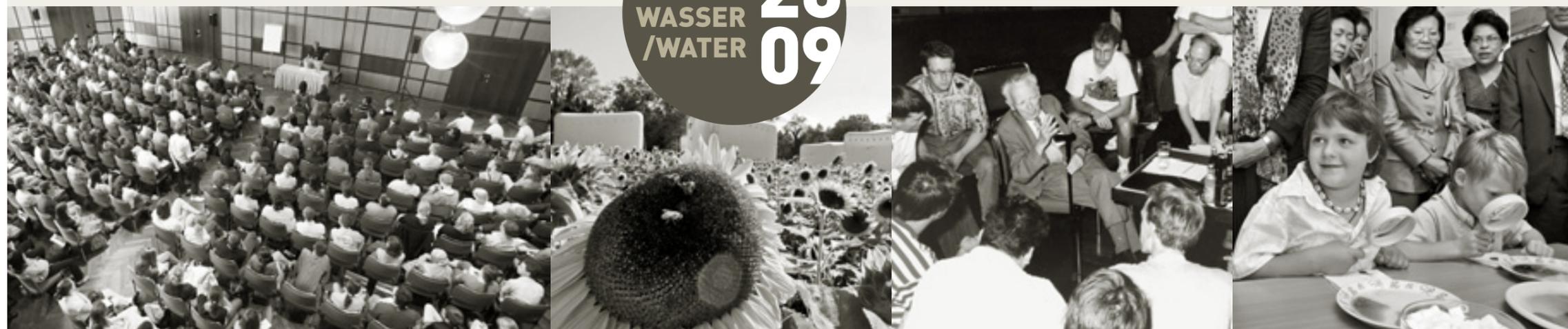
Be it the Lindau Nobel Laureate Meetings, the 'Discoveries' exhibition at the Isle of Mainau, or the mediatheque: it would have been impossible to further strengthen the 'Mission Education' if not for the support of individuals and institutions – like the Federal Ministry of Education and Research with Minister Annette Schavan. They all assisted the Council and Foundation to live up to the vision of Count Lennart Bernadotte, also in the centenary year of his birth. And for this, the Council for the Lindau Nobel Laureate Meetings and the Foundation Lindau Nobelprize-winners Meetings at Lake Constance are deeply grateful to them.

Our 'Mission Education' in 2009

Our 'Mission Education' encapsulates the aims of the work jointly carried out by the Council and the Foundation of the Nobel Laureate Meetings: to educate, to inspire and to connect scientific generations. The Lindau Meetings of Nobel Laureates have embodied this exchange of ideas ever since 1951 – thus our 'Mission Education' has an almost 60-year-old tradition in Lindau. It is here that science and research are celebrated with fervour, the scientific issues of the day are the focus of animated discussion, lasting international contacts and friendships are made and answers to the great challenges of the future are considered.

With carefully selected projects, the aim of the Council and the Foundation was to broaden the objectives of this Nobel Laureate Meeting. It should not only be the aim to nurture the enthusiasm for natural sciences among the 600 carefully chosen up-and-coming young scientists from around the world, but also among children and teenagers. And it should not only be those who were privileged to meet the Laureates personally in Lindau who should be able to learn about and be inspired by their work. Anyone who is interested in science and research should be able to access the lectures and the debates.

The 59th Meeting of Nobel Laureates naturally formed the centrepiece of the work of the Council and the Foundation in 2009. However, further highlights included projects such as the "Discoveries" exhibition on the Isle of Mainau, the mediatheque with its historic archive of lectures given by Nobel Laureates extending back over six decades, and, not least, the support for the "Tiny Tots Science Corner", which demonstrated how our 'Mission Education' can have a truly wide-ranging impact.



59th Meeting of Nobel Laureates from 28 June until 3 July 2009

Twenty-two Nobel Laureates and 580 up-and-coming young scientists from 67 countries met for a week at Lake Constance to engage in discussions, establish contacts and exchange information. More than 120 Academic Partners had nominated the young researchers. This year, lectures and panel discussion covered the topics of climate change and sustainability, the biochemistry of the living cell, the analysis of surface reactions and new strategies in synthesis.

› from page 6

Outreach Beyond the Lindau Meetings

"Discoveries" exhibition on the Isle of Mainau from 3 July until 31 August 2009.

A number of partners from the worlds of science, politics and business helped to show on the Isle of Mainau what research can contribute to the sustainable management of our planet. The exhibition was realised with the support of the German Federal Ministry of Education and Research. It took place as part of the "German Research Expedition" year of science. This year, the spotlight was on the topic of "Water", in the summer of 2010 the focus will be on "Energy" and in 2011 on "System Earth".

› from page 108

The mediatheque with six decades of lectures by Nobel Laureates.

The lectures that have been given by Nobel Laureates at the Lindau Meetings during the past six decades are gradually being digitised – thanks to the generous support of the Gerda Henkel Foundation. An initial selection has been made accessible on-line since May 2009 at www.lindau-nobel.de. Prominent researchers such as Rita Levi-Montalcini, Paul Dirac and James Watson have their say and report on their work in the laboratories on their way to ground-breaking discoveries. The result is a unique archive of science.

› from page 116

Support for the "Tiny Tots Science Corner".

Curiosity and enthusiasm are the key to a positive attitude to the natural sciences and technology. The initiative "Haus der kleinen Forscher" nurtures this interest in children and is supported by the Council and the Foundation. During the 59th Lindau Meeting, Her Royal Highness Princess Maha Chakri Sirindhorn (Thailand) and the German Nobel Laureate Theodor Hänsch visited a kindergarten in Lindau and joined in with the young researchers' experiments.

› from page 120

The 59th Meeting of Nobel Laureates

28 June–3 July 2009

PARTICIPANTS	10
— Nobel Laureates	12
— Up-and-Coming Scientists	14
— Academic Partners of the Lindau Meetings	17
— Facts & Figures: Results from the Participants Survey, Part I	18
— Facts & Figures: Representation by Country & Selection Criteria	20
— Facts & Figures: Summary of a Survey conducted by the U.S. Department of Energy	21
— Facts & Figures: List of Academic Partners Worldwide	22
PROGRAMME	24
— Opening Day	25
— Scientific Programme	35
— Facts & Figures: Timetable of the Scientific Programme	40
— Abstracts from the 59 th Meeting of Nobel Laureates	42
— Facts and Figures: Results from the Participants Survey, Part II	59
— India as the Partner Country of the 59 th Meeting of Nobel Laureates	69
— Social Programme	73
— Final Day on the Isle of Mainau	81
MAECENATES, SPONSORS AND PROJECT PARTNERS OF THE 'MISSION EDUCATION'	87
— Endowment of the Foundation	87
— Project-Based Support	88
— Donations in Kind	89
— List of Maecenates, Patrons, Donors	92
— List of Benefactors	93
COMMUNICATIONS AND MEDIA WORK	94
— Focus: Online Communication	95
— Facebook and Twitter	95
— Official Meeting Blog	97
— Cooperation with <i>Nature</i>	98
— The Economist Online Debate	98
— EBU, TV and Al-Jazeera	100
— Two Commentaries about the 2009 Lindau Meeting from " <i>Nature Chemistry</i> "	103
EXEMPLIFYING APPRENTICESHIP: THE LINDAU MEETINGS	104





**59TH MEETING
OF NOBEL LAUREATES**
Participating Nobel Laureates



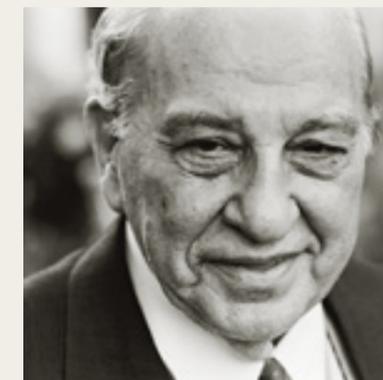
Peter Agre, United States
Chemistry, 2003



Walter Kohn, Austria
Chemistry, 1998



Sir Harold W. Kroto, United Kingdom
Chemistry, 1996



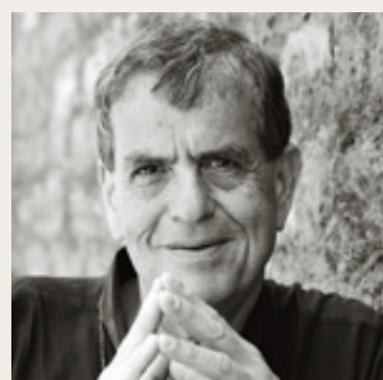
Rudolph A. Marcus, Canada
Chemistry, 1992



Werner Arber, Switzerland
Physiology or Medicine, 1978



Martin Chalfie, United States
Chemistry, 2008



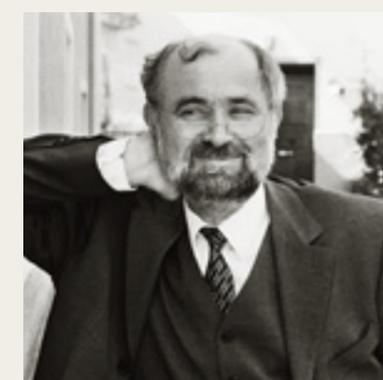
Aaron Ciechanover, Israel
Chemistry, 2004



Hartmut Michel, Germany
Chemistry, 1988



Mario J. Molina, Mexico
Chemistry, 1995



Erwin Neher, Germany
Physiology or Medicine, 1991



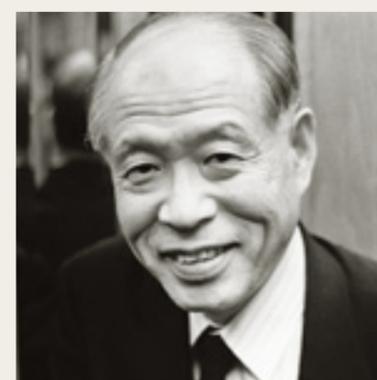
Paul J. Crutzen, Netherlands
Chemistry, 1995



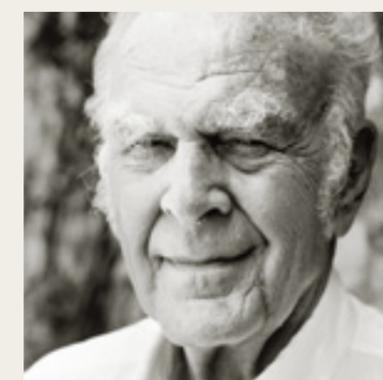
Richard R. Ernst, Switzerland
Chemistry, 1991



Gerhard Ertl, Germany
Chemistry, 2007



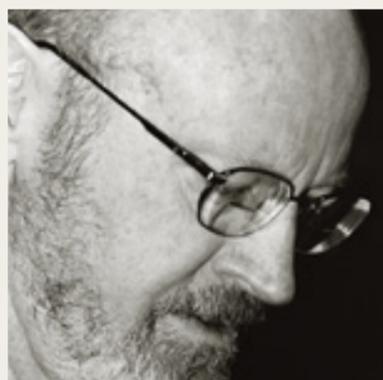
Ryoji Noyori, Japan
Chemistry, 2001



F. Sherwood Rowland, United States
Chemistry, 1995



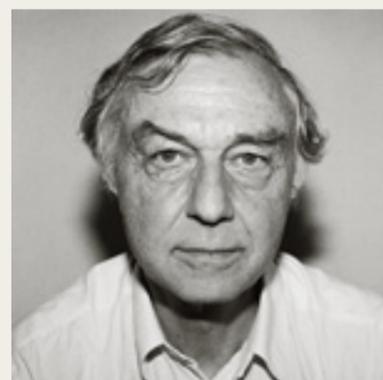
Richard R. Schrock, United States
Chemistry, 2005



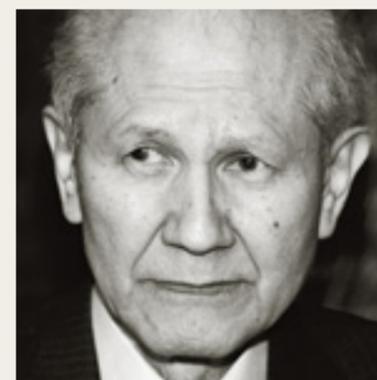
Robert H. Grubbs, United States
Chemistry, 2005



Theodor Hänsch, Germany
Physics, 2005



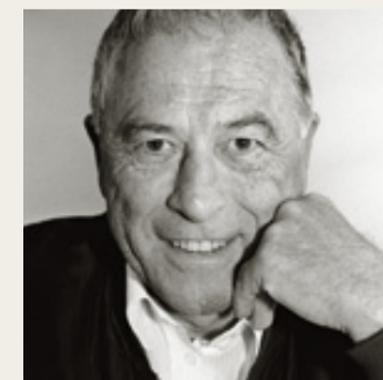
Robert Huber, Germany
Chemistry, 1988



Osamu Shimomura, Japan
Chemistry, 2008



Roger Y. Tsien, United States
Chemistry, 2008



Kurt Wüthrich, Switzerland
Chemistry, 2002

PARTICIPANTS



Impressions from the 59th Meeting of Nobel Laureates.

Twenty-two Nobel Laureates and the Chairman of the IPCC, which was awarded the Nobel Peace Prize in 2007, R. K. Pachauri, took part in the 59th Meeting of Laureates dedicated to Chemistry. All continents were represented in Lindau with a cross-section of their best talent: 580 up-and-coming young scientists from 67 countries. More than 120 institutions from around the world nominated participants for the 2009 Lindau Meeting. New Academic Partners joined the international network established by the Lindau Meetings.

NOBEL LAUREATES

With lectures, panel discussions and student discussions, the Laureates gave the young researchers valuable insights into their latest research projects, discussed societal issues and outlined the prospects for science. Once more, the meeting showed that the issues raised here are of relevance for the future. In the 21st century, chemistry will play a key role when it comes to finding sustainable solutions for alleviating climate change, converting to renewable energies, producing goods and new materials in an environmentally compatible way and fighting diseases. Interdisciplinary projects with other fields in particular, present a potential that should be fully utilised. In his lecture entitled "Chemistry: The Key to the Future", Professor Ryoji Noyori, Nobel Laureate in Chemistry in 2001, made reference to the fact that chemistry is "an essential component in many interdisciplinary sciences" and the most important responsibility in the future is to continue this work in tandem with other research areas.

Founders' Assembly

The Founders' Assembly of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance currently has 229 Nobel Laureates among its members (as of October 2009). They all support the objective of the meetings: to educate, to inspire and to connect scientific generations. During the 2009 Lindau Meeting, two Laureates in Chemistry – Robert H. Grubbs (2005) and Osamu Shimomura (2008) – became members. More Laureates, who similarly dedicate themselves to the aims of the Lindau Meetings, have joined the Assembly in the past few months: Françoise Barré-Sinoussi (Nobel Laureate in Physiology or Medicine 2008), Martin Chalfie (Chemistry 2008), Roger Y. Tsien (Chemistry 2008), Toshihide Maskawa (Physics 2008), Luc Montagnier (Physiology or Medicine 2008), Yoichiro Nambu (Physics 2008), Edward C. Prescott (Economics 2004) and Andrew V. Schally (Physiology or Medicine 1977).

In all, twenty-two Nobel Laureates and the Chairman of the Intergovernmental Panel on Climate Change (IPCC), which was awarded the Nobel Peace Prize in 2007, Professor R. K. Pachauri, took part in the 59th Meeting of Nobel Laureates, which was dedicated to chemistry. There were nineteen Laureates in Chemistry, two Laureates in Physiology or Medicine, as well as Theodor Hänsch, Nobel Laureate in Physics (2005), who all made great efforts to offer wisdom and advice to the up-and-coming young scientists who attended with them.

During the series of lectures and student workshops, the three 2008 Nobel Laureates in Chemistry, Professors Martin Chalfie, Osamu Shimomura and Roger Y. Tsien, provided insights into their work. Together with Gerhard Ertl (Chemistry 2007) and Robert H. Grubbs (Chemistry 2005), they were taking part in a Lindau Nobel Laureate Meeting for the first time.

Chalfie presented his latest research and showed how he uses GFP – the fluorescent protein whose discovery and utilisation in research was the reason for his being awarded the Nobel Prize in 2008 – in his current research: for experiments with sensory nerve cells in the nematode *C. elegans* (in a lecture entitled: "GFP and After"). Shimomura gave a talk on bioluminescence in nature (in a lecture entitled: "Chemistry of Bioluminescence"). Offering some very personal insights, Tsien explained how he came across fluorescent proteins in his scientific work (in his lecture entitled: "Building and Breeding Molecules to Spy on Cells, Tumors, and Organisms").



Nobel Laureates and Countess Bettina Bernadotte:

(First row, from left) Walther Kohn, Rudolph A. Marcus, Werner Arber, Ryoji Noyori. (Second row, from left) Richard H. Grubbs, F. Sherwood Rowland, Gerhard Ertl, Robert Huber, Richard R. Ernst. (Third row, from left) Erwin Neher, Peter Agre, Martin Chalfie, Aaron Ciechanover, Hartmut Michel, Mario J. Molina.



The 2009 meeting was delightful. We all missed Countess Sonja, but her gracious and optimistic spirit seemed present at all occasions.

The students from far and wide all shared life stories, scientific dreams, and put up with us old Laureates and even laughed at our jokes. The small gatherings for lunch and dinner provided an irresistible opportunity to get well acquainted. Lunch with the Aussie students included structural biology conversations as well as chats about beer and body surfing. Dinner with the Scandinavian students was lovely. Astrid Graslund added charm and warm-hearted spirit to our breakfasts.

I even participated in the Economist online debate on sustainability. I won by arguing that sustainability must be pursued.

Peter Agre, 2003 Nobel Laureate Chemistry

UP-AND-COMING SCIENTISTS

A total of 580 up-and-coming young scientists from 67 countries took part in the 59th Meeting of Nobel Laureates. All continents were represented in Lindau with a cross-section of their best talent. Europe took part with 293 young scientists and Asia with 147. From North America there were 99 young researchers. Latin America was represented by 15 promising next-generation researchers, and Australia and Africa took part with 13 each.

Again, a large proportion of female scientists was represented: 255 young female chemists took part. Together with the worldwide network of Academic Partners, the Council and Foundation of Nobel Laureate Meetings aims to promote the participation of these young women. In order to meet the challenges in the field of chemistry, science cannot afford not to make full use of the potential of these young female researchers. That is why the Council and the Foundation see it as being particularly important that they are brought into the international networks that develop in Lindau at the earliest opportunity.

This year, the Chemical Industry Fund within the German Chemical Industry Association (Fonds der Chemischen Industrie im Verband der Chemischen Industrie) supported the Nobel Laureate Meeting for the first time, granting fellowships to 115 young researchers to participate in the meeting. Furthermore, individual chemical companies also gave their support to the meeting by way of substantial grants (see also p. 92). "For Germany as a centre of research, it is an excellent indication that this worldwide unique meeting continues to take place in Lindau," said Andreas Kreimeyer, the Chairman of the Chemical Industry Fund and Member of the Board of BASF SE in Lindau. He added, "Our branch of industry needs young people who are enthusiastic about the future. With their creative ideas and their commitment, they can ensure future innovations in chemistry" .

The German-Chinese year of science and education 2009–2010

The exchange of information between generations of scientists forms the focus of the Nobel Laureate Meetings. Email, chats and text messages are no substitute for the personal meetings that are facilitated and encouraged during the meeting on Lake Constance. The Federal Ministry of Education and Research provided fresh impetus in the form of a special boat trip. To mark the German-Chinese year of science and education 2009–2010, the Federal Minister, Annette Schavan, invited German and Chinese participants at the 59th Lindau Meeting to come together on the "MS Lindau".

Together with her Chinese counterpart, Wan Gang, the Federal Minister welcomed 50 young researchers from both countries to a panoramic trip on the day before the official opening. The Indian Minister for Human Resource Development, Shri Kapil Sibal, also took part. The result was just as Minister Schavan had predicted. On the "MS Lindau" a large number of interesting discussions took place unencumbered by national boundaries. The German and Chinese participants were all in agreement: Science really is a wonderful mechanism for building bridges.

The aim of the German-Chinese year of science and education 2009–2010 is to provide a stimulus for joint ventures between Germany and China in terms of education and science. The Chinese Research Ministry and the Chinese Education Ministry are both involved as partners with equal rights and equal standing. The year was launched in March 2009 and is due to run until the Expo 2010 taking place in Shanghai.



Germany's Federal Minister of Education and Research, Annette Schavan, and her Chinese counterpart, Wan Gang, listening.



50 participants from China and Germany came together on the "MS Lindau".



Interesting discussions between German and Chinese scientists.



Wolfgang Schürer, Chairman of the Foundation, welcomes the Chinese Minister for Science and Technology, Wan Gang, on the boat.

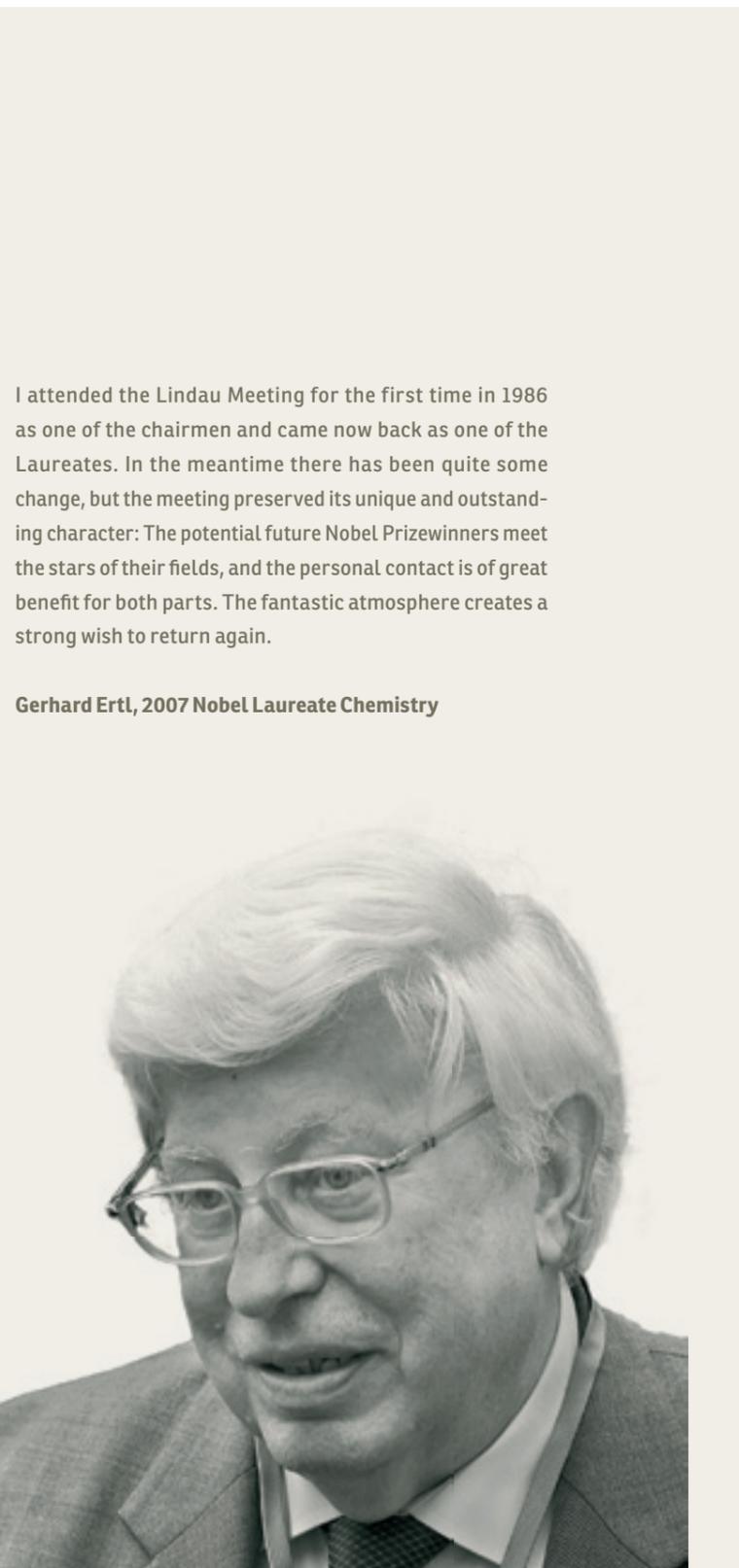
Like all the young scientists, the candidates put forward by the Chemical Industry Fund also took part in an international, multi-stage selection process. Once Academic Partners have initially made their own choices and entered the best candidates into a web-based database, the Council's Review Panel then selects the participants for the meeting. All selections are made on the basis of selection criteria that are set by the Council (see p. 20). Altogether, considerably more than 20,000 young researchers submitted an application to the Academic Partners to take part in the meeting, and the Review Panel was able to make the final selection from among the almost 2,000 candidates suggested by the Academic Partners.

Members of the Review Panel this year were the Council members Professors Wolfgang Lubitz (chairman), Burkhard Fricke, Helmut Sies, and Jürgen Uhlenbusch. They were assisted in their work by Nadine Gärber and Sabine Harder in the executive secretariat and also by Leonore Uhlenbusch and Andreas Schmidt.

Post-Conference Programme for Participants.

As in the previous year, the state of Baden-Württemberg once again invited participants at the meeting to a post-conference programme of events. Over five days, 20 young scientists from 14 countries found out more about the education and research landscape of Baden-Württemberg. This included visits to universities, scientific establishments and companies in Freiburg, Heidelberg, Karlsruhe and Constance, where they engaged in lively discussions with the researchers there.

Another post-conference programme was aimed at participants from Africa and was hosted by the German Research Foundation (Deutsche Forschungsgemeinschaft – DFG). Ten young African chemists were invited to German universities and research establishments in Berlin, Frankfurt, Cologne and Munich. The seven-day programme was concluded by an information event at the head office of the DFG, where the participants at the Nobel Laureate Meeting were able to gather a wide range of information about funding opportunities.



I attended the Lindau Meeting for the first time in 1986 as one of the chairmen and came now back as one of the Laureates. In the meantime there has been quite some change, but the meeting preserved its unique and outstanding character: The potential future Nobel Prizewinners meet the stars of their fields, and the personal contact is of great benefit for both parts. The fantastic atmosphere creates a strong wish to return again.

Gerhard Ertl, 2007 Nobel Laureate Chemistry

M. Arif Adli, Vice President of TÜBITAK, signed the Memorandum of Understanding with the Council and Foundation of the Lindau Meetings.



Both programmes introduced participants at the 59th Meeting of Nobel Laureates to the exciting opportunities for a scientific career in Germany and also further encouraged the personal exchange of information between the participants. In the next few years, the Council and the Foundation, in cooperation with a large number of partners, aim to increase the availability of such post-conference programmes to the participants.

NETWORK OF SCIENTIFIC EXCELLENCE: ACADEMIC PARTNERS OF THE NOBEL LAUREATE MEETINGS

More than 120 institutions from around the world nominated participants for the 2009 Lindau Meeting. Together they form the international network of Academic Partners of the Nobel Laureate Meetings. In view of the rising number of applicants, these institutions also support the Council and Foundation in systematically selecting the participants strictly in terms of their scientific achievements. The significantly improved quality of the participants and the increasing internationalisation of the meetings – as seen also by the Laureates – would scarcely be possible without the involvement and preliminary work carried out by these institutions.

The international network of Academic Partners is continually and systematically being expanded. During the 59th Meeting of Nobel Laureates, a Memorandum of Understanding was concluded with the Scientific and Technological Research Council of Turkey (TÜBITAK). The signing of this agreement gives expression to the joint interest to ensure the participation of highly talented young scientists from Turkey at the Meetings of Nobel Laureates. Just like partner institutions in, for example, Australia, China, Egypt, India, Malaysia, Mexico, Norway, Pakistan, Poland, Slovenia, Hungary and the USA, from now on TÜBITAK

will announce a national competition each year for participation in the "Lindau Dialogue". Adherence to the strict Lindau selection criteria is an essential component of this cooperation agreement.

Furthermore, in the past twelve months, new cooperation agreements have been established with regional partners from Asia (ASEAN – Association of Southeast Asian Nations), the Islamic world (COMSTECH – The Standing Committee on Scientific and Technological Cooperation of the Organisation of the Islamic Conference) as well as with the OFID Fund and the Brazilian Academy of Sciences (ABC). As a consequence, all continents of the world are now represented at the Nobel Laureate Meetings, and the process of internationalisation is further continuing.

Facts & Figures

Results from the Participant Survey, Part I

“Educate. Inspire. Connect.” – these three objectives characterise the ‘Mission Education’ as set out by the Council and Foundation. A series of questions in the annual participant survey deals with the issue of whether the objectives were achieved. The Nobel Laureate Meetings are a platform for the exchange of ideas and information between different generations of scientists – 86% of the surveyed young scientists confirmed that the meeting promotes dialogue between the Nobel Laureates and the young researchers. 94% of all those surveyed feel motivated after having participated in the meeting.

Please evaluate if the Lindau Nobel Laureate Meetings have succeeded to foster a dialogue...

... between Nobel Laureates and young researchers. (Total 499)			
Yes	223	45%	
Rather Yes	204	41%	
Rather No	68	13%	
No	4	1%	

... between young researchers from different countries. (Total 495)			
Yes	322	65%	
Rather Yes	143	29%	
Rather No	20	4%	
No	10	2%	

... between scientists from different fields of chemistry. (Total 463)			
Yes	201	43%	
Rather Yes	178	38%	
Rather No	68	15%	
No	16	3%	

... that will influence your scientific career. (Total 506)			
Yes	169	45%	
Rather Yes	218	41%	
Rather No	106	13%	
No	13	1%	

... that motivates. (Total 528)			
Yes	356	67%	
Rather Yes	141	27%	
Rather No	24	5%	
No	7	1%	

Which events of the meeting did you enjoy particularly? (three choices possible)

Lectures	367
Student Discussions	300
Opening Ceremony	38
Welcome Parties on Sunday	33
Get-Together Evening on Monday	209
Panel Discussion on Tuesday	105
Dinner with Academic Institution	101
Concert of UBS Verbier Festival Chamber Orchestra on Wednesday	129

For young scientists from around the world, the Lindau Meetings offer the unique opportunity to meet Nobel Laureates in person, to exchange information and ideas with them and also to get to know colleagues from more than 60 countries. The expectations of this week on Lake Constance are high. 43% (in 2008: 28%) of the participants at this year’s meeting said that their expectations had been exceeded, and for 53% (66%) of them, these had been met. The survey also demonstrated that the next generation of budding scientists would very much welcome a platform for dialogue “after Lindau” – 51% would “definitely” create a personal profile on a platform of this kind.

As a showcase project at the heart of Europe, the Nobel Laureate Meetings each summer play host to the scientific elites of today – and those of tomorrow. Post-conference programmes offer an excellent opportunity to raise the profile of Europe as a centre of science and research. The participant survey showed that there is considerable interest in this among the international best talents.

The Meeting of Nobel Laureates exceeded my expectations in various respects. The best part of the meeting for me was the discussions in individual groups with Nobel Laureates, which was including not only scientific but also private topics. It was very helpful to understand how they spend their time in their life. Also, it was an outstanding opportunity to meet and network with several young researchers.

Keiji Numata, Japan

My expectations were (Total 509)		
Exceeded	221	43%
Met	272	54%
Not met	16	3%

Would you create your own profile at a platform for former participants of the Lindau Meetings? (Total 511)		
I definitely would create my own profile.	258	51%
I most likely would create my own profile.	212	41%
I would not create a profile.	41	8%

Please tell us what you would expect from such a platform for former participants (choose up to three items): (Total 511)		
Keep in touch with other participants from this year’s meeting.	409	
Start a dialogue with participants from past meetings.	151	
Get news about future Lindau Meetings (e.g. online lectures).	266	
Open forum for discussions between former participants.	174	
I do not have any expectations.	33	

Would you be interested in receiving information about European academic institutions and research facilities following your stay in Lindau? (Total 487)

I am highly interested in it.	218	36%
I am interested in it.	211	43%
I am hardly interested in it.	30	6%
I am not interested.	28	5%



Facts & Figures

Representation by Country & Selection Criteria

REPRESENTATION OF YOUNG RESEARCHERS BY COUNTRY

Armenia	1	Ethiopia	1	Lebanon	1	Portugal	4
Australia	10	Finland	6	Liechtenstein	2	Puerto Rico	1
Austria	4	France	8	Lithuania	2	Romania	3
Bangladesh	3	Germany	168	Luxembourg	1	Russian Federation	10
Belarus	3	Ghana	2	Macedonia, the former		Saudi Arabia	1
Belgium	2	Greece	8	Yugoslav Republic of	1	Singapore	3
Brazil	7	Hungary	2	Malawi	1	Slovakia	1
Cameroon	1	India	45	Malaysia	7	Slovenia	2
Canada	7	Indonesia	1	Mexico	1	Spain	14
Chile	4	Ireland	3	Nepal	1	Sweden	5
China	27	Israel	8	Netherlands	10	Switzerland	3
Colombia	2	Islamic Republic of Iran	3	New Zealand	3	Taiwan	4
Croatia	1	Italy	5	Nigeria	4	Thailand	8
Czech Republic	5	Japan	11	Norway	3	Ukraine	4
Denmark	2	Jordan	3	Pakistan	6	United Kingdom	10
Egypt	4	Korea, Republic of	2	Philippines	2	United States	91
Estonia	2	Latvia	1	Poland	8	Uruguay	1

SELECTION CRITERIA

All selected participants shall

- show a genuine interest in science and research,
- show a strong commitment both to their principal field of studies and to the interdisciplinary dialogue with the international academic community,
- receive an unequivocal support of their application by their academic advisor and/or by internationally renowned scientists,
- be fluent in English and an active participant in discussions,
- be familiar with societal impacts of scientific knowledge and its applications,
- not have participated in previous Lindau Meetings,
- belong to the top 10 per cent of their class, and
- deliver fully completed applications.

It is most welcomed to have a good balance between these three groups:

- (1) Undergraduate students shall**
 - exhibit a solid general knowledge in the natural sciences,
 - have done some research work.
- (2) Master and Doctoral students shall**
 - have excellent academic accomplishments,
 - have produced outstanding research,
 - have tutoring experience.
- (3) Postdoctoral scientists shall**
 - have published results of scientific investigations in refereed journals,
 - have presented research reports at international conferences,
 - have acquired experience in tutoring and teaching.

Facts & Figures

Evaluation of the Lindau Nobel Laureate Meetings conducted by the U.S. Department of Energy (DOE)

The purpose of this evaluation of the Lindau Meeting of the Nobel Laureates and Students Graduate Awards Program was to determine the programme’s long-term impact on its participants. The students were directed to a website to complete the survey confidentially and anonymously. The participants in this evaluation included 196 graduate students who attended one of the Lindau Meetings of Nobel Laureates between 2000 and 2008 as part of the student awards programme. These are some conclusions resulting from the survey:

“Awardees found the Lindau Meeting had a positive impact on their graduate education in that their interaction with other attendees led to a renewed interest in their research and motivation to complete their degrees.”

“Awardees felt their participation in the Lindau Meeting contributed to encouraging them to continue in a research career.”

“Awardees’ scientific perspective and knowledge was broadened as a result of their experience at the Lindau Meeting.”

“Awardees’ perspective on science and technology was changed as a result of their experience at the Lindau Meeting.”

“Awardees’ view the Nobel Laureates as scientific role models as a result of their experience at the Lindau Meeting.”

“As a result of the Lindau trip, awardees engaged in scientific collaboration with the Nobel Laureates, senior researchers, U.S. students, and international students.”



The Lindau Meeting represents a unique experience, providing memories that will last for a lifetime. The afternoon discussions were in my opinion the best part of the meeting. During these sessions, the Laureates had plenty of time not only to answer technical questions but also share their personal experiences beyond science and thereby motivate us, inspire us and pass on their enthusiasm! This feature made the meeting so unique and different to conventional scientific conferences, in which there is often very little time for discussion.

Anna Hirsch, Luxemburg

Facts & Figures

Academic Partners Worldwide

INTERNATIONAL ACADEMIC PARTNERS

Australia	Australian Academy of Sciences	Malaysia	Academy of Sciences Malaysia
Austria	Federation of Austrian Industries	Mexico	Mexican Academy of Sciences
Bangladesh	Bangladesh Academic of Science	Netherlands	Royal Netherlands Academy of Arts and Sciences (KNAW)
Belgium	Fonds National de la Recherche Scientifique	New Zealand	The Royal Society of New Zealand
Belgium	Human Frontier Science Program	Nigeria	Ladoke Akintola University of Technology
Brazil	Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)	Pakistan	Pakistan Science Foundation
Canada	NSERC	Poland	Foundation for Polish Science
Chile	Academia de Ciencias	Portugal	Academy of Sciences Lisbon
China	Sino-German Center for Research promotion	Russia	Russian Foundation for Basic Research
Czech Republic	Academy of Sciences of the Czech Republic	Saudi Arabia	King Saud University
Denmark	Danish Agency for Science Technology and Innovation	Singapore	A-Star University
Egypt	Ministry of Higher Education and Scientific Research	Slovenia	Slovenian Academy of Sciences and Arts
Estonia	Estonian Academy of Sciences	Spain	Confederación de Sociedades Científicas de España (COSCE)
Finland	Academy of Finland	Spain	Agència de Gestió d'Ajuts Universitaris i /Catalonia de Recerca
France	Academy of Sciences	Sweden	Nobel Foundation
Greece	Onassis-Foundation	Sweden	Royal Swedish Academy
Hungary	Hungarian Academy of Sciences	Switzerland	ETH Zurich
India	Department of Science and Technology	Switzerland	Swiss National Science Foundation
Israel	Weizmann Institute of Science	Switzerland	University of Geneva
Japan	Japan Society for the Promotion of Sciences (JSPS)	Thailand	National Science and Technology Development Agency
Jordan	Jordan University of Science and Technology	United Kingdom	Royal Society of Chemistry
Latvia	University of Latvia	United States of America	Department of Energy/ Oak Ridge
Lithuania	The Lithuanian Academy of Sciences		
Luxembourg	Fonds National de la Recherche		

INTERNATIONAL INSTITUTIONS AS ACADEMIC PARTNERS

Association of Southeast Asian Nations (ASEAN)
 European Molecular Biology Organization (EMBO)
 European Science Foundation
 The Academy of Sciences for the Developing World (TWAS)
 United Nations Educational, Scientific and Cultural Organization (UNESCO)

ACADEMIC PARTNERS IN GERMANY

Academy of Sciences Göttingen
 Alexander von Humboldt Foundation
 Association of German Engineers (VDI)
 Bayerische Akademie der Wissenschaften
 Charité Berlin
 Deutsche Telekom Stiftung
 Deutsches Zentrum für Luft- und Raumfahrt
 Elite Network of Bavaria
 Fraunhofer-Gesellschaft
 Fulbright Commission
 Gerhard C. Starck Stiftung
 German Academic Exchange Service (DAAD)
 German Academy of Science and Engineering (acatech)
 German Research Foundation (DFG)
 Gottlieb Daimler- and Karl Benz-Foundation
 Helmholtz Association of German Research Centres
 Jungchemikerforum
 Klaus Tschira Foundation gGmbH
 Konrad Adenauer Foundation
 Leibniz-Gemeinschaft
 Max-Planck-Society
 Robert Bosch Stiftung
 Südwestmetall
 Verband der Chemischen Industrie
 Verein der Bayerischen Chemischen Industrie (VBCI)
 Wilhelm Sander-Stiftung
 Xlab Göttingen

The animated dialogue with the young researchers at Lindau has convinced me that humanity has a bright future. The 21st century must be a century of international cooperation if our species is to survive within the limits of this planet. Friendships across the sea – and firm relationships of trust – are the cornerstone of international security.

Ryoji Noyori, 2001 Nobel Laureate Chemistry



PROGRAMME



Countess Bettina Bernadotte, Nobel Laureate Ryoji Noyori and young researchers at the 59th Meeting of Nobel Laureates.

Science Education, as the Lindau Nobel Laureate Meetings have been promoting it for almost 60 years, is an investment in the future – and therefore “sustainable” in the best sense of the word. Sustainability was one focus of this year’s meeting. Chemistry can make a crucial contribution in ensuring the survival of mankind on this overburdened planet. In the 21st century, it will play a key role when it comes to finding sustainable solutions for easing climate change, converting to renewable energies, the environmentally compatible production of goods and new materials, and fighting diseases.

OPENING DAY

This year, there were changes to the traditional opening ceremony to mark the start of the annual Nobel Laureate Meetings. For the first time, a moderator led the entire proceedings. The Council and Foundation were pleased to enlist the services of Adam Smith, Editor-in-Chief of nobelprize.org, for this task. He skillfully guided the 90 minute opening ceremony, talking to Countess Bettina Bernadotte about her father Count Lennart Bernadotte – the ‘spiritus rector’ of the meetings, the centenary of whose birth the Council and Foundation are commemorating this year – and chairing a lively discussion about the opportunities and challenges of international scientific careers, in which not only the President of the European Commission, José Manuel Barroso, and Council Member and Nobel Laureate, Werner Arber, took part, but also five young scientists from four different continents (see also p. 30).

At the opening of the 59th Meeting of Nobel Laureates, the Council and Foundation were able to welcome guests of honour from the worlds of science, business and politics. Her Royal Highness, Princess Maha Chakri Sirindhorn of Thailand, once again took part in the meeting (following her participation in 2008). The President of the European Commission, José Manuel Barroso, made the trip to Lake Constance to see for himself what the meetings are about. The partner country of the 2009 Nobel Laureate Meeting, India, was represented by Shri Kapil Sibal, Minister for Human Resource Development, and Ambassador Sidhir Vyas. For the traditional Get-Together Evening on the Monday of the meeting, the Indian Minister for Science & Technology and Earth Sciences, Prithviraj Chavan, also travelled to Lindau (see also p. 69). The 2009 Nobel Laureate Meeting was incorporated into the German-Chinese year of science and education 2009–2010, and together with the Federal Minister of Research, Annette Schavan, the Chinese Minister for Research and Technology, Wan Gang, attended the opening. The Prime Minister of Liechtenstein, Klaus Tschütscher, had also come to Lindau. Furthermore,

Council and Foundation were able to welcome Wolfgang Heubisch, Bavarian State Minister of Sciences, Research and the Arts, and Gabriela Dür, Chair of the Commission of Education, Science and Research of the International Lake Constance Conference (IBK).

Countess Bettina Bernadotte: It is About People, not Papers.

Countess Bettina Bernadotte, the President of the Council, opened the 59th Meeting of Nobel Laureates in Lindau, for the first time in her role as President of the Council after having taken over the office from Countess Sonja Bernadotte (1944–2008) in October of the previous year. In her opening speech, Countess Bernadotte emphasised the uniqueness of the Nobel Laureate Meetings: “It is about people, not papers”. The aim of the Lindau Meetings is to interest people in research and science as well as to inspire scientists and to bring them together from around the world.

She made reference to the hard work put in by the Council and Foundation to further develop the Lindau Meetings together with partners from science, business and politics and to transform them into a beacon for science and research. “We do not need to hide it: the Lindau Meetings are a beacon of scientific excellence. May it lead to the best results. Good science demands curiosity, inspiration and dedication. Taken together, that means the drive to understand. We have here the best scientists and the best young talents. And we take every care and seek the best advice to ensure the excellence of our scientific programme too.”

The President of the Council thanked all institutions and individuals who, through their support, make it possible to organise the meeting: “The support of all Benefactors and Donors plays a most important role in translating the agenda of the Lindau Meetings into reality. A large and growing number of companies and individual patrons support our work. The Council and Foundation would like to thank these corporate citizens, as well as government representatives, for their commitment to our public-private partnership, increasingly now cited as a best practice model.”

Countess Bettina Bernadotte challenged the young scientists to make intensive use of the coming days: “We want you to have a great time! Yes, take advantage of the contact with the Laureates and enjoy the atmosphere. Above all, we want you to experience the joy of scientific discovery. Then do not stop at this week. Carry the experience back with you to your universities and laboratories. Then stay in touch – with each other and with Lindau.”

Federal Minister Schavan: The Meetings of Nobel Laureates set new Standards.

The German Federal Minister of Education and Research, Annette Schavan, welcomed the participants and guests of the Nobel Laureate Meeting in Germany. For many years, the Minister has personally played an active part in the continuing development of the meetings. She described the meetings as follows: “Lindau is a place where networks of scientific excellence are created, crossing the boundaries between cultures, disciplines and generations. The Lindau Meetings give people an opportunity to acquire an insight into the world of research. The participants discuss subjects that will figure strongly in the world of tomorrow and beyond. It is a meeting point for the international scientific elite who will give the future a voice.”

Minister Schavan acknowledged the successful work carried out by the Council and the Foundation in further developing the Nobel Laureate Meetings. “The Meetings of Nobel Laureates in Lindau set new standards for dialogue about science and research – I am confident that this year’s meeting will continue this tradition.”

Support for the Nobel Laureate Meetings by the Federal Ministry of Education and Research will be continued in the coming years. “The Federal government will considerably increase its support,” the Minister announced in an interview following the meeting. In future, research ministers from throughout the world should be invited to the opening of the Lindau Meetings at Lake Constance.



Germany’s Federal Minister of Education and Research, Annette Schavan (from left) with the President of the European Commission, José Manuel Barroso, the President of the Council, Countess Bettina Bernadotte, and Shri Kapil Sibal, Indian Minister for Human Resource Development after the official opening ceremony.

New Members of the Honorary Senate: José Manuel Barroso and Shri Kapil Sibal

In the course of the opening ceremony, the Foundation Lindau Nobelprizewinners Meetings at Lake Constance paid tribute to two outstanding personalities from Asia and Europe for their hard work in support of science and international understanding: José Manuel Barroso, the President of the European Commission, and Shri Kapil Sibal, the Indian Minister for Human Resource Development. Both were inducted to the Honorary Senate which brings together leading personalities from science, politics and business and advises the Foundation's Board.

As President of the European Commission, José Manuel Barroso has launched numerous initiatives that have led to a greater networking of science and the economy. As a result, Europe has become more attractive and competitive as a location. He has recognised and repeatedly emphasized the importance of science in finding solutions to the pressing tasks of the future, and in particular, he has worked hard to encourage the young people of Europe.

Shri Kapil Sibal has rendered outstanding service in promoting young Indian talents in particular. As the Minister of Science (until 2009), he dedicated himself to establishing India as a centre of science. His concentrated effort to expand global cooperation and international agreements is reflected not least in the signing of a Memorandum of Understanding with the Meetings of Nobel Laureates.



Wolfgang Schürer (right), Chairman of the Foundation, welcomes President José M. Barroso as new member of the Honorary Senate.



For his efforts to establish India as a centre of science Indian Minister Shri Kapil Sibal was inducted into the Honorary Senate.

José Manuel Barroso,
President of the European Commission, in his acceptance speech on his induction to the Honorary Senate said:



"Today, we face several crises, including of course the financial crisis, a real financial crisis and a potentially even bigger environmental crisis. Some are worried that the financial crisis will push climate change off the front page. I do not think so. I think it has pushed the issue of sustainability further up the agenda."

"I also believe that scientists, economists and politicians must work more closely together. After all, the ball got rolling on climate change because scientists from all over the world made a convincing case for urgent action. And then, also based on sound economic evidence, political leaders took some initiatives."

"Countess Bernadotte, I gather that this year, the Lindau Meetings will be celebrating the 100th anniversary of your father's birth. He was a Swede. He started these meetings here in Lindau in Germany. As a true European, he knew that the really big problems can only be solved by bringing together the best minds from all over the world. It is important to understand that if we want Europe to succeed it has to be open to the world and seize the opportunities of globalisation."

"From modest beginnings, we see the Lindau Dialogues of today. A truly global event here in Germany in Europe. A contribution by Europe to global understanding, to educate, connect and inspire."

Shri Kapil Sibal,
Indian Minister for Human Resource Development, in his acceptance speech on his induction to the Honorary Senate said:



"Lindau provides the idyllic ambience for the confluence of the greatest minds of our times. Distinguished scientists gather here, charged with the passion for science in its quest for the truth. It is science and scientists that make me optimistic for a better world."

"Ironically, scientific solutions and technological breakthroughs will help us emerge successful in our struggle for survival. Lindau, I hope, will give birth to such solutions. The free spirit of scientific dialogue is seed to creativity. Science is not formal logic. It allows Icarus to fly without falling. The gifted young gathered here will find their mentors and thus chart the future course of scientific endeavours. Scientific enterprise is not only about discovering new facts, but it is also about discovering new ways of thinking about them. Lindau provides the ideal platform to do so."

"Countess Bernadotte, you epitomize a most sublime legacy. For 50 years, the concept of bringing together Nobel Laureates with students and young scientists in a relaxed and informal atmosphere has achieved the objective of creating global networks of scientific cooperation, in line with your unflinching commitment. The German government must be lauded for supporting and encouraging the Lindau Foundation."

Lennart Bernadotte Medal for Nobel Laureate and Council Member, Werner Arber.

During the opening ceremony, Countess Bettina Bernadotte presented the Lennart Bernadotte Medal to Werner Arber. The Nobel Laureate from 1978 was honoured for his many years of personal dedication to the Nobel Laureate Meetings. Since 1991, he has brought his knowledge as an outstanding scientist to the work of the Council, thereby actively participating in the further development of the Lindau Meetings. Arber thanked Countess Bettina Bernadotte for the award, saying that as a member of the Council, he has had the opportunity to take part in the Nobel Laureate Meetings more than 20 times. He was delighted that through his work he had been able to play his part in developing a regional German event into a "global activity".

The Lennart Bernadotte Medal is named after the 'spiritus rector' of the Nobel Laureate Meetings, Count Lennart Bernadotte (1909–2004). It has been awarded since 2002 and last year was presented to Wolfgang Schürer, Chairman of the Board of the Foundation Lindau Nobel-prizewinners Meetings at Lake Constance. Others to have received this award include the current Executive Director of the Nobel Foundation, Michael Sohlman, and Nobel Laureates Ernst Otto Fischer and Willis Eugene Lamb.



Nobel Laureate Werner Arber was honoured with the Lennart Bernadotte Medal.

Panel Discussion During the Opening Ceremony: Opportunities and Challenges for Scientific Careers

Towards the end of the official opening ceremony, the moderator, Adam Smith, Editor-in-Chief of nobel-prize.org, invited the President of the European Commission, José Manuel Barroso and the Nobel Laureate Werner Arber to join him in a panel discussion with five selected young delegates from China, Germany, Ghana, India and the USA. This panel was asked to identify both the major opportunities and the major challenges which scientists face nowadays in pursuing their goals.

Opening the discussion, President Barroso stressed the necessity for young scientists to engage in international programmes. "If there is a field where we need to be thinking globally, it is science," he stated. "Nowadays, the problems are more and more global. But for global problems you need global solutions." As an example of a major problem requiring just such an international approach, Barroso pointed to climate change. "We in Europe, even if we all work together, we cannot solve it alone."

Go beyond the limits

Nobel Laureate Werner Arber agreed with this point of view: "There is no barrier to talking to somebody whom we appreciate as a good, qualified scientist. Our meeting here helps in this direction." Further, Arber stressed the importance of mentorship. "In my youth I profited a lot from mentorship, which helped me to find my way in research. Mentorship is a good way to get to grips with science when there is the opportunity for face-to-face contact," he said.

Both Barroso and Arber agreed that one major opportunity for science lies in interdisciplinary work. "Novel research strategies often open up a big number of possibilities. Not only in one field but in different fields," Arber explained, and Barroso concluded, "In the future, many discoveries will come precisely from this capacity to go beyond the limits of different scientific fields".



José Manuel Barroso, Werner Arber and young scientists discussed opportunities and challenges for scientific careers on a lively panel during the opening ceremony.

Negative results as a stepping stone

Open-mindedness towards other fields of research was also a major factor which Stephanie Joanna Benight, from the USA, identified when asked about the skills required for a successful scientific career. She also believed that a readiness to accept failure was crucial. "It is important to pay attention to the birth of new ideas that come through these failures," she said. Her colleague from India, Jency Thomas, agreed and argued, "Negative results should be seen as stepping stones."

Han-Shi Hu from China explained that in addition to external factors like a good mentor or fruitful international collaborations, personal traits such as confidence, interest or ambition were needed to make a good scientist. The conditions Kwaku Kyeremeh, delegate from Ghana, mentioned were in some way more tangible. Whereas, like the others, he was convinced that any scientist needed to develop a philosophy of understanding, he added "But I am working in Africa, and there I need a lot more. What I need most is collaboration and support, which can give me access to funding and the finest equipment."

Have the courage to not give up

Elias Puchner from the Elite Network of Bavaria considered local and global networks as essential, and he invited governments to take action. "Politicians should be courageous and invest in our generation on a national but also on a European level." President Barroso took the opportunity to explain that "This is exactly what we are trying to do in the European Union. But for the next period, that is until 2013, I personally believe that we need to give higher priority to science."

At the end of the discussion, Nobel Laureate Werner Arber said how impressed he was by the motivation of his young colleagues. "It's not always easy. I also had some periods of non-success. But have the courage not to give up, but to take up another question. There are so many questions around. It needs motivation and you have to be open to the whole field of chemistry or even outside chemistry – and eventually there will be success."

Foundation Dinner.

Traditionally, the festive dinner of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance takes place on the day of the opening ceremony. This brings together representatives from science, politics and business with the Council, Nobel Laureates and the Members of the Foundation's Board.

The Chairman of the Foundation's Board, Wolfgang Schürer, welcomed the guests and gave a review of the Foundation's work during the year. In all, 229 Nobel Laureates were now members of the Founders' Assembly. The Foundation was able to achieve a good result in terms of investment management – “in spite of the difficult economic environment,” as Schürer put it.

He reported on the new Memoranda of Understanding that had been signed with Egypt, Austria and Turkey in the past few months. The support of young scientists was also gaining a broader base by virtue of innovative fellowships, such as those that had been organised with the Chemical Industry Fund within the German Chemical Industry Association, the OFID Fund and Henkel AG & Co. KGaA during the year.

In concluding his remarks, Wolfgang Schürer made reference to two new projects within the 'Mission Education'. First, he spoke about the digitisation and scientific editing of lectures given by Nobel Laureates in Lindau over the past 60 years. These were now available online at www.lindau-nobel.de and represented the first phase of a unique archive of science (see also p. 116). Secondly, he drew attention to the “Discoveries” exhibition, which, to mark the occasion of the centenary of the birth of Count Lennart Bernadotte, focused on the contribution of science and research to the sustainable treatment of water as a resource (see also p. 108). The Foundation Lindau Nobelprizewinners Meetings at Lake Constance was organising this series of exhibitions, which the following year would be focusing on the topic of “Energy” and in 2011 on the theme of “System Earth”.

Finally, the Chairman of the Foundation's Board lifted his glass in a toast to the Nobel Laureate Rita Levi-Montalcini who this year celebrated her 100th birthday.



Representatives from science, politics and business met at the festive dinner of the Foundation. Among the guests of honour: HRH Princess Maha Chakri Sirindhorn and HRH Herzog Franz von Bayern, Duke of Bavaria.

In her address, H.R.H. Princess Maha Chakri Sirindhorn expressed her admiration for “the eminent value of the Lindau Meetings in promoting the global nature of science and the importance of knowledge transfer and exchange.” She made reference to the connection between science and interaction: “We can say that advances in scientific knowledge are due to the interaction among scientists, through time and space, across generations and beyond nationalities. Science is also a universal tool to stimulate the learner's curiosity and to make learning fun.”

On behalf of the Bavarian state government, the Minister of State of Sciences, Research and the Arts, Wolfgang Heubisch, welcomed the Nobel Laureates and guests of honour. “A ship will leave the island of Lindau and take them to the Isle of Mainau. Nothing symbolizes the basic idea of this event better than the traditional act of bridging the gap between two islands. For the meeting also connects – as it were – two continents: It brings together young researchers and the greatest names in their field.” Minister Heubisch thanked Countess Bettina Bernadotte and Wolfgang Schürer for organising the Nobel Laureate Meeting and expressed his delight and pride in Bavaria's donation: “We were able to grant an endowment contribution amounting to one million euros! This illustrates the high priority and appreciation we give to this meeting and to research in general.”



Held in beautiful island of Lindau, the Meeting of Nobel Laureates for me was a once in a lifetime experience as such that it made my dream come true to meet and discuss with people who have made huge contributions to science and society, further driving my interest towards scientific research and development. It also provided me with a platform to communicate ideas and works with a wider community of fellow researchers and distinguished scientist, which otherwise might not have been possible!

Garima Ghale, Nepal



Nobel Laureate Paul J. Crutzen during his lecture at the 2009 Lindau Meeting.

SCIENTIFIC PROGRAMME

Chemistry can make a crucial contribution in ensuring the survival of mankind on this overburdened planet. In the 21st century, it will play a key role when it comes to finding sustainable solutions for easing climate change, converting to renewable energies, the environmentally compatible production of goods and new materials, and fighting diseases. These opportunities were reflected in the four important areas which were the focus of the 59th Meeting of Nobel Laureates.

Lectures: Biochemistry of the Living Cell.

Almost half of this year's lectures in Lindau dealt with the biochemical basics of our lives. In researching these fundamentals, the green fluorescent protein GFP has in recent times become indispensable for researchers throughout the world. With the help of this protein, vitally important molecules within a cell can be marked and their behaviour tracked. For the discovery and development of this "intracellular marker", Osamu Shimomura, Martin Chalfie and Roger Y. Tsien received the Nobel Prize for Chemistry in 2008.

At the end of his lecture on "GFP and after", Chalfie presented four hypotheses on the nature of science, provoking some lively discussion among his audience:

1. Science is cumulative.
2. It is the students and post-docs who are the real innovators in science. It is all too easy to forget that they are the originators of some of the key details of Nobel Prize-winning ideas.
3. Basic research is essential and is the engine that drives innovation. Science cannot be done with too specific goals in mind.
4. All life should be studied, not just model organisms.

Aaron Ciechanover (Nobel Prize for Chemistry in 2004) was involved in deciphering the mechanism of the breakdown of proteins. In Lindau, he provided a historical overview of various strategies in discovering and developing medicines, as well as a look ahead to what will be possible with modern methods and on the basis of sequenced human genomes. Ciechanover divided the history of the discovery of medicines into three phases. The first phase – from 1930 to 1960 – he called the era of coincidental discoveries, one example of which was Aspirin. The second phase began in the 1970s and lasted until the turn of the millennium, although even today, many medicines are still discovered in this way. This was the era of systematic screening: “fishing in the dark with no real idea behind it” or “era of serendipity”. Consequently, the third revolution in the discovery and development of medicines has only just begun. They are designer medicines that are based on known mechanisms and are prescribed following individual adaptation: personalised medicines.



Nobel Laureate Aaron Ciechanover.

Lectures: Analysis of Surface Reactions and Climate Change.

When gases such as oxygen or hydrogen meet solid surfaces, there are basically two possible reactions: The surface helps the gas to form new compounds or the gases corrode the surface. The former happens, for example, in the transformation of carbon monoxide into carbon dioxide on platinum surfaces in the exhaust catalytic converter on cars, and the latter happens when iron rusts. Surface reactions also form the basis of the production of artificial fertilizers and the production of energy in fuel cells. As a pioneer in the research of such reactions, Gerhard Ertl was awarded the Nobel Prize for Chemistry in 2007. His lecture entitled “From Atoms to Complexity – Reactions on Surfaces” marked the opening of the meeting’s scientific programme. In Lindau, Ertl showed how with the help of modern physical methods, it became possible to observe the movement of atoms on surfaces or to plot the concentration pattern of certain gases in real time.

Surface reactions which take place on ice crystals in clouds above the South Pole accelerate the depletion of the protective ozone layer of our planet, which was significantly caused by the now prohibited chlorofluorocarbons. In 1995, Paul J. Crutzen, Mario J. Molina and F. Sherwood Rowland were awarded the Nobel Prize in chemistry for their ground-breaking work in this field. All three Laureates took time out to present their work, to participate in discussions, and to exchange ideas with the next generation of researchers.

In recent years, Crutzen has become known for his proposal for climate geoengineering, in which he has suggested infusing the atmosphere with sulphate aerosols. Computer simulations clearly show the reduction of average surface temperature induced by sulphate, although Crutzen himself is careful to emphasize that the model is simplistic. Neither did he fail to mention that any such geoengineering schemes should not neglect other efforts to reduce CO₂ concentrations.

Molina discussed the cardinal question about the climate change: What are the solutions? As Molina (and many others) have noted, at least some drastic changes in our personal and global habits would be necessary to deal with climate change. Alternative energies are key in mitigating CO₂ emissions, as is also carbon capture. Molina also noted the inclusion of nuclear power in future energy options and especially noted the safety and efficiency of the new generation of nuclear reactors. Pricing or taxing carbon emissions and further research in energy technology may also belong to this list of solutions to mitigate climate change. Molina stated that it is possible to battle cli-

mate change, and again pointed to the Montreal Protocol stemming from his own prize-winning research, which showed that cooperation between nations for the betterment of humanity is indeed possible.

Lectures: New Strategies in Synthesis.

Many chemical syntheses are not possible without mostly metallic catalysts, which give the reaction partners a helping hand without changing in themselves. Catalyst research therefore repeatedly leads to revolutionary improvements in chemical production – for example, by the introduction of so-called “metathesis”, the development of which was recognised with the award of the Nobel Prize for Chemistry in 2005. Metathesis involves the exchange of partners in certain groups of atoms between two organic molecules, each of which is characterised by a rather inert carbon double bond. This suddenly increases the scope for chemical syntheses. With the help of metathesis, medicines or synthetic materials can simultaneously be produced more environmentally friendly and also inexpensively. Metatheses are seen as opening the door to “green chemistry”, in which ecology and economics combine perfectly.

Two of the three Laureates from 2005, Robert H. Grubbs and Richard R. Schrock, took part in this year’s meeting. They stuck with the metathesis problem for twenty years and conducted patient and careful work that dealt with details such as making air- and moisture-stable catalysts, improving the yields of the reactions, dealing with a variety of different substrates and modulating the stereochemistry of the products using a wide diversity of ligands of varying size. This was made clear during Schrock’s talk at Lindau. Their incremental success was reported in a string of important papers. The incremental progress gradually led to a robust and outstanding paradigm for conducting organic reactions.

The lecture given by Ryoji Noyori about chemistry as the key to our future was also awaited with excitement. The Japanese scientist is one of the three chem-

The Meeting of Nobel Laureates was a great opportunity for me not only to meet several famous scientists, but also to get in touch with many young researchers from different countries. It was very inspiring to learn about other research projects. I will always remember the unique atmosphere at the meeting.

Tobias Beck, Germany



Nobel Laureates at the 2009 Lindau Meeting (from left):
Osamu Shimomura, Gerhard Ertl, Sir Harold W. Kroto.



ists who were awarded the Nobel Prize in 2001 because they had found ways for the clear catalytic production of chiral substances. In his lecture in Lindau, Noyori said that one of the most important tasks of chemistry today and in the future is working together with and having influence on almost all other fields of research. "It is an essential component in many interdisciplinary sciences," said the Laureate. Chemistry requires a great deal of creativity in order to identify its sheer inexhaustible possibilities. Noyori is particularly interested in the development of medicines. "Medicines are produced from organic base materials, and so naturally, besides other disciplines, chemistry plays the leading role in pharmacy." He concluded with a message to young researchers that emphasized the importance of chemical research as well as public awareness of it in the twenty-first century.

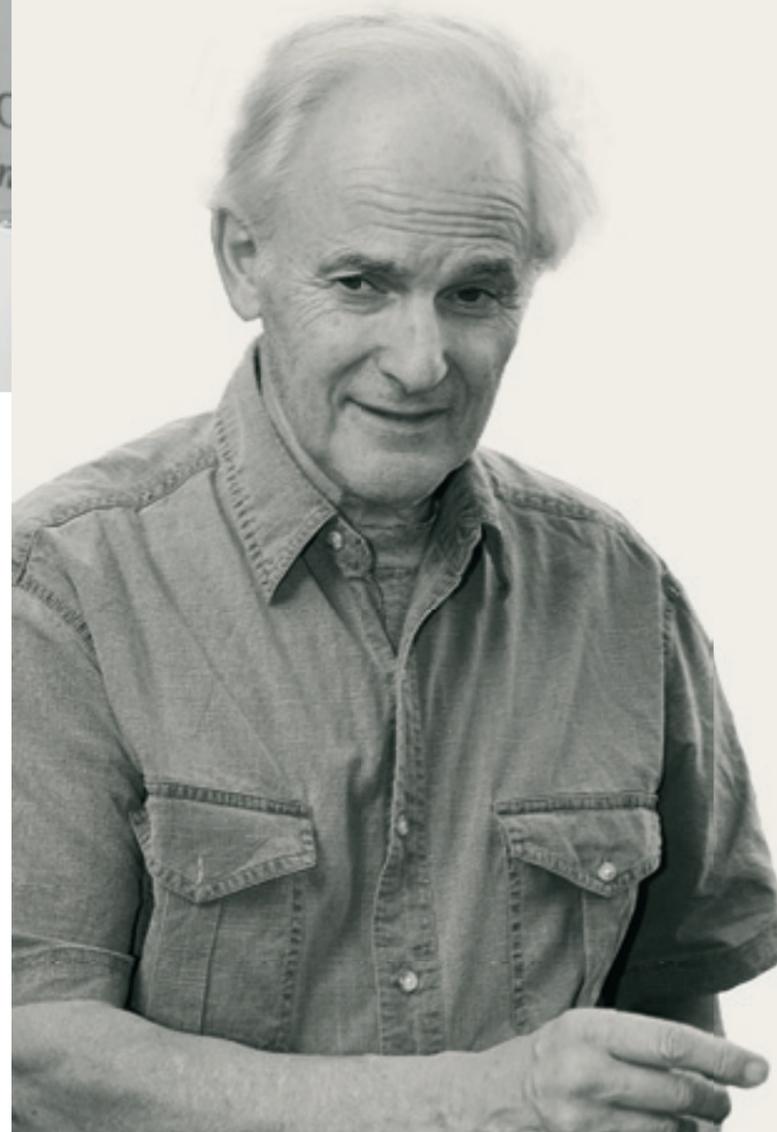
Lectures: Sustainability.

This year, the Council and Foundation of the Nobel Laureate Meetings commemorated the centenary of the birth of Count Lennart Bernadotte, the 'spiritus rector' and co-founder of the meetings. To mark this occasion, they organised the "Discoveries" exhibition on the Isle of Mainau (more about the exhibition on p. 108). Sustainability had, however, already been debated during the meeting, including the panel discussion on the role and future of renewable energies (see the summary on p. 63). The sustainable treatment of resources as well as the contribution made by chemistry in the development of sustainable materials was also highlighted in many of the Nobel Laureates' lectures.

Nobel Laureate Sir Harold W. Kroto (Chemistry 1996), gave a lecture on the subject of "Science, Society and

I would like to see the Lindau lectures streaming in a more state-of-the-art presentation format in which the presenter is shown in a dedicated video window and their data (generally powerpoint) shown in a second dedicated time-synchronised data window. We use this approach in my GEOSSET Global Educational Outreach for Science Engineering and Technology initiative (www.geoset.info and www.geoset.fsu.edu) and it is highly successful, technically relatively simple and educationally efficient.

Sir Harold W. Kroto, 1996 Nobel Laureate Chemistry



Sustainability". Some of the brightest children in the world are the most pressed for access to scientific knowledge. Kroto has started the Vega Science Trust (see website www.vegas.org.uk) which seeks to communicate the value of science and common sense thinking to children in poor countries. The Vega Science Trust offers via its website free access to interviews with Nobel Laureates and other scientists, lectures by famous scientists and many other science resources. In Lindau, Kroto emphasized the importance of the three bastions of modern information access: Google, Wikipedia and Youtube. All three constitute important forms of information access for millions of people in the future.

Kroto used his lecture in Lindau to examine what is still a contemporary dispute between science and religion. He was categorically clear that children should not be indoctrinated with their parents' religion and taught that that is the only "right" one. He has spent more than a decade teaching children to be inquisitive, critical and open-minded.

So why constantly stress the value of scientific thinking? Kroto made it clear that otherwise our future generation would not be able to make the contributions that scientists (like those at Lindau) have made, and they would not be able to reap the benefits of these discoveries. The participants in Lindau might well dwindle down to a trickle. We depend so intimately on continuous scientific discovery that we largely take it for granted. Too much of the science-religion debate ignores the simple fact that science has led to an enormous reduction in the amount of suffering in our world. As just two examples, Kroto quoted the discovery of anaesthetics and penicillin, two discoveries which were watersheds in the amelioration of human disease and suffering.

Science Education, as the Lindau Nobel Laureate Meetings have been promoting for almost 60 years, is an investment in the future – and therefore "sustainable" in the best sense of the word.

Detailed summaries of the scientific programme can be found in German and English on the official blog of the 59th Meeting of Nobel Laureates: www.scienceblogs.de/lindaunobel. Individual extracts in the text above have been taken from the blog.

Facts & Figures

Scientific Programme

MONDAY, JUNE 29 TH	TUESDAY, JUNE 30 TH	WEDNESDAY, JULY 1 ST
09:00 LECTURE (see page 46) Gerhard Ertl: From Atoms to Complexity: Reactions at Surfaces	09:00 LECTURE (see page 44) Aaron Ciechanover: From the Bench to the Bedside – the Journey to Novel Drug Development in Our Time	09:00 LECTURE (see page 30) Rudolph A. Marcus: From ‘On Water’ and Enzyme Catalysis to Single Molecules and Quantum Dots – Theory and Experiment
09:35 LECTURE (see page 46) Richard R. Ernst: Passions and Activities Beyond Science	09:35 LECTURE (see page 47) Robert Huber: Molecular Machines for Protein Degradation inside Cells	09:35 LECTURE (see page 57) Kurt Wüthrich: Structural Genomics – Exploring the Protein Universe
10:10 LECTURE (see page 53) Ryoji Noyori: The Key to our Future	10:10 LECTURE (see page 52) Erwin Neher: Chemistry Helps Neuroscience: The Use of Caged Compounds and Indicator Dyes for the Study of Neurotransmitter Release	10:10 LECTURE (see page 48) Sir Harold W. Kroto: Science, Society and Sustainability
10:45 BREAK	10:45 BREAK	10:45 BREAK
11:15 LECTURE (see page 54) F. Sherwood Rowland: Green House Gases and Climate Change	11:15 PANEL DISCUSSION (see page 63) The Role and Future of Chemistry for Renewable Energy Gerhard Ertl, Robert H. Grubbs, Walter Kohn, Sir Harold W. Kroto, Rudolph A. Marcus, Mario J. Molina, F. Sherwood Rowland Chairpersons: Astrid Gräslund (Stockholm University), Wolfgang Lubitz (Max-Planck-Institut Mülheim/Ruhr)	11:15 LECTURE Mario J. Molina: Energy and Climate Change – Is There a Solution?
11:50 LECTURE (see page 45) Paul J. Crutzen: Atmosphere Climate and Chemistry in the Anthropocene	12:25 BREAK	11:50 LECTURE (see page 48) Walter Kohn: An Earth Powered Predominantly by Solar and Wind Energy
12:25 LECTURE (see page 51) Hartmut Michel: Cytochrome c Oxidase: Structure and Mechanism of a Biological Proton Pump		12:25 LECTURE (see page 42) Peter Agre: Canoeing in the Arctic, a Scientist’s Perspective
13:00 BREAK		13:00 BREAK
15:00–17:00 SCIENTIFIC DISCUSSIONS Individual Groups Between Nobel Laureates and Young Researchers	15:00–17:00 SCIENTIFIC DISCUSSIONS Individual Groups Between Nobel Laureates and Young Researchers	15:00–17:00 SCIENTIFIC DISCUSSIONS Individual Groups Between Nobel Laureates and Young Researchers

THURSDAY, JULY 2 ND	FRIDAY, JULY 3 RD
09:00 LECTURE (see page 56) Osamu Shimomura: Chemistry of Bioluminescence	8.00 Boat Trip to the Isle of Mainau
09:35 LECTURE (see page 44) Martin Chalfie: GFP and After	
10:10 LECTURE (see page 56) Roger Y. Tsien: Building and Breeding Molecules to Spy on Cells, Tumors, and Organisms	
10:45 BREAK	
11:15 LECTURE (see page 55) Richard R. Schrock: Recent Advances in Olefin Metathesis Catalyzed by Molybdenum and Tungsten Alkylidene Complexes	11:00 PANEL DISCUSSION (see page 65) Global Warming and Sustainability Rajendra K. Pachauri (Chairman of the Intergovernmental Panel on Climate Change (IPCC), Nobel Peace Prize Winner 2007), Bjørn Lomborg (Copenhagen Business School), Mario J. Molina (University of California and Nobel Laureate Chemistry 1995), Cornelia Quennet-Thielen (State Secretary of the Federal Ministry of Education and Science), Richard R. Schrock (MIT and Nobel Laureate Chemistry 2005), Thomas Stocker (University of Bern and IPCC), Chairperson: Geoffrey Carr (Science Editor, The Economist)
11:50 LECTURE (see page 43) Werner Arber: Molecular Darwinism	
15:00–17:00 SCIENTIFIC DISCUSSIONS Individual Groups Between Nobel Laureates and Young Researchers	13:00 Opening of the Exhibition “Discoveries”

Programme Chairs of the 59th Meeting of Nobel Laureates

Astrid Gräslund received her Ph.D. in Biophysics at Stockholm University in 1974. She is Chairman of the Department of Biochemistry and Biophysics at Stockholm University since 2001. She has published 290 scientific papers in the field of molecular biophysics and biochemistry. Gräslund is Secretary of the Nobel Committee for Chemistry since 1996 and Deputy member of the Board of the Nobel Foundation since 2006. Gräslund has been a member of the Council for the Lindau Nobel Laureate Meetings since 2002.

Wolfgang Lubitz is scientific member of the Max Planck Society and Director at the Max Planck Institute for Bioinorganic Chemistry in Mülheim an der Ruhr (since 2000). His research work is focused on the investigation of catalytic metal centres in metalloproteins, the primary processes of photosynthesis and structure determinations using spectroscopic methods and quantum chemical calculations. He is a Fellow of the Royal Society of Chemistry (UK) and member of the Council for the Lindau Nobel Laureate Meetings (since 2004).



ABSTRACTS FROM THE LECTURES

Peter Agre:

CANOEING IN THE ARCTIC – A SCIENTIST'S PERSPECTIVE

As scientists, our livelihoods are supported by teaching and research, but we also have the opportunity to make observations beyond our usual confines and share these with non-scientific citizens. Growing up in my native state of Minnesota, I have always had a fascination for water and the canoe wilderness at the US-Canada boundary. These adventures have continued throughout my adult life, leading to our discovery of cellular water channels – the aquaporins. But my interest in the far north continues, and I will share some of the adventures of recent canoe journeys.

The rivers in northern Canada and Alaska provide the sustenance needed for life in a desert with drastically altering environment. Frozen solid in winter, white water torrents in spring, and smoothly moving but tranquil oases in summer, these streams provide a pathway for viewing some of the most remote landscapes on our planet. We found that the climate changed not only with the season, but the climate changed rapidly from day-to-day. Temperatures in July and August varied 32 Celsius and bright sun to freezing drizzle to bone-chilling 100 km winds leading to rapid hypothermia for those unprotected. The scenery changes from boreal pine forest to taiga, covered with stunted trees, to tundra, where permafrost maintains a seemingly endless prairie.

While life in the far north is challenging for individual organisms, selected species appear to thrive by adaptation. Fish here grow to enormous sizes feasting upon the rich insect populations, and themselves provide sustenance for inland grizzlies. Coastal seal populations frolic but serve as the major source of nutrition for the majestic polar bears. Caribou follow the succulent grasses in summer but migrate long distances to endure winter with greater protection at lower latitudes. Arctic wolves survive by following the caribou. Inuit have lived in the far north for thousands of years and have adapted to the harsh climate. But the natives face severe challenges from the loss of their predicted winter food source – migrating caribou. How they will adapt is uncertain, but interestingly, their concern is not for themselves but for the rest of us.

Werner Arber:

MOLECULAR DARWINISM

Evolutionary biology and genetics have their roots some 150 years ago, but they were developed largely independently until about 1940 when the modern evolutionary synthesis came into being. Still at that time, the postulated gene was an abstract concept without known material basis. This changed when microbial genetics was introduced in the 1940's. Very rapidly, it was discovered that DNA rather than any other biological molecule is the carrier of genetic information. It was a fortunate coincidence that a few years later the structure of DNA could be identified as long filaments of double-helical molecules. It then became clear that genetic information could be stored in the linear sequences of nucleotides of DNA. While phenotypic variations, defined as mutations in classical genetics, could be shown to be caused by DNA sequence alterations, it also became clear that by no means all DNA sequence alterations cause a phenotypic change and why this is so.

According to the neo-Darwinian theory of evolution, phenotypic variants are, together with their parental forms, the substrates for steadily exerted natural selection. The availability of genetic variants drives evolution, while natural selection, together with the available forms of life, directs evolution, and geographic and reproductive isolations modulate the process of evolution.

Efficient approaches are now available to study the molecular mechanisms that generate genetic variations. In microbial genetics, individual cases of spontaneous mutagenesis can be analysed experimentally. It has thereby become obvious that a number of different specific mechanisms are at work independently. With knowledge of these identified molecular mechanisms, one can compare DNA sequences from organisms that are more or less closely related. This allows one to draw conclusions about their evolutionary history. This approach can be applied for functional domains, single genes, groups of genes and entire genomes of any kind of living organism.

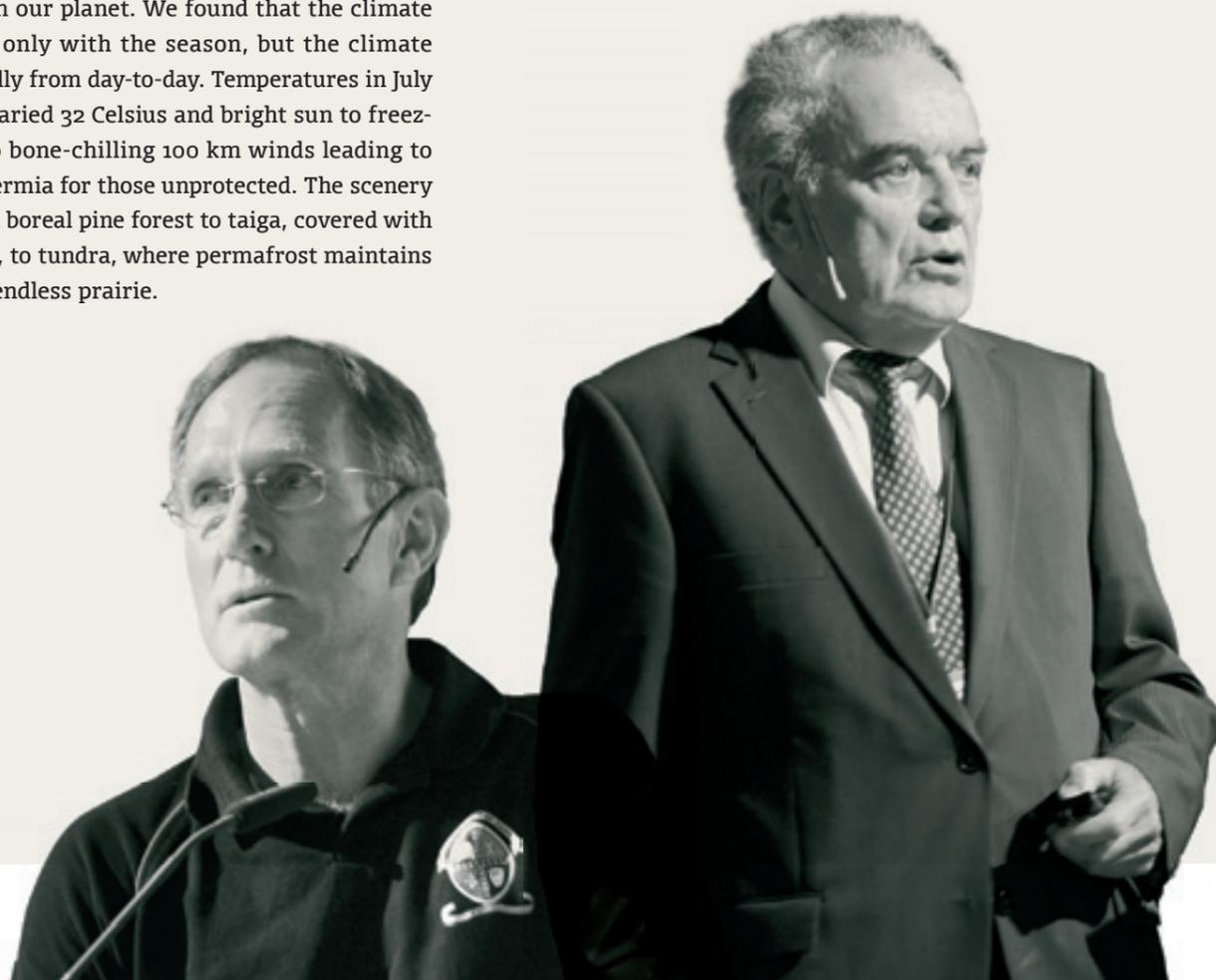
The identified molecular mechanisms of genetic variation can be classified into three qualitatively distinct natural strategies, namely: (1) local sequence changes affecting one or a few adjacent nucleotides, (2) recombinational rearrangements of DNA segments within the genome, and (3) acquisition of a foreign DNA segment by horizontal gene transfer. Selected examples of these spontaneously occurring alterations in nucleotide sequences and in the genome structure will be discussed as well as their possible functional consequences.

The theory of molecular evolution that we also call "Molecular Darwinism" is based on the acquired knowledge of genetic variation. In genetic variation, products of evolution genes are involved as variation generators and/or as modulators of the rates of genetic variation. These evolution gene products act together with several non-genetic elements that can be assigned to intrinsic properties of matter, to environmental mutagens and to random encounter. We can thus conclude that naturally occurring processes are sufficient to ensure active biological evolution. The evolution genes must have been fine-tuned for their functions by second-order selection, so that spontaneous genetic variation with different evolutionary qualities occurs at quite low rates. This ensures a relatively high genetic stability to individuals, as well as an evolutionary progress at the level of populations.

The presence of evolution genes points to a duality of the genome: While many genes act to the benefit of the individuals for the fulfilment of their lives, the evolution genes act to the benefit of an evolutionary development, for a slow, but steady expansion of life and biodiversity.

References for more detailed information:

- W. Arber, Elements for a theory of molecular evolution, *Gene*, 317, 3-11 (2003).
W. Arber, Genetic variation and molecular evolution, In: R.A. Meyers (ed.), *Genomics and Genetics*, Wiley-VCH, Weinheim, Vol. 1, 385-406 (2007).



Martin Chalfie:**GFP AND AFTER**

Since its introduction as a biological marker, the *Aequorea victoria* Green Fluorescent Protein (GFP) has had a strong impact in biology, being used in an ever-increasing variety of ways. I will review a bit of the history of GFP and show how having a genetically encoded marker that can be visualized in living tissues has affected the research in my laboratory. Instead of dwelling entirely on the past, however, I will describe some of the problems that we are currently trying to address. These problems range from the genetic control of cell differentiation to the molecular basis of mechanosensation, work that utilizes molecular genetics in the nematode *Caenorhabditis elegans*.

Aaron Ciechanover:**FROM THE BENCH TO THE BEDSIDE – THE JOURNEY TO NOVEL DRUG DEVELOPMENT IN OUR TIME**

Many important drugs such as penicillin, aspirin, or digitalis, were discovered by serendipity - some by curious researchers who noted an accidental phenomenon, some by isolation of active ingredients from plants known for centuries to have a specific therapeutic effect. Other major drugs like statins were discovered using more advanced technologies, such as targeted screening, yet, the discoverers were looking for a different effect. In all these cases, the mechanisms of action of the drug were largely unknown at the time of their discovery, and were discovered only later. With the realization that not all patients with diseases that physically and histopathologically appear to be the same - different malignancies for example - respond similarly to treatment, and their clinical behaviour is different, we have begun to understand that their molecular basis is distinct. Accordingly, we are exiting the era where our approach to treatment is "one size fits all", and enter a new one of "person-

alized medicine" where we shall tailor the treatment according to the patient's molecular/mutational profile. Here, unlike the previous era, the understanding of the mechanism will drive the development of the new drugs. This era will be characterized the development of technologies where sequencing and processing of individual genomes will be cheap (US\$ <1,000) and fast (a few min), by identification and characterization of new disease-specific molecular markers and drug targets, and by design of novel, mechanism-based, drugs to modulate the activities of these targets. It will require a change in our approach to scientific research and development and to education, where interdisciplinarity will domineer and replace in many ways the traditional, discipline-oriented approach.

Paul J. Crutzen:**ATMOSPHERIC CHEMISTRY AND CLIMATE IN THE ANTHROPOCENE**

Despite their relatively small mass, 10^{-5} of the earth biosphere as a whole, generations of ambitious 'homo sapiens' have already played a major and increasing role in changing basic properties of the atmosphere and the earth's surface. Human activities accelerated in particular over the past few hundred years, creating a new geological era, the 'Anthropocene', as already foreseen by Vernadsky in 1928: "...the direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater influence on their surroundings."

Vernadsky's predictions are more than fulfilled. Human activities are affecting, and in many cases out-competing, natural processes, for instance causing the 'ozone hole', the rise of greenhouse gases with their impact on climate, urban and regional air pollution, 'acid rain', species extinction, with all their consequences for human and ecosystem health.



Richard R. Ernst:
**PASSIONS AND ACTIVITIES BEYOND
 SCIENCE**

“Success in science requires full devotion and relentless day and night activity in the research lab!” This is a notion common among the public, and often also among teachers and new students. “Let your scientific activities become your most beloved passions, and success will not fail to arrive!” – Indeed there is much truth in this opinion. Without passion, no scientific breakthroughs will ever be achieved! But it is not the full truth. In fact, there is a world beyond science, and our humanness requires a much broader field for its full development. Without developing several of our gifts and satisfying our diverging ambitions, we will also lack the ultimate scientific insight, and we may not reach the envisioned professional goals even by working 24 hours per day. The scientific view of reality reveals only part of the truth, and we experience reality through its projection on to a lower dimensional scientific subspace.

One might caricature an ambitious scientist as a one-legged person hopping along a dusty road without any chance ever to reach the remote goal. He or she can move much more efficiently by developing a second leg beyond the scientific discipline. And the creative interaction between the professional and the passionate leg may lead ultimately to the inspiration he or she is longing for.

There is no strict rule for the selection of the second leg. Each person has to find one (or perhaps more than one) for itself. But not unexpectedly, the more remote the field of passion is from the field of professional activity, the more stable will be the stand and the more inspiring the interaction.

The lecture will be illustrated by the experiences and passionate choices of the author. He is convinced that his passions have paved the way towards scientific achievements and have enormously enriched his personal life.

Gerhard Ertl:
**FROM ATOMS TO COMPLEXITY:
 REACTIONS AT SURFACES**

The interaction of molecules with the surfaces of solids forms the basis of heterogeneous catalysis and can now be investigated in atomic detail. Systems of this kind may, on the other hand, serve as models for studying self-organisation of matter leading to some of the complex structures in nature as will be demonstrated by examples.

Robert Huber:
MOLECULAR MACHINES FOR PROTEIN DEGRADATION INSIDE CELLS

Within cells or subcellular compartments misfolded and/or short-lived regulatory proteins are degraded by protease machines, cage-forming multi-subunit assemblages. Their proteolytic active sites are sequestered within the particles and located on the inner walls. Access of protein substrates is regulated by protein subcomplexes or protein domains which may assist in substrate unfolding dependent of ATP. Five protease machines will be described displaying different subunit structures, oligomeric states, enzymatic mechanisms, and regulatory properties.

References for more detailed information:

Proteasome

- Groll, M., Ditzel, L., Löwe, J., Stock, D., Bochtler, M., Bartunik, H. D. and Huber, R. (1997) Structure of 20S proteasome from yeast at 2.4 Å resolution. *Nature* 386, 463-471.
- Groll, M., Heinemeyer, W., Jäger, S., Ullrich, T., Bochtler, M., Wolf, D. H. and Huber, R. (1999) The catalytic sites of 20S proteasomes and their role in subunit maturation: A mutational and crystallographic study. *Proc. Natl. Acad. Sci. USA* 96, 10976-10983.
- Groll, M., Bajorek, M., Köhler, A., Moroder, L., Rubin, D. M., Huber, R., Glickman, M. H. and Finley, D. (2000) A gated channel into the proteasome core particle. *Nature Struct. Biol.* 7, 1062-1067.
- Groll, M., Schellenberg, B., Bachmann, A. S., Archer, C. R., Huber, R., Powell, T. K., Lindow, S., Kaiser, M. and Dudler, R. (2008) A plant pathogen virulence factor inhibits the eukaryotic proteasome by a novel mechanism. *Nature* 452, 755-758. HslV/HslU
- Bochtler, M., Hartmann, C., Song, H. K., Bourenkov, G., Bartunik, H. and Huber, R. (2000) The structure of HslU and the ATP-dependent protease HslU-HslV. *Nature* 403, 800-805.
- Song, H. K., Hartmann, C., Ramachandran, R., Bochtler, M., Behrendt, R., Moroder, L. and Huber, R. (2000) Mutational studies on HslU and its docking mode with HslV. *Proc. Natl. Acad. Sci. USA* 97, 14103-14108.
- Ramachandran, R., Hartmann, C., Song, H. J., Huber, R. and Bochtler, M. (2002) Functional interactions of HslV(ClPQ) with the ATPase HslU(ClPY). *Proc. Natl. Acad. Sci. USA* 99, 7396-7401.

Tricorn

- Brandstetter, H., Kim, J. S., Groll, M. and Huber, R. (2001) Crystal structure of the tricorn protease reveals a protein disassembly line. *Nature* 414, 466-470.
- Kim, J. S., Groll, M., Musiol, H. J., Behrendt, R., Kaiser, M., Moroder, L., Huber, R. and Brandstetter H. (2002) Navigation inside a protease: substrate selection and product exit in the tricorn protease from *Thermoplasma acidophilum*. *J. Mol. Biol.* 324, 1041-1050.
- Goettig, P., Groll, M., Kim, J. S., Huber, R. and Brandstetter, H. (2002) Structures of the tricorn interacting aminopeptidase F1 with different ligands explain its catalytic mechanism. *EMBO J.* 21, 5343-5352.

Dipeptidyl peptidase IV

- Engel, M., Hoffmann, T., Wagner, L., Wermann, M., Heiser, U., Kiefersauer, R., Huber, R., Bode, W., Demuth, H. U. and Brandstetter, H. (2003) The crystal structure of dipeptidyl peptidase IV (CD26) reveals its functional regulation and enzymatic mechanism. *Proc. Natl. Acad. Sci. USA* 100, 5063-5068.

DegP(HtrA)

- Krojer, T., Garrido-Franco, M., Huber, R., Ehrmann, M., and Clausen, T. (2002) Crystal structure of DegP (HtrA) reveals a new protease-chaperone machine. *Nature* 416, 455-459.
- Krojer, T., Pangerl, K., Kurt, J., Sawa, J., Stingl, C., Mechtler, K., Huber, R., Ehrmann, M. and Clausen, T. (2008). Interplay of PDZ and protease domain of DegP ensures efficient elimination of misfolded proteins. *Proc. Natl. Acad. Sci. USA* 105, 7702-7707.
- Krojer, T., Sawa, J., Schäfer, E., Saibil, H. R., Ehrmann, M. and Clausen, T. (2008). Structural basis for the regulated protease and chaperone function of DegP. *Nature* 453, 885-890.



Walter Kohn:

AN EARTH POWERED PREDOMINANTLY BY SOLAR AND WIND ENERGY

I shall present and explain the thesis that mankind is on the threshold of a dramatic transition: from an earth, predominantly powered by oil and other fossil fuels, with unsustainable global warming, to a new earth predominantly powered by "clean" solar and wind energy with greatly reduced global warming. A common choice for the transition point is "peak oil", when global oil-production peaks and begins to decline. I suggest that "peak-oil per capita" is more useful. While "peak-oil" may be 15 or more years in the future, "peak-oil per capita" is practically upon us because of the still rapidly rising world population. My best estimate is 2015 with an uncertainty of a few years. I shall discuss the great urgency for preparing as best as possible for this impending global transformation.

Sir Harold W. Kroto:

SCIENCE, SOCIETY AND SUSTAINABILITY

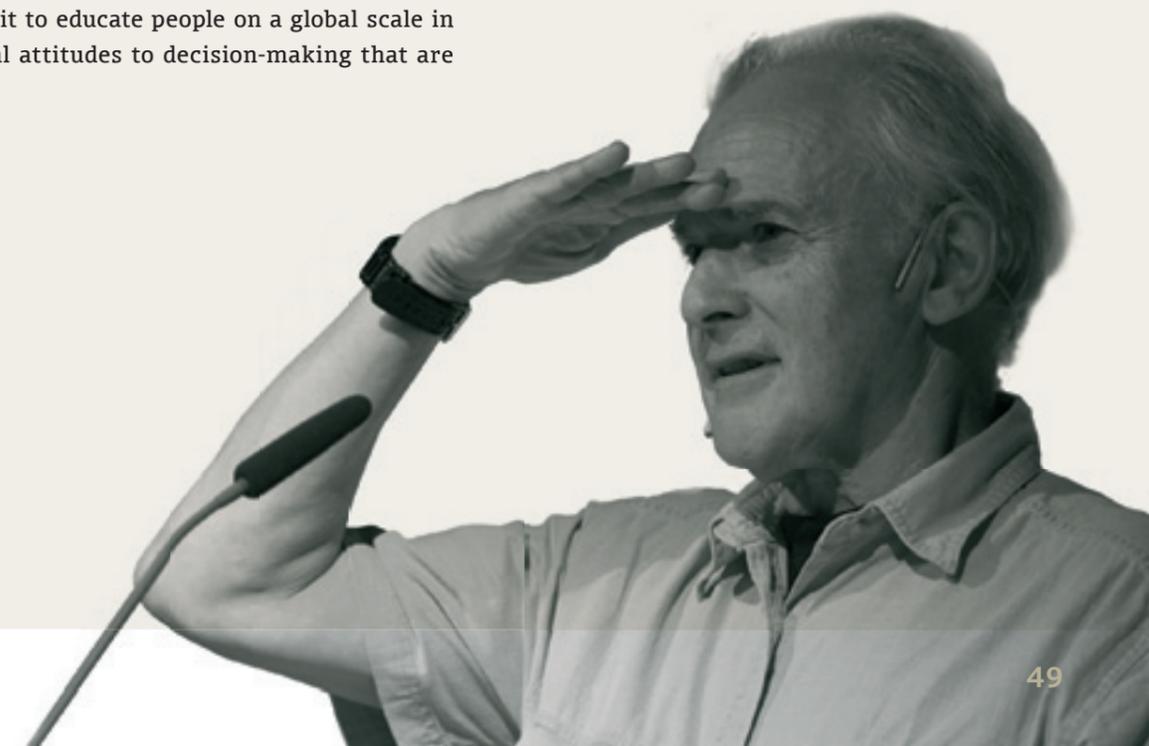
The fact that our modern world is so completely and precariously balanced on Science, Engineering and Technology (SET) makes an understanding of these disciplines by all in positions of significant responsibility vital. Although wise decision-making may not be guaranteed by knowledge, common sense suggests that wisdom is not a likely consequence of ignorance. So far SET have truly revolutionised our lives and there is no doubt that the humanitarian contributions have improved the quality of life in the developed world immeasurably. It is worth reminding ourselves that, for instance, in the 18th Century half of all children died by the age of 8. It is also worth reflecting on the fact that this improvement was brought about by scientific/technological advances based on doubt and questioning – evidence dependent philosophies totally at variance with the belief-based concepts that underpin all mystical societal attitudes. The conflict between these two orthogonal philosophies is nowhere more obvious than in the recent avalanche of attempts to undermine the validity of Darwin's Theory of Evolution and in particular corrupt the intellectual integrity of our educational system. The fact that this is taken at all seriously indicates a level of basic public gullibility which is being wilfully and maliciously exploited by intellectually corrupt organisations focused primarily on undermining the rational principles that led to Democracy and the Enlightenment. The mindless

acceptance of the claims is hard to credit when one considers that almost everyone in the western world has benefited from the socio-economic advances of SET – in particular medical advances based on a deep understanding of the evolutionary process.

Society has the power to use technology so that it can be of benefit or be detrimental. On the latter score one should note that political decisions have resulted in the existence of some 28,000 nuclear weapons worldwide. In addition, it now appears that our technologies may well have also catalysed a mindless mass-production driven plundering of the Planet's resources. We may be hurtling towards disaster - we may not need an asteroid. For a 50:50 chance of surviving into the next century every segment of society, from industrialists, engineers and scientists to politicians, farmers and fishermen must now recognise that these issues are the most serious that the human race has ever confronted. Our only hope for survival rests on the shoulders of those who take survival and sustainability issues seriously - and do something about it.

I see a key role for "Nanoscience and Nanotechnology" which is arguably – and I would argue it – just a new name for Chemistry where this discipline overlaps Condensed Matter Physics, Molecular Biology and Materials Engineering. I also see improved SET education as vital. We have manifestly failed in this endeavour but there may be one last hope: The Internet is a major new communications technology which we must exploit to educate people on a global scale in the rational attitudes to decision-making that are

now vital to our very survival. With the Vega Science Trust, (www.vega.org.uk), we have made over 200 TV and Internet programmes (almost half shown on the BBC). It is a highly successful platform for scientists to communicate directly and improve public awareness and understanding of SET. With an exciting new Global Educational Outreach for Science Engineering and Technology (GeoSet, www.geoset.info) initiative we are working with other universities to make outstanding educational material available in any part of the world. The major aim is to empower teachers, worldwide, by giving them access to the best teaching material, packaged for direct use in the classroom, together with expert examples of how the material might best be presented.



Rudolph A. Marcus:**FROM 'ON WATER' AND ENZYME CATALYSIS TO SINGLE MOLECULES AND QUANTUM DOTS – THEORY AND EXPERIMENT**

Much of theoretical chemistry has involved equations and their application to experiments, Debye, Debye-Hueckel, Transition State Theory, Kramers, LCAO, RRKM, among others. In fortunate circumstances one can, as in a theory of electron transfer reactions, relate different experiments to each other without adjustable parameters, and indeed make predictions without computations. More recently a major focus in theoretical chemistry has been on computations for individual systems, on the specific rather than on the generic, and not on equations relating data in different fields. In practice the two approaches are complementary.

We choose for illustration two or three of the following topics where analytical theory, sometimes complemented by computation, is used to treat novel phenomena: catalysis of organic 'on-water' reactions in emulsions¹, enzyme catalysis, including several specific effects, the temperature independence of the H/D kinetic isotope effect for some enzymes operating under their natural conditions², an abnormal change in the Arrhenius pre-exponential factor for the catalytic rate of a thermophilic enzyme operating below its break-point temperature² (an analogy to a glass transition), predictions relating single mol-

ecule enzyme catalysis to other single molecule properties³, and a topic drawn from the nanoparticle field, the intermittent fluorescence of semiconductor nanoparticles, interpreted in terms of an electron transfer, structural diffusion, and trap surface states theory⁴. In particular what can be learned from single-molecule studies? Are they and the usual bulk ensemble studies complementary?

The research topics were each stimulated by puzzles arising from the experiments.

References for more detailed information:⁵

1. Y. Jung & R. A. Marcus, *J. Am. Chem. Soc.* 129, 5492 (2007).
2. R. A. Marcus, in *Quantum Tunneling in Enzyme Catalyzed Reactions*, R. Allemann & N. S. Scrutton, eds. (2009).
3. M. K. Prakash & R. A. Marcus, *Proc. Nat. Acad. Sci. USA* 104, 15982 (2007) and *J. Phys. Chem. B* 112, 399 (2008).
4. J. Tang & R. A. Marcus, *J. Chem. Phys.* 123, 054704 (2005) and P. Frantsuzov & R. A. Marcus, *Phys. Rev. B* 72, 155321 (2005).
5. These references contain citations of the large body of experiments in these fields.

Hartmut Michel:**CYTOCHROME C OXIDASE: STRUCTURE AND MECHANISM OF A BIOLOGICAL PROTON PUMP**

In biology, membranes are barriers for the transport of ions and polar substances. Biological membranes are even electric insulators. These properties have allowed nature to use mitochondrial and bacterial membranes for energy transduction via electric voltages (potentials) and ion gradients. Cytochrome c oxidase is an enzyme which transfers electrons from cytochrome c onto oxygen and consumes protons to form water as a product. This reaction creates an electric voltage and a pH difference across the membrane, because cytochrome c delivers its electrons from the outer surface of the membrane whereas the protons originate from the inner surface of the mitochondria or bacteria. In addition, the enzyme translocates ("pumps") four protons from the inner to the outer surface per reaction cycle enhancing both electric voltage and the pH difference. This so-called "electrochemical proton gradient" drives protons back via the ATP-synthase lead-

ing to the synthesis of the universal biological energy carrier adenosine-5'-triphosphate ("ATP") from adenosine-5'-diphosphate ("ADP") and inorganic phosphate. The reaction catalysed by the cytochrome c oxidase is understood insufficiently and the subject of controversial discussions. The active site of the enzyme, where oxygen is reduced and water is formed, consists of a heme-iron and a copper atom. It is located in the center of the membrane. There are proton transfer pathways in the enzyme which allow and control the access of protons, required for water formation, to active site. One of these pathways is also used for protons to be pumped. However, it is unclear, for example, which chemical entity is bound to the active site when the enzyme is in its oxidized form. The author's view, based on X-ray structures of the enzyme, will be presented.



Erwin Neher:**CHEMISTRY HELPS NEUROSCIENCE: THE USE OF CAGED COMPOUNDS AND INDICATOR DYES FOR THE STUDY OF NEUROTRANSMITTER RELEASE**

Synaptic transmission is a complicated process by which two neurones communicate with each other. The 'presynaptic' neuron sends a signal by releasing a substance, the neurotransmitter. This diffuses across a thin gap to the receiving or 'postsynaptic' neuron. Binding to special receptors, the neurotransmitter opens ion channels in the membrane leading to an electrical signal. This three step process:

- a nerve impulse being converted into a chemical signal
- diffusion of that chemical
- conversion back into an electrical signal

happens within a fraction of a millisecond. My laboratory concentrates on the presynaptic aspects, the mechanisms by which an electrical impulse releases neurotransmitter. It has been known since the early 1960s that this process is initiated by an influx of calcium ions into the presynaptic nerve terminal. This leads to an increase in intracellular calcium concentration ($[Ca^{++}]_i$), which – in turn – causes small vesicles (which contain the neurotransmitter) to fuse with the cell membrane and to release their contents. It has also been known for a long time that the Ca^{++} influx occurs through ion channels, which are specific for the permeation of Ca^{++} ions and which open in response to the nerve impulse. These channels must be located very close to synaptic vesicles. Only at close distance can they elicit the release within a short enough time. However, it has not been known until recently how short the distances between ion channels and vesicles are and what the amplitude and time course of the local Ca^{++} signal must be, in order to elicit the proper response.

Here, chemistry made a first contribution by making available so-called Ca^{++} indicator dyes (Grynkiewicz et al., 1985). These are fluorescent molecules, which bind calcium ions and, upon binding, change their fluorescence. Cells can be loaded with such substances and one can observe under the fluorescence microscope localized changes in fluorescence, which mirror local changes in $[Ca^{++}]_i$. This way many features of the Ca^{++} signal can be studied.

However, these so-called Ca^{++} imaging studies are limited by the spatial resolution of light microscopy. This means that no details of Ca^{++} signals can be observed on the length scale of 100 nm and shorter. This, however, is exactly the range of distances, which are relevant for the assemblies of Ca^{++} channels and synaptic vesicles. One can estimate by biophysical modeling, that a channel at 8 nm distance from a vesicle has an impact 10000 times stronger than a channel at 80 nm distance. The actual distance is probably in between these two values, which both are below the resolution limit of light microscopy.

In order to obtain more insight into the properties of the relevant Ca^{++} signal we borrowed another tool from chemistry: caged Ca^{++} . Such compounds, e.g. DM nitrophen are chelators, which bind Ca^{++} tightly, but are light sensitive (Ellis-Davies & Barsotti, 2005). Exposure to a flash of UV-light causes them to disintegrate and to quickly release Ca^{++} . This way we can increase $[Ca^{++}]_i$ in a step-like fashion. We use a special large nerve terminal, the Calyx of Held, which can be loaded with both a Ca^{++} indicator dye and a caged Ca^{++} compound. $[Ca^{++}]_i$ is increased by a flash of UV-light while the response of the postsynaptic cell is measured. The increase of $[Ca^{++}]_i$ is spatially uniform in this experiment, such that the $[Ca^{++}]_i$, which we measure by means of the indicator dye is the same,

Ryoji Noyori:**CHEMISTRY: THE KEY TO OUR FUTURE**

Chemistry is not merely a science of making observations in order to better understand Nature. Our science is creative and productive, generating substances of very high value from almost nothing. Chemists already have made an enormous contribution to the progress of science and technology at large. One clear direction, both now and in the future, of this core science is to merge with other fields to produce more interdisciplinary science. In view of its significance, chemistry demands the highest level of scientific creativity and insight to explore its limitless possibilities. Furthering our understanding of precise biological mechanisms will lead to the discovery of rational, more effective pharmaceuticals in the post-genome era. Chemical synthesis provides a logical basis for rapidly growing biosciences and material sciences. Catalysis has been, and will remain, one of the most important research subjects, because this is the only rational means of producing useful compounds in an economical and environmentally benign way. Ideally, we should aim at synthesizing target compounds with a 100% yield and 100% selectivity and avoid the production of waste. Such Green Chemistry is creative and brings about prosperity, and at the same time takes responsibility for society at large. In fact, the state-of-the art of our science, coupled with industrial endeavors, determines the quality of life. Close involvement with society is the destiny of science. Our efforts will be directed toward solving a range of existing, or even unforeseen, social and global issues associated with health, food, materials, energy, and environments. I am very much certain that our successors worldwide will create new values in the 21st century through chemistry.

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which acts on the vesicle. Thus, we can establish a quantitative relationship between the speed of the response and the amplitude of the $[Ca^{++}]_i$ signal. Once we have established such a 'dose-response-curve', we can ask what $[Ca^{++}]_i$ is required to achieve a response as fast and large as the physiological one. Such reasoning, together with a more quantitative biophysical model of the release mechanism, allows one to conclude, that the effective Ca^{++} signal at the location of the vesicle has an amplitude of about 20 μM and lasts for less than a millisecond (see Neher & Sakaba, 2008, for review). Further biophysical modeling shows that such signals are expected to occur at distances of 30 to 50 nm from Ca^{++} channels, when these open for sub-millisecond periods.

References for more detailed information:

- Ellis-Davies, G.C.R. and R.J. Barsotti (2006). Tuning caged calcium: Photolabile analogues of EGTA with improved optical and chelation properties. *Cell Calcium* 39, 75-83.
- Grynkiewicz, G., Poenie, M. and R.Y. Tsien (1985). A new generation of Ca^{2+} indicators with greatly improved fluorescence properties. *J. Biol. Chem.* 260, 3440-3450.
- Hell, S.W. (2009). Microscopy and its focal switch. *Nat. Methods* 6, 24-32.
- Neher E. and T. Sakaba (2008). Multiple roles of calcium ions in the regulation of neurotransmitter release. *Neuron* 59, 861-87



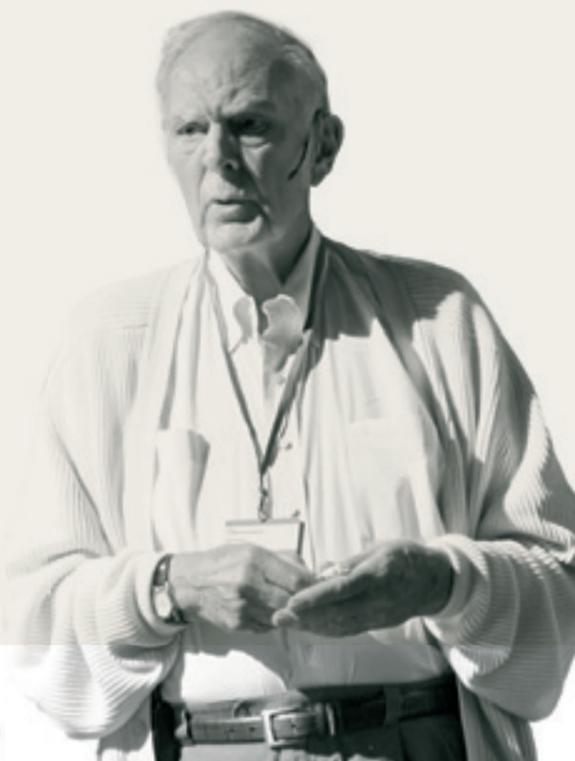
F. Sherwood Rowland:**GREENHOUSE GASES AND CLIMATE CHANGE**

The "greenhouse gases (GHG)" intercept a fraction of outgoing terrestrial infrared radiation, creating the natural greenhouse effect which warmed the atmosphere by approximately 32° Celsius at the beginning of the 20th century. The activities of mankind have caused several of these gases to increase in atmospheric concentration during the past century, raising the atmospheric temperature by another 0.7° Celsius. Carbon dioxide, the most prominent GHG is released primarily by the burning of the "fossil" fuels coal, oil and natural gas, and has increased from 315 ppmv (parts per million by volume) in 1958 to 388 ppmv in 2008. Methane increased about 1% per year in the 1980s from 1.52 ppmv, but has slowed down to a nearly constant 1.78 ppmv from 2000 to 2008. Nitrous oxide (N₂O) and ground level ozone (O₃) are also steadily increasing in concentrations. The increase in GHGs will warm the Earth much more during the 21st Century unless controls on these gases are rapidly put in place.

The chlorofluorocarbons (CCl₂F₂, CCl₃F, etc.) are not only GHG contributors but also the suppliers of atomic chlorine to the upper atmosphere, causing the loss of stratospheric ozone. Every September since the mid-1980s a rapid loss of ozone occurs in a few weeks over the South Polar area, resulting in the formation of the well-known Antarctic Ozone Hole, which fades away in mid-spring (November). These losses in stratospheric ozone led in 1987 to the international adoption of the Montreal Protocol which banned the further manufacture and release of the chlorofluorocarbon gases.

This Protocol has now been in effect for 22 years, and has been very successful. Nevertheless, the Antarctic ozone loss will occur throughout the 21st century because of the long survival lifetimes of the CFCs which have already been released.

Feedback processes involving reductions in reflectance (albedo) from ice to water, or from snow to rock cause enhanced warming in the Polar north, and the climate is changing rapidly in the Arctic with substantial biological effects.

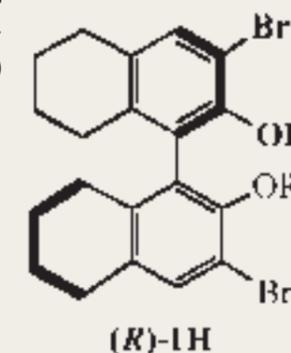
**Richard R. Schrock:****RECENT ADVANCES IN OLEFIN METATHESIS CATALYZED BY MOLYBDENUM AND TUNGSTEN ALKYLIDENE COMPLEXES**

In the process of preparing M(NR)(CHCMe₂R')(OR')₂ (R' = Me or Ph) species (or analogs that contain enantiomerically pure biphenolate or binaphtholate ligands) in situ by treating M(NR)(CHCMe₂R')(pyrrolide)₂ species with alcohols, we have discovered M(NR)(CHCMe₂R')(OR)(pyrrolide) (MonoAlkoxidePyrrolide or MAP) complexes (M = Mo or W). *i* MAP complexes are chiral at the metal by virtue of having four different covalently bound ligands. When the alcohol is enantiomerically pure then M(NR)(CHCMe₂R')(OR*)(pyrrolide) diastereomers are formed. MAP species are remarkably active olefin metathesis catalysts (as much as 100x more active than the best bisalkoxide or diolate catalysts for a given transformation) and highly enantioselective. Catalyst loadings are typically <1%. A dramatic example of the efficacy of these new catalysts is Mo(NAr)(CHCMe₂Ph)(Me₂Pyr)(1) (where Ar = 2,6-diisopropylphenyl, Me₂Pyr = 2,5-dimethylpyrrolide, and 1 is derived from (R)-1H where R = Si(t-Bu)Me₂), which serves as an initiator for an asymmetric ring-closing of an intermediate in the enantioselective synthesis of the Aspidosperma alkaloid, quebrachamine, a reaction that yielded no product when asymmetric Mo(NR)

(CHR')(diolate) catalysts were employed. *ii* Mo(NAr)(CHCMe₂Ph)(Me₂Pyr)(1) can be prepared in situ and is effective (95% ee) at relatively low loadings as a 7:1 mixture of diastereomers. New findings include (inter alia) the use of MAP complexes for Z- and enantioselective ring-opening/cross metathesis reactions, *iii* for the ROMP synthesis of polymers with new structures, and for Z-selective metatheses of internal olefins.

References for more detailed information:

- i* Schrock, R. R. Chem. Rev. 2009, 109, online 3/13.
- ii* Malcolmson, S. J.; Meek, S. J.; Sattely, E. S.; Schrock, R. R.; Hoveyda, A. H. Nature 2008, 456, 933-937.
- iii* Ibrahim, I.; Yu, M.; Schrock, R. R.; Hoveyda, A. H. J. Am. Chem. Soc. 2009, 131, 3844-3845.



Osamu Shimomura:**CHEMISTRY OF BIOLUMINESCENCE**

There are numerous kinds of luminous organism on earth. Mysterious emission of light from them inspired the curiosity of mankind ever since the ancient times. In history, Raphael Dubois discovered luciferin and luciferase from one of them, a click beetle, in 1885. Then, the chemical secret of some of the bioluminescent organisms began to be uncovered in the 1940s. In the following half a century, the chemical structures of 9 different luciferins were determined and the mechanisms of their light-emitting reactions were elucidated at least in part.

According to our present knowledge, bioluminescence reactions can be divided into 3 types: luciferin-luciferase type, photoprotein type, and the others. The luciferin-luciferase type includes the bioluminescence reactions of the firefly, luminous bacteria, the ostracod *Cypridina*, coelenterazine, fresh water limpet *Latia*, earthworm, krill, dinoflagellates, and the Bermuda fire worm *Odontosyllis*. The photoprotein type includes the bioluminescence reactions of various coelenterates (*Aequorea*, *Obelia*, *mitrocoma*, etc), ctenophores, the tubeworm *Chaetopterus*, the scale worms, the clam *Pholas*, the squid *Symplectoteuthis*, and the millipede *Luminodesmus*. As to "the others", only one kind of bioluminescence system is presently known: the luminous fungi.

Today, some of the bioluminescence reactions are used as indispensable analytical tools in various fields of science: for example, the firefly luminescence reaction for measuring ATP; Ca^{2+} -sensitive photoproteins for monitoring the intracellular Ca^{2+} ; certain analogues of *Cypridina* luciferin for measuring superoxide anion; and the green fluorescent protein (GFP) as a marker protein in the field of biomedical research.

Roger Y. Tsien:**BUILDING AND BREEDING MOLECULES TO SPY ON CELLS, TUMORS, AND ORGANISMS**

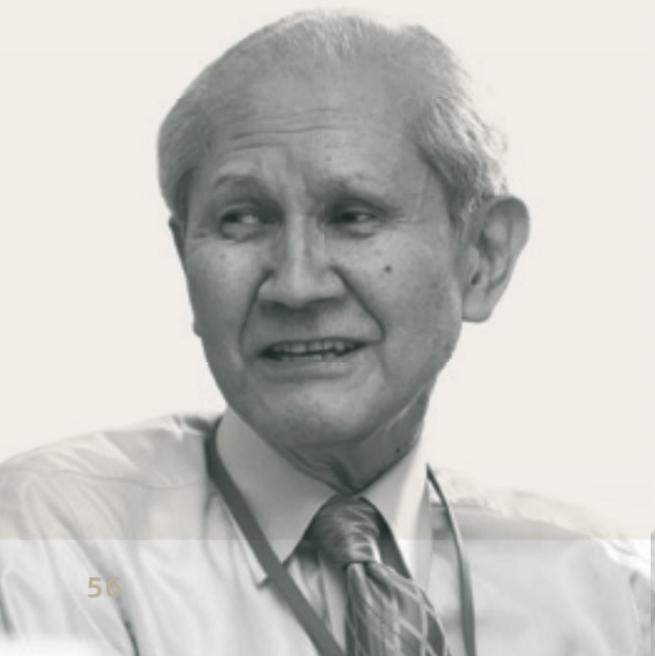
Molecules to observe and manipulate biological systems can be devised by a variety of strategies, ranging from pure chemical design and total synthesis to genome mining and high-throughput directed evolution. Examples of both successes and failures will be chosen mainly from my own experience, including calcium and sodium indicators, caged second messengers, molecular voltmeters and photomultipliers, fluorescent proteins, genetically encoded indicators of intracellular biochemistry, and clinically applicable peptides to target human tumors.

Kurt Wüthrich:**STRUCTURAL GENOMICS – EXPLORING THE PROTEIN UNIVERSE**

In today's post-genomic era, with the availability of the complete DNA sequences of a wide range of organisms, structural biologists are faced with new opportunities and challenges in "structural genomics". In contrast to classical structural biology, research in structural genomics is focused on gene products with unknown structures, unknown functions, and minimal similarity to previously studied proteins. A precisely formulated goal of structural genomics is to determine representative three-dimensional structures for all protein families, which requires 'high-throughput' technology for protein production and structure determination, and the long-term outlook is to predict physiological protein functions from knowledge of new three-dimensional structures. The California-based Joint Center for Structural Genomics (JCSG; PI Dr. Ian A. Wilson) is one of four large-scale consortia in the NIH-funded Protein Structure Initiative (PSI). The JCSG developed and operates an extensively automated high-throughput pipeline for protein production, crystallization and crystal structure determination. However, there remain gaps in the coverage of protein fold space that arise because certain proteins are not readily amenable to crystal structure determi-

nation. My research team (the "NMR Core") works on filling such gaps with a 'high-output' approach, which involves novel strategies of target selection as well as new technology for NMR structure determination. When compared to structure determination by X-ray crystallography, the NMR method is complementary by the fact that atomic resolution structure determination and measurements of supplementary function-related data can be performed under solution conditions that can be very close to the physiological milieu in body fluids. By generating data on protein structure stability, dynamics and intermolecular interactions in solution, NMR has an exciting role also in the longer-term challenge leading from the expanding protein structure universe to new insights into protein functions, chemical biology and biomedical applications.

The JCSG is supported by the National Institute of General Medical Sciences, Protein Structure Initiative: Grant U54 GM074898.





Nobel Laureate Richard R. Ernst signing the book "Nobels".

Facts & Figures

Results from the Participant Survey, Part II

"The Meetings of Nobel Laureates in Lindau set new standards for our dialogue about science and research – I am confident that this year's meeting will continue this tradition," said the Federal Minister of Research, Annette Schavan, during the opening ceremony. In order to be able to prepare an excellent meeting, both in terms of content as well as organisation, the participants' feedback is taken into account when compiling the programme. The entire scientific programme has received very positive ratings and the results also show that, compared to previous years, it had been possible to achieve improvements in the areas of the database, the provision of information and the catering. The newly devised opening ceremony was also rated more highly than in the previous years (40% Excellent, 47% Good, in 2008: 25% Excellent, 44% Good).

PLEASE ASSESS THE FOLLOWING PARTS THE PROGRAMME

General Impression of the Scientific Programme (Total 616)

Excellent	371	60%	<div style="width: 60%;"></div>
Good	215	35%	<div style="width: 35%;"></div>
Fair	22	4%	<div style="width: 4%;"></div>
Poor	8	1%	<div style="width: 1%;"></div>

Panel Discussion "The Role and Future of Chemistry for Renewable Energy" (Tuesday) (Total 524)

Excellent	148	28%	<div style="width: 28%;"></div>
Good	224	43%	<div style="width: 43%;"></div>
Fair	125	24%	<div style="width: 24%;"></div>
Poor	27	5%	<div style="width: 5%;"></div>

Plenary Lectures (Mornings) (Total 515)

Excellent	207	40%	<div style="width: 40%;"></div>
Good	267	52%	<div style="width: 52%;"></div>
Fair	29	6%	<div style="width: 6%;"></div>
Poor	12	2%	<div style="width: 2%;"></div>

Student Discussions with Laureates (Afternoons) (Total 519)

Excellent	193	37%	<div style="width: 37%;"></div>
Good	242	47%	<div style="width: 47%;"></div>
Fair	79	15%	<div style="width: 15%;"></div>
Poor	5	1%	<div style="width: 1%;"></div>

Opening Ceremony (Total 433)

Excellent	173	40%	<div style="width: 40%;"></div>
Good	204	47%	<div style="width: 47%;"></div>
Fair	51	12%	<div style="width: 12%;"></div>
Poor	5	1%	<div style="width: 1%;"></div>

Get-Together Evening (Monday) (Total 488)

Excellent	265	54%	<div style="width: 54%;"></div>
Good	183	37%	<div style="width: 37%;"></div>
Fair	37	8%	<div style="width: 8%;"></div>
Poor	3	1%	<div style="width: 1%;"></div>

ORGANISATION OF THE MEETING

› ORGANISATION			
Overall Organisation			(Total 515)
Excellent	343	67 %	
Good	158	31 %	
Fair	11	2 %	
Poor	3	<1 %	
Registration Desk			(Total 463)
Excellent	327	70 %	
Good	128	28 %	
Fair	8	2 %	
Poor	0		
Information Provided			(Total 508)
Excellent	273	54 %	
Good	191	37 %	
Fair	39	8 %	
Poor	5	1 %	
› DATA BASE (FOR NOMINATION)			
Navigation			(Total 480)
Excellent	172	36 %	
Good	252	53 %	
Fair	49	10 %	
Poor	7	1 %	
Usability			(Total 487)
Excellent	283	56 %	
Good	188	37 %	
Fair	28	6 %	
Poor	7	1 %	
› COMMUNICATIONS			
Internet Access at Inselhalle			(Total 506)
Excellent	283	56 %	
Good	188	37 %	
Fair	28	6 %	
Poor	7	1 %	
Internet Access at Accommodation			(Total 448)
Excellent	98	21 %	
Good	75	17 %	
Fair	68	15 %	
Poor	207	46 %	
Homepage			(Total 488)
Excellent	145	30 %	
Good	281	57 %	
Fair	47	10 %	
Poor	15	3 %	

› ACCOMMODATION			
Standard of your Accommodation			(Total 513)
Excellent	168	33 %	
Good	246	48 %	
Fair	81	16 %	
Poor	18	3 %	
Location of your Accommodation			(Total 502)
Excellent	220	44 %	
Good	133	27 %	
Fair	98	19 %	
Poor	51	10 %	
Accessibility by Public Transport			(Total 428)
Excellent	153	36 %	
Good	175	41 %	
Fair	70	16 %	
Poor	30	7 %	
› CATERING			
Overall Quality of Meals in Tent			(Total 504)
Excellent	76	15 %	
Good	239	47 %	
Fair	160	31 %	
Poor	29	6 %	
Variety of Food			(Total 505)
Excellent	45	9 %	
Good	169	33 %	
Fair	194	38 %	
Poor	97	19 %	



It was indeed an auspicious gathering well prepared and organised. I feel honoured and induced to have been part of such a high profile scientific learning experience. I take with me the wonderful memories with committed vigour – invigorating renewable Lindau energy with ripple effects – I intend to chase that award of Noble Prize with extra zeal transmitted by this gathering.

Humaira Seema, Pakistan



The first of two panel discussions brought together Nobel Laureates to discuss opportunities for chemistry in the field of renewable energy.



PANEL DISCUSSION

THE ROLE AND FUTURE OF CHEMISTRY FOR RENEWABLE ENERGY.

On Tuesday, after the first session of lectures, seven Nobel Laureates, namely Professors Gerhard Ertl, Robert H. Grubbs, Walter Kohn, Sir Harold W. Kroto, Rudolph A. Marcus, Mario J. Molina and F. Sherwood Rowland took part in a panel discussion. The high-calibre team took on the issue of opportunities for chemistry in the field of renewable energy and was moderated by the scientific co-ordinators of the meeting, Astrid Gräslund from Stockholm University (Sweden) and Wolfgang Lubitz from the Max-Planck Institute for Bioinorganic Chemistry (Germany).

Energy cannot be produced.

At the beginning of the discussion, Nobel Laureate Ertl gave a reminder that energy cannot be produced or created because the amount of energy is constant. Energy could only be transformed. "The question is just how we can transform available energy into useable energy." In his opinion, photovoltaics with silicon might be an efficient solution for the future. Just like Ertl, Walter Kohn also emphasized the significance of solar energy. "There is a huge amount of solar energy available. There is still a huge but smaller amount of wind energy available. We are challenged to turn this vast amount into useful energy," he concluded.

On the other hand, Robert H. Grubbs stressed the importance of the materials area. "That's really critical and many times left out in the discussion on climate change." He stated that light composites were the enabling technology to increase the efficiency of transport or build larger, more efficient windmills. New materials could also help to make solar energy cheaper.

It is a matter of costs.

Mario J. Molina argued in his introductory statement that it was not only a question of scientific ideas but also of society's eagerness to invest. "We can already convert solar energy to electricity. But it is a matter of costs. In order to be competitive with fossil energy,

the costs have to go down by a factor of four or five." He concluded that chemistry had to be creative and come up with cheaper methods.

"One of the attractions of this whole problem of solar energy conversion is the intellectual aspects involved," Rudolph A. Marcus stated, inviting young researchers to turn to this area of research. "We need a lot of interaction of thoughtful ideas and experiments in this field. The whole thing is not only of importance for society but it is an intellectual challenge, too."

If trees can do it, we should be able to do so.

For Sir Harold W. Kroto the most probable solution was to split water into hydrogen and oxygen and thus take nature as an example. "If stupid trees can do it, we should be able to do so, but unfortunately trees are not that stupid. Besides, they spent millions of years trying to find out how to do it. It's not trivial." Kroto is rather critical in judging the success of the different scientific approaches: "All the non-scientists think we will solve this problem – but it is not clear we shall."

Therefore, F. Sherwood Rowland did not focus on the transformation of energy itself but rather on reducing the damage of using fossil resources. "We have to focus on the problem of taking carbon dioxide out of the atmosphere. That's a field at least worth exploring," he explained.

After these introductory statements, the moderators confronted the Laureates with a variety of questions from the audience. What might be the most likely technologies to overcome the storage problem for energy, the Laureates were asked. "Methanol certainly is one of the possible resources for energy storage," Gerhard Ertl explained. "By a fuel cell methanol can be converted into energy again. But the recent problem is that conventional fuel cells are poisoned by methanol." In reference to this, Robert H. Grubbs claimed that another possibility was rechargeable batteries,

and Walter Kohn proposed that the storage problem could be reduced by combining different resources, such as the wind and sun, within the same geographic area. "There are now mathematical studies going on how to optimize this mixture of different sources of energy."

We do not have the time.

The further question arose as to whether nuclear power can be an alternative to renewable energies. "It's the only interim technology that we know works at this time," Kroto admitted. "Not that we should use it, but I think it is almost inevitable that we shall. Human beings will clutch at any desperate measure to satisfy their present dynamics and I can't see how we can do much about that. It is a disturbing possibility." Walter Kohn agreed but considered the consequences were even more dramatic: "If nuclear energy should become a major direction in replacing oil and gas, the number of countries with hundreds of power plants would increase drastically. That would create a social and political circumstance with a huge probability of its leading to a catastrophe."

As the Laureates agreed that nuclear fission could be no real solution, the feasibility of nuclear fusion and the ITER-project were critically discussed. "ITER is intended to prove that a fusion reactor can be built." Ertl explained. "If it is successful in 30 years, then they will start to build the first reactor, which will take another 30 years. And there are still unsolved problems like the plasma-wall interaction and the waste which is then produced. No one can say if it will be successful. But I think we should continue this." Walter Kohn slightly disagreed: "We don't have the time. They say perhaps by the end of the century it might make a significant contribution. That's too late. We cannot depend on it." In reaction to this, Kroto referred to the available funding, which, in comparison to the magnitude of the problem, was certainly not enough. "How long will it be?" Molina asked, "We don't know. Still, it's reasonable for society to continue this investment because if it pays off, it will pay off big."

We do have a social responsibility.

Referring to F. Sherwood Rowland's introductory statement, the panel moved on to the issue of sequestration of CO₂. Molina stated that according to the MIT study, there were enough underground cavity spaces to store huge amounts of CO₂. This allowed us to continue using coal without letting CO₂ escape into the atmosphere. In this context the issue of transforming CO₂ into something else was raised and Ertl reminded the audience that "We should not forget that CO₂ is on the lower end of the energy scale. Whenever you want to transform it into something else chemically, you need energy. That won't help you!"

At the end of the discussion, all of the Nobel Laureates agreed that scientists generally had the responsibility to go out and speak to the public about environmentally important issues. "We do have a social responsibility," Mario J. Molina explained, "But we have to be wise about it." Referring to his support for President Clinton in 1997 and the still unsigned Kyoto protocol, Rowland stated that such efforts were not always crowned with success. However, Marcus was not willing to share this pessimistic appraisal and encouraged scientists to take action. "It can be done. When there is enough pressure and enough basic knowledge so that it is not only opinion, it can work."

PANEL DISCUSSION

SUSTAINABILITY AND CLIMATE CHANGE.



For the first time in the history of the Lindau Meetings, a panel discussion took place on the Isle of Mainau: "Sustainability and Climate Change".



With Friday's panel discussion, the 59th Meeting of Nobel Laureates came up with one final outstanding highlight just before the closing ceremony. The panel for the discussion, which took place on an open-air site on the Isle of Mainau, consisted of six experts from the fields of science and politics, moderated by Geoffrey Carr, Science Editor of "The Economist". The incredible summer heat, which even fans, hats and cool drinking water could not combat, made the perfect setting for a debate on the threat of global warming and the probable solutions mankind might come up with.

In order to get the panel going, Geoffrey Carr referred to the Copenhagen Conference in December, where a replacement treaty to the Kyoto Protocol is to be negotiated. "If that treaty is to do its job, it will prescribe who cuts what and when in terms of carbon dioxide production," he said and added that such cuts were only possible with new technologies made available and supporting environmental policies. These two fields, new technologies and appropriate policies were to be the major subjects of the discussion.

Romanticism or economic reality.

Before questions from the audience were dealt with, each panellist was asked to give a short introductory statement. Rajendra Pachauri, Chairman of the Intergovernmental Panel on Climate Change (IPCC) which won the Nobel Peace Prize of 2007, first of all clarified his understanding of sustainability. "Sustainable development is that form of development which meets the needs of the current generation without compromising the ability of future generations to meet their own needs." He then called on the world to realize the enormity of the problem. "This is not merely an issue that reflects the romanticism of environmentalists. This is something that is going to turn into economic reality," he claimed.

Bjørn Lomborg from the Copenhagen Business School, a well-known dissenting voice on the issue of climate change, struck a conciliatory note with his introductory statement. "We all agree that climate change is an important issue," he admitted. But referring to the fact that three-quarters of the world's population lived in what he called "medieval conditions", he then qualified his statement by adding, "Global warming is a problem we need to fix, but crucially it is not the most

important one." He stated that for a truly sustainable development, both aspects of this notion had to be taken into account. "Yes, let's please be sustainable but let's also please focus on development!" he said and invited governments rather to invest in research and future development than to waste efforts on inefficient technologies and international climate targets that would not be met.

A price on emissions.

Mario J. Molina, Nobel Chemistry Laureate of 1995, agreed with Lomborg in that erasing poverty certainly was one of the millennium goals. "But if we look at how this economic growth is happening, both in developing and developed countries, it's not in the right path. We are making climate change a lot worse," he explained. Nevertheless he seemed rather optimistic that a solution to this problem was at hand. "We can reduce emissions very drastically. But that means changing." For him an appropriate policy to start with would be to incorporate the costs of damage into the economic system. "There has to be a price on emission," he concluded.

State Secretary Cornelia Quennet-Thielen of the German Federal Ministry of Education and Research, insisted that it was important for governments to respond to the call for action expressed by scientists from all over the world. Germany had, for example, developed strong environmental policies and within Europe an emission trading scheme was established, Quennet-Thielen explained. "This kind of action has not hampered our economic development", she added. In response to Lomborg's statement, she concluded: "We would not like to sit back and wait for solutions in the future, neglecting the solutions that are already at hand."

Richard R. Schrock, who was awarded the Nobel Prize for Chemistry in 2005, pointed out the importance of chemistry. "Chemistry is certainly not an answer to all of our problems. But there are many problems that we can solve through chemistry." As examples of promising research fields he then referred to splitting water into hydrogen and oxygen just using the sun and artificial photosynthesis. "There is much to be discovered. There always has been and there always will be," were his encouraging words to the young researchers present.

Climate change is more than global warming.

Professor Thomas Stocker from the IPCC referred to the day's extreme heat and reminded the audience that extreme weather situations would be more and more likely to happen. "But climate change is more than global warming," he warned and left no doubt that other changes such as sea level rises or the changing water cycles and consequent water scarcity will have just as dramatic implications. To combat climate change, he suggested a global climate charter comparable to the human rights charters of former times. This charter should then include a globally binding climate target. "We need all countries on this planet by the year of 2050 to have reduced carbon dioxide emissions by 80%," he claimed.

After these statements, the panel entered into a lively debate, stimulated by questions from the audience. The main controversy between Lomborg and the rest of the panel arose when it came to the question of whether agreements like the Kyoto Protocol could solve the problem or not. "If you focus on cuts, you inevitably end up focusing on technologies that are premature." was Lomborg's criticism. "You also invest a lot in inventing loopholes, which a lot of the post-Kyoto process was about." The rest of the panel was much more convinced of the necessity of an international agreement. "The existing Kyoto is not a good example," Molina admitted, "but something can happen that imposes change."

Dictatorship for sake of environment?

An interesting question coming from the audience was whether the urgency of climate change required going beyond the limits of democracy. Here, all participants agreed that regulations certainly were necessary but democratic values had to be respected. "The best countries as far as environmental record is concerned, are the ones that practice democracy as faithfully as possible," Pachauri concluded.

As most of the discussion focused on the appropriate policies, and some new technologies like geoengineering and fusion were denied a prominent role, the Nobel Laureate, Roger Y. Tsien, picked up the audience's microphone and wanted to provoke a more technical answer with his question "Can you name some actual tangible areas of scientific and technical research that are not garbage to you?" he asked. The panel was however hesitant in giving a specific answer. "We have never been successful in dictating technologies," was how State Secretary Quennet-Thielen summarised the situation. It was ultimately the otherwise generally dissenting voice of Lomborg which identified the consensus view of the panel with an important message for the young researchers. "I think the panel agrees that what you should be looking at is not one technology. It should be solar, wind, fusion, fission, green energy technologies, second- and third-generation biomass fuels and even energy efficiency. It depends on you showing us that it works. And that it actually works better than what we have."



The 59th Meeting of Nobel Laureates dedicated to chemistry was a fantastic week and a unique chance for me, as young researcher, to broaden my view of Sciences in general and of Chemistry in particular by sharing ideas with Nobel Laureates. The whole meeting was so exciting; an occasion to satisfy my curiosity, learn more about time-management between researches, passions and family, to receive advice and make new contacts. I particularly enjoy the lectures, the scientific discussions and very important the interactions with other young scientists over the world, a great moment.

Alain C. Tagne Kuate, Cameroon



Indian participant Poornima Rangadurai performed for the audience a classical dance from Southern India at the traditional Get-Together Evening of the 2009 Lindau Meeting.

INDIA AS THE PARTNER COUNTRY OF THE 59TH MEETING OF NOBEL LAUREATES

After the state of North Rhine-Westphalia (2007) and the Free State of Bavaria (2008) in previous years, for the first time ever an international scientific partner presented itself at the Lindau Meeting. That happened on 29 June 2009, when the government of India ensured that top representatives of Indian research and culture made a lively and notable appearance at Lake Constance.

Throughout the whole day, Nobel Laureates and young scientists had the opportunity to get to know India better. After the Indian Minister for Human Resource Development Shri Kapil Sibal had participated in the meeting's opening on Sunday, on the following day the Indian Minister for Science, Technology and Earth Sciences, Prithviraj Chavan, travelled to Lake Constance.

Minister Chavan described the Lindau Meetings as "a unique forum, having an unparalleled legitimacy and inclusivity." He invited all participants to get to know India. "We have brought a large contingent to interact and discuss with other young researchers the issues of building bridges amongst themselves besides meeting their idols. I do believe that these young Indian researchers should mingle with their counterpart researchers from other countries as well as pass on as much information about India as they possibly can so that their foreign friends get a little more Indianised."

During the course of Monday evening, a young scientist from India, Tokeer Ahmad from the Jamia Millia Islamia University in New Delhi also presented his research work with his talk on "Nano-Materials: An Art of Synthesis". It was focused on how to fabricate different nano-materials in various shapes and sizes to make them more useful for the electronic and medical industries.

It was not only the science of India that presented itself during the course of the evening. Poornima Rangadurai, a young female scientist from the Stella Maris College in Chennai, performed for the audience a classical dance from southern India, the 'Bharatanatyam'. Dressed in her magnificent costume and accompanied by traditional Indian music, she brought the flair of India right into the Inselhalle of Lindau.

In Lindau, India presented itself to Nobel Laureates and young scientists from throughout the world as a modern centre of science and research. At the opening of the 59th Meeting of Nobel Laureates, the President of the EU Commission, José Manuel Barroso, announced that the European Union will be presenting European education and research as a partner of the 60th Meeting of Nobel Laureates.

The 2009 Meeting of Nobel Laureates - This is the best opportunity that I got in correct time, because now I'm going to start my research career. This gave me a chance to interact with Nobel Laureates, scientists and young researchers from other countries. I got more information about current research and I also found my research area of interest. Including this I enjoyed a lot the get-togethers and I'm proud to be one of the participants. Best part of the meeting was the Monday Get-Together and the dinner with Nobel Laureates where I was able to interact with many students and scientists.

Sridhar Arulmani, India



Indian flair at the Bavarian city of Lindau.



Indian Minister Prithviraj Chavan.



Young researcher Tooker Ahmad.



The Lindau Meeting this year has continued to be a wonderful incubator where – I want to believe - the careers of many young scientists are being shaped in a significant way. The intimate association with leading scientists, and as importantly, with peers coming from dozens of countries, cultures, and backgrounds, must infiltrate and leave a memorable impact on the future generation of scientists and on the way they shape it. The meetings have certainly influenced me, as the association with the young generation has shown me that the fire of passion, originality, and scholarliness is still going from strength to strength. The involvement of young students and fellows from developing countries, especially from Africa, gives hope that we are progressing towards a better world, where resources are shared, and where generation of new knowledge and fostering of education have become a top priority.

Aaron Ciechanover, 2004 Nobel Laureate Chemistry





Bavarian flair for an international audience at the Bavarian Evening on Thursday.

SOCIAL PROGRAMME

The Lindau Nobel Laureate Meetings are unique in the world. Apart from the top-class scientific programme (from p. 40), there is the important supporting programme which is an integral part of the meeting concept. The personal interactions between Laureates and young scientists which are encouraged here aim to educate, inspire and connect generations of scientists.

Welcome Parties.

This year too, the three welcome parties on Sunday evening gave all the young scientists a first opportunity to engage in conversations with their colleagues from around the world. At the invitation of Spielbank Lindau, the U.S. Department of Energy (DOE), the National Science Foundation (NSF), the Oak Ridge Associated Universities (ORAU) and Mars Incorporated, as well as the Foundation Lindau Nobelprizewinners Meetings at Lake Constance, personal contacts were made and discussions held at three different locations around the Isle of Lindau.

Get-Together Evening.

The traditional Get-Together Evening on Monday is a sign of the bond between the tradition and the future of the Nobel Laureate Meetings. This event has taken place since the meetings' inception, and it gives the Laureates and young researchers an opportunity to get to know each other better in an informal setting. This year, thanks to the meeting's partner country, India, the evening was given a touch of Asian flair. Besides the polonaise, there were also a number of traditional Indian dances performed for the guests' entertainment. German beer was served on the Indian-style terrace to the sounds of Indian pop music. In a short speech, an Indian participant, Tokeer Ahmad, presented his research work, and the Indian Minister for Science & Technology and Earth Sciences, Prithviraj Chavan, welcomed the guests and highlighted India as a centre of education and research.

Academic Partners' Dinners.

On Tuesday evening, a range of institutions invited Nobel Laureates and young scientists to small group dinners at a number of restaurants in Lindau. The evening was used by all participants for an intensive exchange of information and ideas and for getting to know one another. The German Research Foundation (Deutsche Forschungsgemeinschaft), the Alexander von Humboldt Foundation, the Max-Planck Society, the U.S. Department of Energy, the German Academic Exchange Service (Deutscher Akademische Austauschdienst – DAAD), the Nobel Foundation, the Elite Network of Bavaria (Elitenetzwerk Bayern), as well as the Helmholtz Association had all extended such invitations.

Henkel AG & Co KGaA, which had granted fellowships to more than 50 young scientists, also extended an invitation to an evening of social interaction. Sixty students from 20 countries as well as the Nobel Laureates Osamu Shimomura and Kurt Wüthrich accepted the invitation.

Paula Schramm, who was a member of the team writing the official meeting blog and took part in the Helmholtz Association's evening meal, was clearly delighted by it all. In her article she wrote, "At the end of the evening, everyone was quite exhausted because of all the input, but almost everyone seemed happy and satisfied. For me, this dinner is probably the highlight of the entire week and I'm delighted that the Helmholtz Association has made this possible for us."

Concert by the Verbier Festival Chamber Orchestra.

The Nobel Laureate Meeting and the Verbier Festival combine the idea of nurturing talented young people. On Wednesday eight young musicians from Australia, China, France, Israel, Serbia, Turkey, Hungary and the USA played the "Octet in F major for strings and wind D803" by Franz Schubert in the municipal theatre in front of an audience of the participants at the Nobel Laureate Meeting. The concert was arranged by Martin Engstroem, 'spiritus rector' of the Verbier Festival.



Young researchers at the reception given by Henkel AG & Co KGaA.



The Verbier Festival Chamber Orchestra.



Nobel Laureate Robert Huber guided through the Bavarian Evening.

Bavarian Evening.

This year again, the Free State of Bavaria and the Elite Network of Bavaria extended an invitation to attend a Bavarian Evening during the Lindau Nobel Laureate Meeting. Following the welcome by the Bavarian Minister of State for Sciences, Research and the Arts, Wolfgang Heubisch, the Nobel Laureate Robert Huber addressed some words of welcome to the guests. Afterwards, four members of the Elite Network of Bavaria had the unique opportunity to present their research work to the meeting's top-class audience. Musicians from Hintersberg and performers from Nußdorf wearing their traditional costumes enlivened the proceedings in the more informal part of the evening.

The Minister of State stressed the importance of the Nobel Laureate Meetings for the Free State of Bavaria in the following terms. "These meetings have a high priority for the State of Bavaria," and he invited the participants to get to know more about the state of Bavaria during the course of the evening. "Bavaria is more than scientific excellence. Bavaria is also a way of living," said Heubisch.

Nobel Laureate Robert Huber, a "genuine" Bavarian, presided over the evening. For him the most important topics of the evening were, in a nutshell, "Beer. Laureates. Young researchers." He told the participants that Bavaria and beer should be seen as synonymous and told them about the academic course of studies entitled 'Brewing and beverage technology' at the Technical University of Munich in Weihenstephan. He went on to say that the State had already produced 33 Nobel Laureates, including Wilhelm Conrad Röntgen, who received the first Nobel Prize in Physics in 1901. As he presented it to the up-and-coming scientists who were present, Bavaria is an ideal centre of science and research and he praised the funding opportunities there for budding young scientists.

The following members of the Elite Network of Bavaria presented their scientific work during the evening, following introductions by Nobel Laureate Robert Huber:



Culture and science were presented at the Bavarian Evening.

Stephan Reitmeier from the international doctorate programme 'NanoCat'

Andreas Karolewski from the elite programme 'Macromolecular Science'

Verena Herz from the international doctorate programme 'NanoCat'

Elias Puchner from the international doctorate programme 'Nano-Biotechnology'

A total of six members of the Elite Network took part in the 59th Meeting of Nobel Laureates in Lindau. Daniel Kluge from the University of Bayreuth was one of these and he wrote, "So what can I take from this? 'Lindau' is an experience that is unparalleled. Its motto – "Educate. Inspire. Connect." – hits the nail on the head and is, if anything, somewhat understated. In the lectures, you learn a great deal of informative things, which wasn't explicitly just technical in its nature. The discussions provided inspiration and motivation for activities within and outside of research."



Bavarian Minister of State for Sciences, Research and the Arts, Wolfgang Heubisch.



Elias Puchner and Verena Herz from the Elite Network of Bavaria presented their scientific work.



The Meeting of Nobel Laureates made me feel important and contented with my chosen career. It was a week of knowledge acquisition, exchange of ideas, exposure, inspiration, interaction and making international connections that I can never forget. The lectures opened my eyes to the beauty of chemistry in medical research and I went home with a better research focus and with a vision to become a female Nobel Laureate. I would have loved to hear a female Nobel Laureate present and also see more Africans as participants, but, overall, it was a lifetime experience.

Mary Bosede Ogundiran, Nigeria





Nobel Laureate Aaron Ciechanover and young researchers during the 59th Meeting of Nobel Laureates.



The state of Baden-Württemberg presented itself as a seat of science throughout the final day of the 59th Meeting of Nobel Laureates.

FINAL DAY ON THE ISLE OF MAINAU

The coming together of generations of scientists also formed the focus of the last day of the Nobel Laureate Meeting. Traditionally, this takes all the participants to the Isle of Mainau. As in 2008, the State of Baden-Württemberg once again played host. On the boat trip to the Isle of Mainau, young scientists and Nobel Laureates made equal use of the opportunity to get to know Baden-Württemberg as a centre of science. The State's universities presented themselves, as did numerous research institutes and innovative companies such as BASF and Boehringer Ingelheim. "Research, development and innovation form the basis of the social and economic success of Baden-Württemberg. The encouragement of the next generation of scientists and also the acquisition of outstanding students and young scientists from abroad play a vital role in this," Minister of Science, Peter Frankenberg said during his welcome speech on the "Sonnenkönigin", the most modern ship on Lake Constance.

For the first time, not only participants at the current meeting took part in the final day, but also former participants at the Nobel Laureate Meetings. In memory of the centenary of Count Lennart Bernadotte, the co-founder and 'spiritus rector' of the meeting, the Council and Foundation had invited 50 participants from previous decades to Mainau. Many of them have made their career in science and are themselves currently teaching at universities or working in company research laboratories. Some of those previous participants who had been invited had embarked on particularly long journeys in order to be there for the day – Countess Bettina Bernadotte welcomed former participants to Lake Constance who had come not only from the North of Germany, but also from India and the USA.

Panel Discussion: "Sustainability and Climate Change".

Once participants had arrived on the Isle of Mainau, an eventful day began. First of all, the scientific programme of this year's Nobel Laureate Meeting came to an exciting and interesting conclusion with the panel discussion on "Sustainability and Climate Change". With this panel discussion, the annual Nobel Laureate Meeting opened a new chapter in its almost 60-year history. Usually, the last day of the meeting is dedicated to a rather gentle trip to the Isle of Mainau. This year, however, the Laureates and numerous young scientists were able to listen to a highly political debate. In the castle gardens of Mainau, a top-class panel of personalities had assembled: Bjørn Lomborg from the Copenhagen Business School, Mario J. Molina, Nobel Chemistry Laureate of 1995, State Secretary Cornelia Quennet-Thielen of the German Federal Ministry of Education and Science, and Richard R. Schrock, Nobel Laureate in Chemistry in 2005, Rajendra Pachauri, Chairman of the IPCC, and Thomas Stocker from the University of Bern who co-chairs one of the working groups of the IPCC. The discussion was chaired by Geoffrey Carr, the Science Editor of "The Economist" magazine.

The topic of water – also the focus of the exhibition on the Isle of Mainau that was opened following the panel discussion – also played a part in the sometimes quite heated debate about climate. Rajendra Pachauri, Mario J. Molina and Thomas Stocker emphasized that climate change will not be restricted to an increase in temperatures: since sea levels will rise, coastal areas will become flooded, in many regions of the earth agriculture will change and for countless people clean drinking water will become even more valuable and scarcer than it is today. All these changes would bring with them major potential for conflict. Bjørn Lomborg, however, sees the situation as being less dramatic. Although climate change is indeed an important issue, it is surely not the biggest problem for mankind, he said. Hunger, thirst and disease are much more urgent for many people around the world. It was here that the available resources must be invested first and foremost.

Following a question from the audience about how we could best counter climate warming in terms of technology, the panel discussion ended with an appeal that ties in wonderfully with the spirit of the Lindau Nobel Laureate Meeting: the excellent young scientists gathered there should get involved in research into and development of technologies of the future. (A detailed summary of the discussion can be found on p. 65.)

Opening of the "Discoveries" Exhibition.

Following the panel discussion on "Sustainability and Climate Change", the State Secretary, Cornelia Quennet-Thielen (Federal Ministry of Education and Research) and Countess Bettina Bernadotte, the President of the Council for the Lindau Nobel Laureate Meetings, opened the "Discoveries" exhibition on the Isle of Mainau.

In 20 white pavilions, which were spread across the island on Lake Constance like spots of light, sustainability became tangible for young and old alike. The inflatable pavilions stood within a sea of sunflowers. They are made from recyclable material and are operated with air and solar power alone. Inside them, partners such as the Fraunhofer-Gesellschaft, the University of Constance or Mars Incorporated, brought science to life and invited young discoverers in particular to get involved. The German Maritime Museum in Bremerhaven also sent a fascinating contribution from the far North to the Swabian sea.

Countess Bettina Bernadotte described the exhibition as a contribution to the social debate about how to "put sustainability into practice" – an important task in view of the fact that much of the discussion still remained very theoretical. She was convinced that with this outreach initiative, it would be possible to interest a large number of visitors to the Isle of Mainau in the topics of science and research. In her opening speech, Countess Bernadotte thanked the Chairman of the Board of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance, Wolfgang Schürer, for coming up with the idea of this exhibition and his hard work in enabling it to take place on the occasion of the centenary of the birth of Count Lennart Bernadotte.



Countess Bettina Bernadotte (left) and State Secretary Cornelia Quennet-Thielen opened the exhibition "Discoveries" on the Isle of Mainau, accompanied by Rajendra Pachauri and Peter Frankenberg.

She gave special thanks to the Federal Ministry of Education and Research (BMBF) for its considerable financial backing for the exhibition and for its “German Research Expedition” initiative supporting 2009 as the year of science.

The Federal Minister of Research, Annette Schavan, was represented by the State Secretary, Cornelia Quennet-Thielen. She recalled the influence of Count Lennart Bernadotte, the ‘spiritus rector’ of the Nobel Laureate Meetings, and called him “one of the front runners in our country who pushed for environmental protection, for an integrated approach, and for all what we call today sustainable development.” With the “Discoveries” exhibition, said the State Secretary, “a new element will be added to the Lindau Meetings of Nobel Laureates”. The theme of the exhibition – water – was of particular importance for humanity. “Water is an issue of life”. More than a billion people do not have access to clean water – and it is a “huge task” overcoming this problem. “Certainly, technology is part of it,” said Ms. Quennet-Thielen.

Countess Bettina Bernadotte concluded by saying, “Such an exhibition needs inspired and convinced supporters. In this Public-Private-Partnership we have found them with the Federal Ministry of Education and Research, RWE AG, the Holcim Foundation and Mars Incorporated.” She also thanked Professors Bernhard Graf, the Chairman of the Scientific Advisory Board, and Jürgen Uhlenbusch, Member of the Council, and Andreas Gundelwein for their valuable work.

In the afternoon, the official tour of the exhibition took place. Accompanied by the State Secretary, Cornelia Quennet-Thielen, Nobel Laureates as well as guests of honour and young scientists, Countess Bettina Bernadotte guided the tour through the field of sunflowers, in which 12 out of the 20 pavilions were to be found. As part of the tour, Mars Incorporated presented a gift of three cocoa trees to the Isle of Mainau on Lake Constance. Pamela Mars-Wright, Member of the Honorary Senate of the Foundation Lindau Nobelprize-winners Meetings at Lake Constance, gave them to Countess Bettina Bernadotte in front of the pavilion



Peter Frankenberg, Science Minister of Baden-Württemberg, at the closing ceremony.



Sarah Bowman thanked on behalf of all young researchers for an unforgettable week.



Nobel Laureate Kurt Wüthrich congratulated the organisers to a successful meeting.

that Mars Incorporated had designed. (More information about the “Discoveries” exhibition can be found from p. 108.)

Official Farewell.

After the state of Baden-Württemberg had invited all participants of the 59th Nobel Laureate Meeting to a lunch, the official farewell took place in front of the castle on the Isle of Mainau.

In his speech, the Science Minister of Baden-Württemberg, Peter Frankenberg, emphasized that answers to the questions of our time can only be found when scientists around the world work together. “Challenges such as climate change can only be overcome when the cleverest minds in the world work together in order to find common strategies and solutions for sustainable development,” said Frankenberg. “That is why it is so important to attract talented young people to science and also interest them in exchanging thoughts and ideas with partners from other cultures and ways of thinking”.

On behalf of all the young scientists, Sarah Bowman (USA), from the University of Rochester thanked not only the organisers – the Council and the Foundation – for these unforgettable days on Lake Constance, but also the Laureates. “We thank the Nobel Laureates for your willingness to participate in the meeting, to tell us your stories, to share your science and other passions and to interact with us in such a personal way” The Nobel Laureate, Kurt Wüthrich, appeared impressed by the questions asked by the young researchers over the previous few days, and he wished them lots of success for their future careers in science. On behalf of the Nobel Laureates, Kurt Wüthrich congratulated the Council and Foundation on a successful meeting and thanked, in particular, the Bernadotte family for their hospitality.

Countess Bettina Bernadotte, the President of the Council, encouraged the participants of the 59th Meeting of Nobel Laureates to maintain the contacts they had established in Lindau and to make use of them for their own science projects. Then perhaps one day they could take part in the meeting once more – as a Nobel Laureate.

The Meeting of Nobel Laureates widely met my expectations. I enjoyed some wonderful days of high scientific quality and I had the opportunity to interact not only with the Nobel Laureates but also with talented young researchers from around the world. Undoubtedly, the slogan “educate, inspire and connect” fits perfectly to the sensations experienced in that unforgettable week.

Asier González, Spain



The 59th Meeting of Nobel Laureates

MAECENATES, SPONSORS AND PROJECT PARTNERS OF THE 'MISSION EDUCATION'



Bavarian State Minister Wolfgang Heubisch (left), Chairman of the Foundation Wolfgang Schürer, and President of the Council Countess Bettina Bernadotte after signing the agreement for a donation to the Foundation's endowment.

Lindau has a special place in the world's scientific calendar. It cannot be reproduced or copied anywhere else in the world. But tradition alone would not be enough. The Lindau Meetings have been successful in recent years in securing its foundations. The finances of the meetings are solid. At Lindau, a real public-private partnership has been established – thanks to the support of many busy people, leaders in their fields, who give freely of their time. The Foundation and the Council are grateful to the many who have supported the 'Mission Education', often over many years. They help to hold the Lindau Dialogue in trust for future generations. There is a new dynamism thanks to the energy, commitment and enthusiasm of these many supporters.

Endowment of the Foundation.

Even prior to this year's meeting, the Free State of Bavaria announced that it would be contributing € 80,000 in assistance for future meetings at an institutional level, along with a special one-off donation by the state, unique throughout Germany, given towards the foundation capital. Bavarian State Minister of Sciences, Research and the Arts Wolfgang Heubisch underscored the significance of the meetings: 'The Lindau Meetings for the cultivation of young talents in the sciences are the only such gatherings of their kind in the world. These meetings serve as a showcase to the world, promoting Bavaria and Germany as a setting for science.' The Free State of Bavaria invited all of the participants to an informative 'Bavarian Evening' in a spirit of scientific inquiry and Bavarian hospitality (see also p. 76).

The Microsoft Corporation, which also reached its donor status in the 'Maecenates' category in summer 2009, is one more globally active company committed to the Nobel Laureate Meetings. This places the US software company in the ranks of other international Maecenates. Likewise, Volkswagen AG promised a considerable donation of its own this year and is now a 'Principal Patron' of the foundation. New additions to our group of Donors are the GfK Group and the Alexander S. Onassis Public Benefit Foundation.

With this, the Foundation endowment currently totals to € 19.5 million. During the 59th Meeting of Nobel Laureates, however, Wolfgang Schürer, Chairman of the Board of the Foundation, muted the enthusiasm regarding the endowment somewhat: the sustained financial and economic crisis had practically cut the Foundation's interest income in half, and endowment proceeds covered only a fraction of total costs. The survival of the Foundation was not in jeopardy as a result, however. Donations in kind and the services of volunteers will remain indispensable for the foreseeable future. It will be several years before the Foundation will be able to shoulder half of the expenses of the meetings through interest income.

Project-Based Support.

The German Federal Ministry of Education and Research (BMBF) provided support to the Meeting of Nobel Laureates again this year – sponsoring the continued internationalisation and professionalization of the meeting in the process. The Ministry also served as the principal sponsor for the 'Discoveries' exhibition on the Isle of Mainau and facilitated inclusion of the exhibition in the 2009 Year of Research, 'Research Expedition Germany'. The BMBF provided funding for the entire infrastructure involved in the exhibition. In this way, the public-private partnership established for the Meetings of Nobel Laureates was successfully applied to another project initiated by the Foundation and the Council. With this exhibition, and in conjunction with their partners – EnBW Energie Baden-Württemberg AG, Holcim Foundation for Sustainable Construction, Mainau GmbH and RWE AG – the German Federal Ministry of Education and Research and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance made a lasting contribution to bridging the gap between the world of science and the general public (for more, cf. p. 108).

This year, the Fund of the Chemical Industry within the German Chemical Industry Association (Verband der Chemischen Industrie, VCI) helped 115 young researchers studying in Germany take part in the meeting. This model of support for German meeting participants was first implemented last year for participants in the field of physics (sponsored by the Wilhelm and Else Heraeus Foundation). The Council and Foundation hope to be able to garner the support of the Fund of the Chemical Industry again within the framework of the interdisciplinary meeting in 2010. When sponsors help assume the costs of participation, the organizers of the Nobel Laureates Meetings can direct their efforts to providing assistance to scientific talent from countries which are aspiring to develop their scientific landscapes, linking participation by top talents to their substantive qualifications alone. For the first time, OFID, the OPEC Fund for International Development, supported this mission with a donation.



Deutsche Telekom AG provided the Internet café of the meeting.



Lindau Alumni Thomas Müller-Kirschbaum (left) from Henkel AG & Co. KGaA with Nobel Laureates Osamu Shimomura and Kurt Wüthrich at the reception during the 2009 Lindau Meeting.



A special day for Nobel Laureates and their spouses was organized by Zeppelin GmbH.

During the past year, the website www.lindau-nobel.de was systematically broadened and developed on an ongoing basis. Thanks to the support of the International Lake Constance Conference (IBK) and the Free State of Bavaria, the website is increasingly evolving into a platform in which people with an interest in science the world over can take part in the Nobel Laureate Meetings. The IBK and the Free State of Bavaria provide assistance for live transmission of the scholarly programme during the meeting itself, and for keeping it available after the meeting.

As part of a unique project for the history of science, the Gerda Henkel Foundation provides assistance for the digitization, scholarly presentation and Internet posting of lectures held by Nobel Laureates in Lindau over the course of the past decades (for more about this project, cf. p. 116).

As a partner for the Nobel Laureate Meetings, the German State of Baden-Württemberg invited all of the participants to Mainau Island on the concluding day of this year's meeting. The State not only assisted with the programme of events for the day but also assumed a portion of the costs. Mars Incorporated was involved again this year – the meeting blog at www.scienceblogs.de/lindaunobel would not have been possible if it had not been for Mars' support. In addition to this, Pamela Mars-Wright, a member of the Honorary Senate of the Foundation, personally became involved in deepening the partnership between her company and the Lindau Meetings. This year, Henkel AG & Co. KGaA financed the attendance of 61 young scientists from all over the world. Henkel also invited its Fellows out to a dinner during the week of the meeting. Overseeing the exchange between their Fellows and researchers from within the company was in the hands of Thomas Müller-Kirschbaum, Corporate Senior Vice President for R&D, Technology and Supply Chain with Henkel's Laundry & Home Care business sector – and a Lindau alumnus from the year 1986.

This year's Nobel Laureate Meetings also enjoyed the support of the German Research Foundation (DFG), the Deutsche Telekom Foundation, EnBW Energie Baden-

Württemberg AG, the Jacobs Foundation, OFID – The OPEC Fund for International Development, Robert Bosch Stiftung GmbH, RWE AG and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance, which is also paying to offset the shortfall in view of the economic situation.

Donations in Kind.

Donations in kind help ensure a high standard for the meetings. Thanks to the assistance of well-known companies, Council and Foundation were able to satisfy the needs of the Laureates and young researchers for a modern meeting.

This year, Deutsche Telekom AG not only more than doubled the capacity of the Internet café for all attendees (compared to 2008) but also saw to it that all of the young researchers were perfectly well informed wherever they went: with the mobile telephones provided to them, not only were they able to go online, but they were also able to call up detailed information about Lindau using applications set up just for them.

Once again, the Volkswagen Group provided limousine service (Audi and VW) for the Laureates in attendance. All week long, 15 limousines equipped with modern, environmentally friendly technology were in use. Deutsche Lufthansa AG provided a considerable bloc of airline tickets to bring the Laureates to Lake Constance comfortably, safely and quickly. Two coaches for transportation were placed to the meeting's disposal by MAN AG.

Superb sound was available thanks to Sennheiser electronic GmbH & Co. KG. The high-quality sound system provided participants with outstanding acoustics in the Inselhalle and in the various venues where student discussions were held. The podium discussion on the Isle of Mainau, with 1000 audience members on hand, was very professionally looked after once again by Sennheiser staff who had come to Lake Constance for the purpose.

Hewlett-Packard provided again office equipment for the Executive Secretariat – state-of-the-art laptops, screens

and printers will serve the professional needs of the Lindau Meetings in years to come.

Thanks to the support of the City of Friedrichshafen and the donation in kind by Zeppelin GmbH, Nobel Laureates and their spouses were able to become acquainted with the Lake Constance region from an entirely new point of view. During the week of the meeting, two Zeppelin flights lifted off from Friedrichshafen for impressive sightseeing flights. Following this, guests received an exclusive sneak preview of the new Dornier Museum, which only opened several weeks after the 2009 Nobel Laureate Meeting.

Like in previous years, Business Wire supported the meeting's press relations by distributing press releases worldwide. EnBW Energie Baden-Württemberg AG provided bottled water for all participants – a much appreciated service.

Core assignment of the Foundation are: the investment of the foundation endowment, ongoing outreach to new donors and sponsors, acquisition of donations in kind, enhancement of the global network of Academic Partners and relations with leaders in governments and the private sector for enhancing Lindau's 'Mission Education'. As chairman of the board, Wolfgang Schürer launches the necessary initiatives, is dedicated to keep the senior level relations continuously updated and reaches out to gain new partners. He fulfils his tasks on a pro bono basis – adding up to more than 150 working days over the past 12 months.

As of April 2009, Nikolaus Turner who has been a member of the foundation's board since its creation in the year 2000, has assumed the newly created position of Managing Director of the Foundation. Together with the chairman, he will undertake further efforts to strengthen the 'Mission Education' (For more, cf. p. 131.).

In addition, Senior Research Fellow Andreas Böhm is making important contributions to our success within the office of the Foundation's chairman in St. Gallen.

The Lindau experience gave me inspiration and hope, new ideas and friends from around the globe! It was incredible to have discussions with the people who have surpassed the limits of common academic careers and to enjoy the peaceful and beautiful environment of Lindau island. At this stage of my research path it was extremely useful, since it reminded me the reasons why I began to study on this field and it cultivated my enthusiasm towards future accomplishments.

Christophoros Christophoridis, Greece.



Nobel Laureate F. Sherwood Rowland in discussion with young researchers.

MAECENATES, PATRONS, DONORS

The Lindau Nobel Laureate Meetings would like to thank all Maecenates, Patrons and Donors for their contribution to the endowment of the Foundation.

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The Lindau Nobel Laureate Meetings would like to thank all Benefactors for their support of the 2009 Lindau Meeting in Chemistry.

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COMMUNICATIONS AND MEDIA WORK



Al-Jazeera's "Understanding Tomorrow" reported from Lindau.

The international flavour of the meeting is reflected in the international diversity of the reporting. More than 100 journalists from 30 countries reported on the 59th Meeting of Nobel Laureates. The meeting has expanded its online presence, as the successes and experiences of the previous years have been added to. Contacts with science journalist associations in Europe, the USA, Latin America and the Arab states have once again played an important role in giving the Nobel Laureate Meeting an international profile. The core theme of sustainability, which was dealt with from a range of perspectives in panel discussions and lectures at the meeting, met with a broad response in the media.



100 journalists from 30 countries covered the 2009 Meeting.

Focus: Online Communication.

The communication activities were characterised by a main focus on the online sphere. The official meeting blog www.scienceblogs.de/lindaunobel, Twitter, Facebook, the online debate at www.economist.com and the live stream of the scientific programme on its own dedicated website – never before have the meetings opened themselves up so far to those people around the world who are enthusiastic about science. The expanded online presence also makes the meeting a real experience for those who are not in Lindau. Discussions take place not only in enclosed groups there and then, but are also supplemented by online debates and broadcast in real time to the outside through services such as Twitter. The Nobel Laureate Meetings were assisted in this by the science journalist, Beatrice Luger.

In the future, online-based applications for science communication will play an increasingly important role. They provide totally new access to knowledge and new forms of interaction, which promote the process of scientific communication. Consequently, the Nobel Laureate Meetings will be making use of the resulting opportunities for the Lindau Dialogue in the sense of their 'Mission Education', and the experiences from this year will be of great help.

Facebook and Twitter.

Social communities such as Facebook are one possible way of bringing the Nobel Laureate Meetings to the attention of those people around the world who are interested in science and continuously providing them with all the news from Lindau. In association with this year's meeting, 600 members of Facebook have already registered themselves for the "Lindau Nobel" group. These include many of those participating at this year's meeting, but also young scientists who have taken part in one of the meetings in previous years. The hope is that this group will grow with each meeting.

Official Meeting Blog:

WWW.SCIENCEBLOGS.DE/LINDAUNOBEL



Now, the Nobel Laureate Meetings are also twittering at www.twitter.com/lindaunobel. In the run-up to the 59th Nobel Laureate Meeting, updates about the scientific programme and events during the meeting were posted there. Within only a very short space of time, more than 300 people interested in science had subscribed to this source of information. Twitter is a social network and is also described as a 'micro-blog'. Registered users – like the Nobel Laureate Meetings – can enter text messages with a maximum length of 140 characters and exchange information this way.

Official Meeting Blog.

This year, the official meeting blog reported from Lindau for the first time in two languages – German and English. With the support of Mars Incorporated, a comprehensive report from the 59th Nobel Laureate Meeting was to be found at www.scienceblogs.de/lindaunobel. Almost 30,000 visitors used the blog for information on the meeting.

The team of authors comprising seven bloggers was there live throughout the meeting: Ashutosh Jogalekar (USA), Matthew Chalmers (Great Britain) and from Germany: Tobias Maier, Paula Schramm, Oliver Schuster, Jessica Riccò and Marc Scheloske. Beatrice Lugger, a proven expert in online communication, assumed editorial control of the blog.

Besides reports on individual lectures and panel discussions as well as extensive video interviews with Nobel Laureates, the special atmosphere of Lindau was also documented within the blog. The bloggers were also there when Nobel Laureates and young scientists met in small groups for lunch or dinner and set off by boat to the Isle of Mainau.

In addition to providing reports and interviews, JoVE – the Journal of Visualized Experiments – also conducted video interviews with Nobel Laureates. These can be accessed free of charge via the blog and have also been incorporated into the JoVE database. JoVE became the first and only video-based scientific journal to be indexed in MEDLINE and PubMed, the official repositories of the National Library of Medicine (NLM) at the National Institute of Health (NIH). The interviews produced in Lindau will be referenced and archived there for the future.

The blog was represented both on the German science blog page as well as on the American parent page www.scienceblogs.com. This was founded by the Seed Media Group in January 2006 and is the world's biggest blogging community, comprising more than 70 researchers and science journalists. Since the beginning of 2008, ScienceBlogs.de has been a valuable addition to the international community. Thirty blogs are now active on the German platform.



The Lindau Nobel Laureate Meeting 2009 has been a thoroughly satisfying experience for me. It exceeded my wildest expectations and gave me fond memories to cherish. The meeting was like a scientific fair where every moment was a learning experience. My participation in a documentary by NATURE also gave me a chance for personal interaction with Nobel Laureates. A fairy tale week. I believe that provision of Muslim food and plain water at the meeting will be a marked improvement.

Faroha Liaqat, Pakistan

Cooperation with "Nature".

Nature Publishing Group (NPG) and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance have signed an agreement to collaborate in the production of online videos of this year's Lindau Nobel Laureate Meeting on Chemistry. The videos, hosted and made freely available on NPG's website nature.com, one of the world's most renowned scientific websites, will feature one-on-one, two-on-one or three-on-one discussions between individual Nobel Laureates and selected young scientists from among the 580 young scientists from all over the world participating in the Lindau Meeting. The formal agreement between the Lindau Foundation and NPG follows a successful pilot project last year where NPG produced and published online videos of the Nobel Laureate Meeting at Lindau on physics.

In the 10-minute reports, the film team led by Martin Freeth, Adam Rutherford, David Wilde and Charlotte Stoddart succeeded in capturing the special atmosphere of the Lindau Meetings. Together with an introductory film, these films are available online at www.nature.com/lindau.

The Economist Online Debate.

For the first time, the Nobel Laureate Meeting participated in an online debate on the website of "The Economist" magazine. Complementing one of the main areas of focus at the meeting in Lindau, the discussion on www.economist.com was fully devoted to the debate about sustainability. Under the heading of "This house believes that sustainable development is unsustainable", Nobel Laureate Peter Agre from the Johns Hopkins Malaria Research Institute, and David G. Victor from the University of California conducted their discussion. The debate lasted seven days and was regularly supported by guest comments from Robert Axtell (Department of Computational Social Science, George Mason University), Jillian L. Dempsey (Graduate Student in Chemistry at the California Institute of Technology and participant at the Nobel Laureate Meeting 2009), Jürgen Kluge (Director of McKinsey) as well as Annette Schavan (Federal Minister of Education and Research, Germany).

"nobel reactions" – Six educational films by Nature show interactions and discussions between Nobel Laureates and young researchers at the 2009 Lindau Meeting.

Breaking down Alzheimer's with Aaron Ciechanover

Alzheimer's disease is caused by abnormal clumps or aggregations of proteins in the brain. Simon Pöpsel is about to embark on PhD work on a protein that might help us to treat this devastating disease, and Nobel Prize winning biochemist Aaron Ciechanover is clearly excited by his ideas.

Nanotechnology: Use and misuse with Sir Harold W. Kroto

Sir Harold W. Kroto won the Nobel Prize for discovering the football-shaped fullerenes, strangely-structured carbon molecules also known as buckyballs. These molecules led to the development of carbon nanotubes and the burgeoning field of nanoscience. But young chemists Stephanie Benight and Maher El-Kady want to know how we can use buckyballs in the future, and whether we should be worried by some aspects of these new nano-scale technologies.

Smart drugs and sneaky microbes with Peter Agre

Young scientists like Maartje Bastings are set to revolutionise the way we deliver drugs. Her work will aid the development of 'smart drugs' which target specific proteins in the membranes of particular cells, proteins like the aquaporins discovered by Nobel Laureate Peter Agre. But medical science is also facing huge challenges, as we hear from Australian chemist David Jacques who's battling with drug-resistant bacteria.

Seeing green

with Roger Y. Tsien and Richard R. Ernst

The 2008 Nobel Prize in chemistry was awarded to Roger Y. Tsien and colleagues for work on the green fluorescent protein (GFP). This protein, originally found in jellyfish, enables scientists to track the activity of individual proteins within living cells. But student Tyler Arbour is worried that sometimes, using GFP as a label is messing things up. Can Roger Y. Tsien put his mind at ease? Tyler also has questions about science education for Chemistry Laureate and Tibetan art enthusiast Richard R. Ernst.

Catalysts and collaboration

with Richard R. Schrock

Catalysts facilitate almost every reaction in the human body. They also enable us to make all kinds of molecules in the lab, and few people have contributed more to this field than Richard R. Schrock. Can he help Norwegian student Christer Øpstad to catalyse reactions with his carotenoid molecules? And what will happen when another young chemist, Jeffrey Lancaster, proposes a collaboration with this Nobel Prize winning chemist?

Climate change: The two degree target

In December, policy makers will meet in Copenhagen, Denmark, to thrash out a new global deal on climate change. The aim is to limit global warming to two degrees Celsius above pre-industrial temperatures. We sent three young climate researchers along with *Nature's* Olive Heffernan to find out just how much of a challenge this ambitious target will be. Join them as they seek advice from climate experts including the IPCC's Rajendra Pachauri, challenge the sceptical views of political scientist Bjørn Lomborg, and learn lessons from the Nobel Laureates who showed that CFCs were destroying the ozone layer.

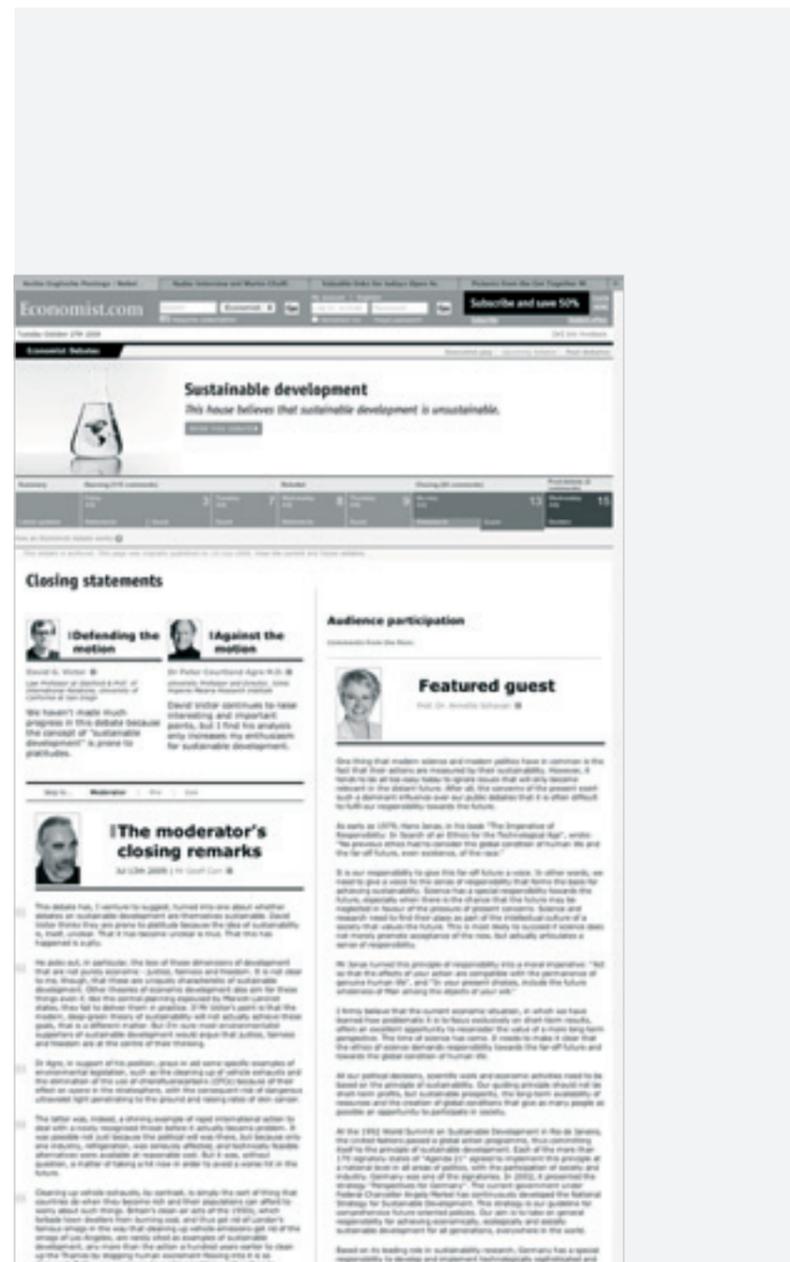
The screenshot shows the 'naturevideo nobel reactions' page. At the top, there's a banner for Mars, Incorporated. Below that, the page title 'naturevideo nobel reactions' is displayed. A navigation menu includes 'Home', 'Publications A-Z Index', and 'Browse by subject'. The main content area features a video player and a list of video summaries with dates and titles. The footer contains 'Related Links' and contact information for NPG.

Peter Agre argued against the motion: "With apologies to English teachers everywhere, my position on this statement is the double negative—"sustainability is not unsustainable." David G. Victor defended it: "Sustainable development is a beautiful-sounding idea that has become intellectually bankrupt and should be abandoned." Geoffrey Carr, Science Editor of "The Economist", moderated the vigorous debate (just as he did at the debate on the Isle of Mainau). In his introductory comments on the initial statements given by Agre and Victor, he summed up their viewpoints as follows. "The past, of course – as advertisements for investments are always enjoined to point out – is not necessarily a guide to the future. So it comes down to whether you bet on a way (sustainable development) that would certainly solve the climate-change problem if it could be implemented, but which would be hard to persuade people to act on (Agre), or choose to rely on innovations that will happily be adopted if they become available, but do not yet exist, and might never do so (Victor)."

The entire debate, including the opening statements, rebuttals and concluding comments from Agre and Victor, the guest comments and the feedback from the online audience is available at: <http://www.economist.com/debate/overview/148>. There, you can also see the result of the online survey: 41% of the users agreed with the motion that sustainability is not sustainable, 59% of the users were against it.

EBU, TV and Al-Jazeera.

The European Broadcasting Union (EBU) once again broadcast live from Lindau to all TV stations in Europe. In addition, it also made the high-quality live stream available at www.lindau-nobel.de. The lectures shown there were incorporated into the website's mediathèque after the meeting, where, together with the contributions from previous Nobel Laureate Meetings, they form a unique archive of scientific history. (See also the article about the historical lectures from p. 116.)



Impression from the "Economist Online Debate" on sustainability.

Apart from the EBU team, TV stations from Germany, Malaysia and Thailand also reported directly from the Nobel Laureate Meeting. The Arab TV station Al-Jazeera dedicated its science programme "Understanding Tomorrow" to the Nobel Laureate Meeting and made recordings in Lindau. This weekly science show reaches about 40 million viewers each week. Jay Tuck from Airtime Dubai (<http://airtime.ae>), Executive Producer of the show, and his team produced a thirty-minute science special, including extensive interviews with the Nobel Laureates on subjects ranging from global warming to the responsibilities that scientists bear



The Meeting might be the best organized and festive scientific event I have ever been to. I am grateful to the Nobel Foundation for the chance. I should also thank Nobel Laureates who were so enthusiastic to share their thoughts with us and the friends I have met between young fellows.
Petr Vlasov, Russian Federation (nominated by the Nobel Foundation, Stockholm)

for the discoveries they make. Many of the participants were questioned about the Arab world and the perspectives for its young scientists. The entire programme is available online at YouTube: <http://www.youtube.com/watch?v=6uOVda7CG6k>.

Al-Jazeera's documentary channel Al Jazeera Mubasher also gave a live broadcast of the panel discussion on "Global Warming and Sustainability". Thanks to the broadcasting technology of the European Broadcasting Union and with the support of Jay Tuck (Airtime Dubai), it was possible to make this broadcast at very short notice.

The radio reports were also further expanded this year. Together with the multimedia agency BundB-Medien, ready-to-broadcast reports on the opening ceremony and on the theme of climate change were produced, and interviews with young scientists were conducted. The offer was taken up by radio stations around Germany and in all neighbouring states around Lake Constance. As a result, it was possible to reach more than 5 million listeners.

Thomas Ellerbeck, Spokesman and Member of the Council as well as Member of the Foundation's Board, is responsible for communications. The communications activities of the Nobel Laureate Meeting 2009 were planned and carried out by Christian Rapp, communications officer at the executive secretariat in Lindau. In the months immediately preceding the meeting, he was assisted by a hard-working team: Gila Birk, Felice Puopolo, Maria Regele and Lisa Suckert. This year too, the scientific content of the meeting was prepared in advance for journalists by the science journalist, Joachim Pietzsch.



Press conference of the Council and the Foundation during the 2009 Lindau Meeting, with Andreas Kreimeyer, the Chairman of the Chemical Industry Fund and Member of the Board of BASF SE.

International Press Coverage



Two commentaries from Nature Chemistry (November 2009)

Martin Chalfie*: Learning from students at Lindau

Jeffrey R. Lancaster*: Looking back on Lindau

"As informative and thought provoking as these lectures were, the real high points of the meeting, to me, were the discussions with the students. (...) They wanted to know details of the experiments and they wanted to discuss potential future experiments. Conclusions about my research that had taken me years to realize (and which I have not written about or described in my talk) were instantly suggested by several of the students at the session. Seeing their excitement and quickness was humbling, but also invigorating. These conversations about the work continued through to the end of the meeting (including on the trip to Mainau), and I was impressed by how intelligent and interested the students were. I wanted all of them to come to my lab."

"The second benefit of being chosen to attend these meetings, I think, is the acknowledgement it gives to young scientists, especially at a time when they do not get much recognition, that they are on their way to succeeding in science, and that we think that they are important. Although they really do not need any seal of approval, everyone likes to get the occasional pat on the back. The Lindau Nobel Laureate Meetings do a terrific job of giving that pat on the back."

* Nobel Laureate, Chemistry 2008 (USA)

"However, two subtle points have ultimately distinguished the Lindau Meeting for me as a unique event of which I was honoured to have been a part. First, conversation and the sharing of ideas were fostered not solely between scientists with comparable levels of experience, but also across scientific generations and geographies. (...) Second, the activities pursued by scientists outside of publishable, academic research also featured prominently at the meeting."

"The Lindau Meeting is one of a special set of hagiographic celebrations that recognizes and reinforces our collective scientific history. (...) We gathered in Lindau to honour the heroes in our field, to try and gain something from interacting with them, and to hear from the scientists themselves how history 'actually' developed."

"As much as the conference is centred on the Laureates, I believe that the true focus was on the young researchers. Through shared experiences such as this we are able to distil what it is to be a scientist, and in that we recognize our identity as scientists. (...) This is one of only a handful of events that shapes our understanding of what it means to be a scientist, what our place in society can be, and how it feels to be part of a global community of researchers sharing a passion for science."

* Participant 2009, Columbia University (USA)



Looking back, this was more than I have ever expected! It was a week full of impressions and emotions influencing me: meeting different people from around the world, making new friends, having fun with them, discussing with Noble Laureates so close, catching their passions, getting inspired and even more impressed. All together it was so intense – "my brain really felt like growing". Finally, there remains this feeling of being together, them and us, enjoying the relaxing and creative atmosphere at Lindau. I am deeply grateful for having been part of this! Thank you very much!

Tilmann Schulz, Germany

Read more articles about the 2009 Lindau Meeting on our website. Visit http://lindau-nobel.de/Media_Coverage.AxCMS?ActiveID=1223.

Exemplifying Apprenticeship: The Lindau Meetings

The tradition of apprenticeship has long and august roots. Through the millennia, young men and women wanting to acquire knowledge have travelled far and wide to learn at the feet of the masters of the trade. In China, India and Europe for instance, it was customary for students to travel hundreds or thousands of miles to take up residence in a city or university where the best practitioner in their field was to be found. The students hungrily lapped up the knowledge that the master had to offer. In return their existence was intimately intertwined with that of their teacher, with many of them living in the homes of their teachers and helping out with daily chores.

The apprenticeship tradition was a necessary one in ages where electronic communication was non-existent, relatively few books and papers were published, and actual physical contact was the only way for someone to learn. The tradition guaranteed the existence of “schools” of thought, perpetuated from one generation to another. We see this tradition blazing across the history of civilization, from the famous Aristotelian school to the more recent twentieth century school of Arnold Sommerfeld in Munich.

Indeed, apprenticeship was a visible part of the development of science in the twentieth century. Perhaps the most famous example that comes to mind concerns the development of physics and especially nuclear and quantum physics in Europe in the first half of the century. This development was epitomized by three outstanding schools and their leaders; Ernest Rutherford and his group at the Cavendish laboratories in England, Max Born and his group of young Wunderkinder at Göttingen and Niels Bohr and his band of acolytes in Copenhagen. An equally important school from the point of view of teaching was Arnold Sommerfeld’s school in Munich. Many of the best physicists of the century including Heisenberg, Pauli, Bethe, Oppen-



heimer, Rabi, Teller, Chadwick, and Gamow were products of these schools.

One distinctive and key feature of these schools was that its students carried the knowledge they had gained to different parts of the world and in turn educated their own students. Thus the tradition of apprenticeship was passed on not only through time but through space. For instance, Hans Bethe established an outstanding school of physics at Cornell University, partially based on Sommerfeld’s teachings. Robert Oppenheimer founded modern theoretical physics in the United States at the University of California, Berkeley, again using the knowledge he had inherited in

Europe. Today the collective that has been spawned by the original efforts of these stalwarts numbers in the thousands.

In other fields too, you find similar patterns. For instance, Julius Axelrod who won a Nobel Prize for his work on adrenaline and related substances inherited the mantle from Steve Brodie at the NIH. He in turn passed on the torch to Solomon Snyder at Johns Hopkins who in turn educated Candace Pert. Together, the Brodie school has given rise to many pioneers in the field of psychopharmacology.

Thus it’s clear that apprenticeship has been one of the most valuable modes of learning through the millen-

nia. However apprenticeship extends not only to a single individual or school but to an entire generation. It is the task of a particular generation to pass on its collective knowledge to the next, to point out the limitations and strengths in its own work. In today’s age the internet has accelerated the dissemination of knowledge by leaps and bounds. And yet there is a certain visceral satisfaction, and perhaps also a sense of nostalgia, in learning from actual physical contact. There is no better instance of how this can be done than the Lindau Meetings which have been organized for more than fifty years.

Every year since 1951, dozens of Nobel Prizewinners meet at Lindau along with more than 500 students chosen from universities and colleges throughout the world. The explicit goal is the “transfer of knowledge between generations” and this goal can only be seen as upholding the highest promise of apprenticeship.

The meetings exemplify many of the defining features of scientific inquiry; that science is essentially a global enterprise and that open inquiry between the most esteemed scientists and the youngest of students is not only possible but essential and valued. Most importantly, the meetings tell us that science is an infinitely interesting and open-ended search, with the younger generation pushing the boundaries of the necessarily incomplete knowledge acquired from the earlier generation. In incompleteness lies opportunity. And the Lindau Meetings should provide a unique opportunity for the transfer of knowledge. We should all look forward to them. See you again in 2010!

Author: Ashutosh Jogalekar,
one of the bloggers from the official meeting blog
www.scienceblogs.de/lindaunobel

Outreach Beyond the Lindau Meetings

THE EXHIBITION "DISCOVERIES" ON THE ISLE OF MAINAU	108
— The Idea	109
— The Opening	111
— A Resume	112
— Supporters and Exhibitors	115
THE MEDIATHEQUE WITH SIX DECADES OF LECTURES BY NOBEL LAUREATES	116
— Example: Lawrence Bragg at the 1968 Lindau Meeting	118
— Example: Rita Levi-Montalcini at the 1993 Lindau Meeting	119
SUPPORT FOR THE "TINY TOTS SCIENCE CORNER"	120
— Strong Partners	121
— Distinguished Visitors for Little Researchers	122



Nobel Laureate Walter Kohn in a discussion with a young scientist during the 2009 Lindau Meeting.

Outreach Beyond the Lindau Meetings

THE EXHIBITION "DISCOVERIES" ON THE ISLE OF MAINAU



20 pavilions offered insights into science and research related to water. In 2010, the focus of the "Discoveries" exhibition will be on energy.

2009: Water

2010: Energy

2011: System Earth

ENTDECKUNGEN
/DISCOVERIES
WASSER
/WATER

20
09

The Idea.

Count Lennart Bernadotte was intensely engaged with environmental and nature conservation issues as early as the 1950s and 60s. A milestone of his work was the "Green Charter of Mainau", which, based on his initiative, was formally adopted on 20 April 1961 by representatives from the worlds of politics, business and culture. 'The very foundations of our lives are endangered because vital elements of nature are being contaminated, poisoned and destroyed', the Charter observes – a sentence that retains all of its currency to this day. The manifesto describes the conflict between use and preservation of natural resources, thereby laying the foundations for a broad social discussion of the environment.

The co-founder of the Lindau Meeting of Nobel Laureates would have turned 100 this year. The memory of Count Bernadotte and his advocacy of scientific dialogue was not only the stimulus for this year's Nobel Laureate Meeting, it was also the inspiration for a new project by the Council and the Foundation as part of their 'Mission Education': the exhibition "Discoveries" on the Isle of Mainau, which took place for the first time this summer. It combines two issues that were close to the heart of Count Lennart Bernadotte: enthusiasm for research and commitment to nature and sustainability.

How can we treat the planet responsibly? Can we save valuable resources and conserve them for future generations? How can sustainability be incorporated into our everyday lives? The exhibition takes up these questions and shows the contribution made by scientific research to answering them. The exhibition, like the Lindau Nobel Laureate Meeting – which is also organised by the Council and Foundation of Nobel Laureate Meetings – would like to awaken an interest in science and research among young people. But unlike the meeting, where up-and-coming scientists meet Nobel Laureates, the "Discoveries" exhibition is deliberately aimed at the general public.



Impressions from the 2009 exhibition "Discoveries" which took place from July 3rd to August 31st at the Isle of Mainau.

The "Discoveries" exhibition is a three-year project. Each year, the focus of the exhibition is on a different area of sustainability research. In 2010, the spotlight will be on "Energy", and in 2011 visitors can take a voyage of discovery around "System Earth". This summer, the first exhibition dealt in detail with the sustainable treatment of the planet's most important resource: water.

The series of exhibitions is being funded largely by the Federal Ministry of Education and Research, which provided the infrastructure for the project. Federal Minister Annette Schavan took on the role of patron. The exhibition "Discoveries" was also part of the "Research Expedition Germany", an initiative in the Science Year 2009, which is promoting dialogue between the general public and the scientific community throughout Germany. Like the exhibition, its objective is to interest young people in particular in scientific research.

In a successful public-private partnership, EnBW Energie Baden-Württemberg AG, the Holcim Foundation for Sustainable Construction, Mainau GmbH and RWE AG, as well as the Federal Ministry of Education and Research, worked together with the Foundation Lindau Nobelprizewinners Meetings at Lake Constance – in support of a sustainable dialogue between the scientific community and the general public.

Expert partners from Germany and abroad developed and produced the contents of the exhibition. The contributors come from the fields of science, research, business and politics. Among them were the Fraunhofer Gesellschaft, the Helmholtz Association, the US Department of Energy, the Department of Science and Technology (Government of India) and Mars Incorporated (see also list on p. 115). In twenty white pavilions, they provided an insight into their research results and enabled visitors to explore the subject of water

in all its diversity. Is it possible to obtain water in a desert? How can tsunamis be predicted? Can concrete contribute to making the planet's oceans more bountiful? What do satellites tell us about the melting of the polar ice-caps? From often surprising perspectives, the exhibited projects, simulations and hands-on experiments revealed why water is such an important resource and how it can be protected in the long term.

Just as the exhibit focuses on the subject of sustainability, the pavilions themselves are paradigms of sustainable architecture. Designed by the Swiss architectural team DRKH Architecture (Dirk Hebel, Tobias Klauser, Leonard Kocan, Sascha Delz) with the support of Professor Marc Angélil from the ETH Zürich, the inflatable constructions were supported only by compressed air and recyclable material. The required energy was provided by solar cells.

The Opening.

The final day of the 59th Lindau Nobel Laureate Meeting took place on the Isle of Mainau. Count Lennart Bernadotte's centenary provided a celebratory context not only to bid farewell to the participants of the meeting but also to officially open the three-year exhibition series "Discoveries".

Following the panel discussion "Sustainability and Climate Change", which provided the thematic introduction, the ribbon to mark the official opening of the exhibition was ceremoniously cut by Countess Bettina Bernadotte (President of the Council) and State Secretary Cornelia Quennet-Thielen from the Federal Ministry of Education and Research. "Visitors, be they children, parents or grandparents, will find explanations of how sustainability could be put into practice," was how Countess Bernadotte explained the main objec-

On occasion of the exhibition's opening, Pamela Mars-Wright (right) from Mars, Incorporated presented two cocoa plants to the Isle of Mainau. The company was one of the exhibitors.



Many school classes visited the exhibition to learn more about water.

tive of the exhibition in the presence of Nobel Laureates, up-and-coming scientists, and guests of honour. "Water is an issue of life," said State Secretary Queneth-Thielen, and highlighted the significance of the subject: "In this part of the world we take it too much for granted. But more than a billion people have no access to clean water." The exhibition is thus designed to show how new technologies can help to conserve this valuable resource.

After the opening, Countess Bettina Bernadotte showed the guests of honour and Nobel Laureates around parts of the exhibition. She also accepted a gift of two cocoa plants from Pamela Mars-Wright, Member of the Board of Mars Incorporated, which will enrich the island's flora. (Further information about the final day on p. 81, a summary of the panel discussion "Sustainability and Climate Change" from p. 65)

A Resume.

It was a successful prelude to the three-year series of exhibitions "Discoveries", which could be seen for the first time on the Isle of Mainau between 3 July and 31 August 2009. During these two months, 250,000 visitors to Mainau gained new insights into scientific research dealing with every aspect of water. The exhibition appealed in particular to the scientists of tomorrow: in July alone, before the start of the school holidays, around 100 school classes visited the pavilions and took part in short guided tours. The teachers who accompanied these trips were supported with additional teaching material, which was developed exclusively for the exhibition by www.lehrer-online.de, an online portal for teachers. In order to give even more school classes from the Lake Constance area the opportunity to go on a voyage of discovery, the exhibition will open earlier next year and will therefore run for longer.

The "Discoveries" exhibition was also represented at the Konstanzer Wasserwoche (Constance Water Week). During the week, the science train "Expedition Future" stopped in Constance – after the organisers of the "Discoveries" exhibition persuaded the Federal Ministry of Education and Research to include the town in their itinerary. Since April the train has been touring through Germany, presenting insights into the world of tomorrow. Twelve themed wagons were dedicated to different research, environmental and working worlds: from the search for the origins of our world to the merging of biological, nano, information and cognitive sciences, through to the future of medicine, food, mobility and energy, the theme of the 2010 "Discoveries" exhibition. In addition to the train tracks, the road was also being utilised: two Science Trucks from the Federal Ministry of Education and Research provided additional discovery opportunities on the day of the opening.

For those who were thirsty for knowledge after visiting the exhibition, or who were interested in a particular aspect of the exhibition, the series of lectures "Discoveries on Wednesday" provided the opportunity for them to delve deeper into the world of water. Scientists of the exhibition partners explained their projects in more detail for everyone to understand, showed ways in which their research could potentially be applied, and were available to answer questions and to participate in discussions.

The specially created website www.mainau-entdeckungen.de gave potential visitors a comprehensive insight into the exhibition. Newspapers from the entire Lake Constance region reported on the exhibition, among them the Vorarlberger Nachrichten (Austria), the St. Galler Tagblatt (Switzerland) and the Stuttgarter Zeitung (Germany) – partly in extensive articles not only about the exhibition, but also about the panel discussion "Sustainability and Climate Change". Trade publi-



State Secretary Cornelia Quennet-Thielen being interviewed by Dirk Augustin (left) from German newspaper "Schwäbische Zeitung".

cations such as the Lebensmittelzeitung and the Handwerker-Zeitung also reported on "Discoveries". The targeted radio PR campaign reached almost 1.5 million listeners; in one particular promotion, free tickets to the exhibition could be won.

Preparations are already well under way so that the voyage of discovery can continue next year with the subject of Energy. Once again, various partners will present different aspects of the meaning of energy for our standard of living, from the need to save energy through to the generation of energy from renewable resources. The hands-on aspect in particular will be further expanded. In this way, schools and school groups can be involved and addressed in a more targeted way.

The Foundation Lindau Nobelprizewinners Meetings on Lake Constance, as the organiser of the "Discoveries" exhibition, would particularly like to thank Professor Jürgen Uhlenbusch, former vice-president of the Council, and especially the scientific advisory board with its chairman Professor Bernhard Graf, Director of the Institute for Museum Research/ Prussian Cultural Heritage Foundation in Berlin, for promoting and carrying out the joint project with professionalism and commitment.

"Discoveries" on the Isle of Mainau

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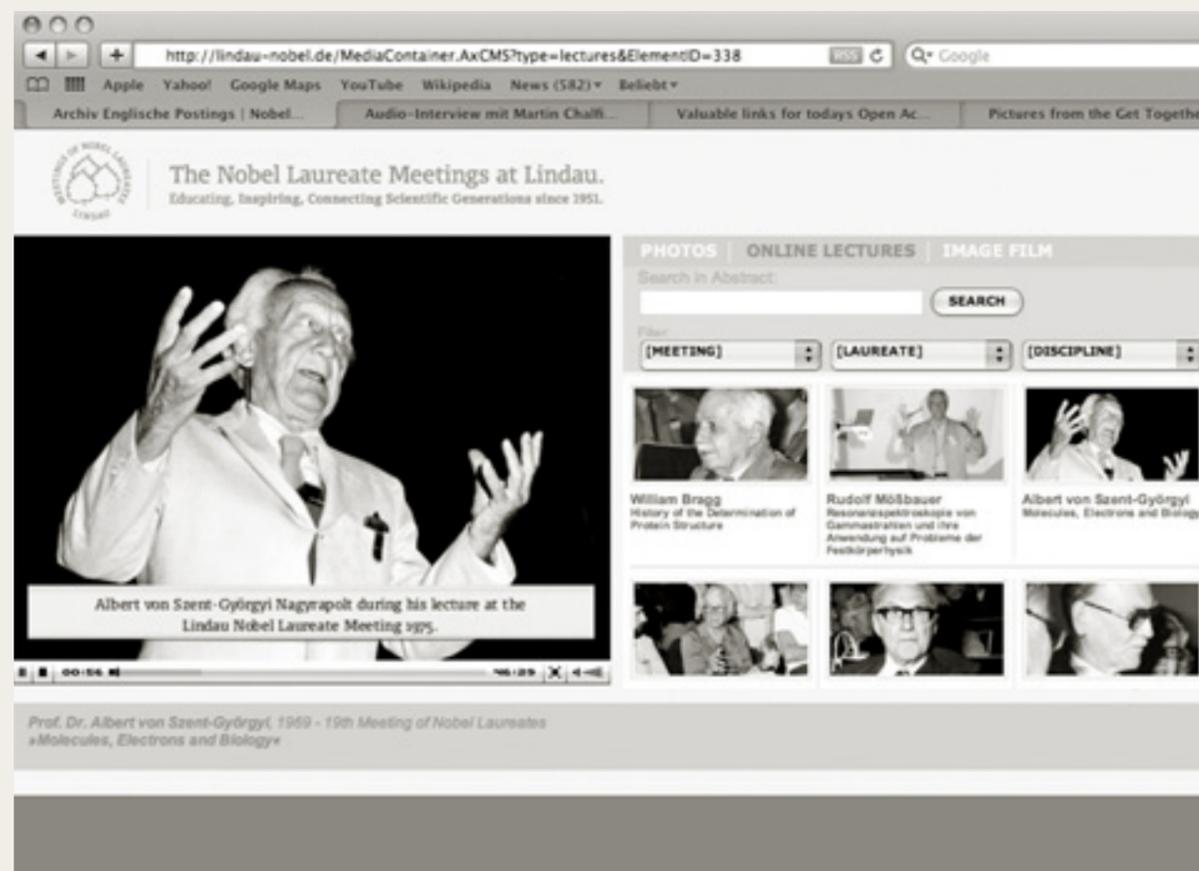
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Outreach Beyond the Lindau Meetings

THE MEDIATHEQUE WITH SIX DECADES OF LECTURES BY NOBEL LAUREATES.



The online mediatheque with lectures and the digitalisation of tapes were made possible by the Gerda Henkel Foundation.

The Mediatheque– Scientific History from Lindau.

The Nobel Laureate Meetings are commemorating the 100th birthday of their co-founder, Count Lennart Bernadotte (1909–2004), with the launch of a project in science history: lectures held by Nobel Laureates over the past six decades at the meetings in Lindau will be digitalised and made accessible online starting 8 May – Count Lennart’s 100th birthday – at www.lindau-nobel.de. Notable researchers like Rita Levi-Montalcini, Werner Heisenberg, Paul Dirac, Konrad Lorenz and James Watson will share their experiences – of working in the laboratory, or even of the pathway to making groundbreaking discoveries. Listeners will be able to understand their successes, failures, and unexpected detours. With the project, the Council and Foundation of Nobel Laureate Meetings encourage young people’s interest in science and research within their ‘Mission Education’.

The first eleven lectures – held at Nobel Laureate Meetings from 1968 to 1993 – have been accessible since 8 May 2009. The Nobel Laureate in Physics from 1915, Lawrence Bragg, describes the complexity of crystallographic processes for determining the structure of protein molecules in his lecture from 1968. Bragg had been focusing on this area of work together with scientists (and Nobel Laureates) like Max Perutz and Francis Crick since 1938. The second woman to win a Nobel Prize for Physiology or Medicine, Rosalyn Yalow (1977), can also be heard. Ragnar Frisch, who won the first-ever Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel along with Jan Tinbergen in 1969, offers an optimistic view of the potential uses for “Computer Science” – a method that still remains relevant today in the light of the current international economic crisis. Rita Levi-Montalcini (Physiology or Medicine, 1986), who was born the same year as Count Lennart Bernadotte and is celebrating her 100th birthday this year, discusses the “Magna Charta of Human Duties”. This catalogue of human responsibilities, whose preparation was in progress at the time, made it possible to effectively implement declarations on human rights.

This project in science history has been made possible by the Gerda Henkel Foundation. The first phase of the project began six months ago with the digitalisation of the audio documents – cassettes and audio tapes dating from 1951 to 2000 – and securing them for future use. The digitalisation process will be finished by summer. At the same time, Professor Anders Bárány (Stockholm) is simultaneously sorting through the comprehensive material to choose Nobel Laureate lectures that are suitable for publication on www.lindau-nobel.de. Professor Bárány then creates brief introductions to the audio files provided online, placing them in a historical context and providing a quick introduction to the lecturing Laureate. The lectures are available as Flash movies on the Mediatheque website. Each lecture is accompanied by photos of the Laureates at the Nobel Laureate Meetings. With great dedication, Anke Burzler working at the executive secretariat in Lindau is supporting Anders Bárány in his work and organizing the production of films.

Two Examples of lecture commentaries.

Lawrence Bragg (1890–1971)

The Nobel Prize in Physics 1915, together with his father William Bragg “for their services in the analysis of crystal structure by means of X-rays”

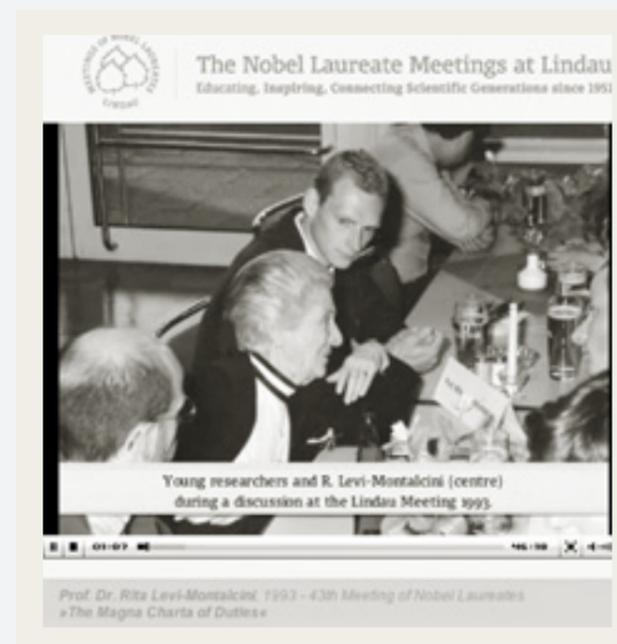
Lecture: “History of the Determination of Protein Structure” at the 18th Lindau Nobel Laureate Meeting (1968/Physics)

At the record low age of 25, Lawrence Bragg received the Nobel Prize in Physics 1915 jointly with his father. The young man had developed a theory for X-ray diffraction, which he and his father used to determine the structure of simple molecules, like NaCl.

In 1968, more than 50 years later, when Bragg for the first and only time visited the Lindau Meeting, he had a fascinating story to tell. In 1938 he succeeded Ernest Rutherford as director of the Cavendish physics laboratory in Cambridge. There a small group around J.D. Bernal had started to take an interest in the structure of protein molecules. A young Austrian, Max Perutz, had already started to study haemoglobin. Under Bragg’s enlightened directorship, the group expanded with John Kendrew (myoglobin) and Francis Crick and James Watson (DNA). During the 1950’s the structures of the complicated molecules were finally revealed. For this work, in 1962, Perutz and Kendrew received Nobel Prizes in Chemistry, while at the same time Crick and Watson received Nobel Prizes in Physiology or Medicine!

In his lecture at Lindau, Bragg describes the complexity of the crystallographic procedure. This starts with attempts to make usable crystals out of the biologically interesting large molecules. The crystals are irradiated with X-rays from all possible angles and the diffraction patterns are recorded on many thousands of photo plates. At the end, a mathematical treatment is needed to interpret the locations and intensities of the spots of the diffraction patterns. A haemoglobin molecule has about 10 000 atoms, which means that there are about 100 000 000 pairs of atoms, the relative positions of which have to be determined. Even with the help of the newly invented electronic computing machines, this turned out to be a formidable task. A measure of this task is, e.g., that it took Max Perutz 25 years to unravel the structure of haemoglobin!

By Anders Bárány.

**Rita Levi-Montalcini (b. 1909)**

The Nobel Prize in Physiology or Medicine 1986, together with Stanley Cohen “for their discoveries of growth factors”

Lecture: “Magna Charta of Duties” at the 43rd Lindau Nobel Laureate Meeting (1993/Medicine)

When Rita Levi-Montalcini for the first time visited the Lindau Meetings in 1992, she chose to speak on a theme which had a lot to do about her role as a scientist, but very little to do with the particular research for which she received the Nobel Prize in Physiology or Medicine. Instead she turned to the young people in the audience giving a progress report on a work that she had actively taken on a few years earlier. This work had as a final goal nothing less than a declaration like the United Nation’s Declaration of Human Rights, but this time concerned with a set of scientifically based Duties instead of Rights. The inspiration originally came from an article published in 1972 by her friend and colleague Roger Sperry, Nobel Laureate in Physiology or Medicine 1981, entitled “Science and the problem of values”. In the article, brain scientist Sperry argues that “the world we live in is driven not solely by mindless physical forces but, more crucially, by subjective human values. Human values become the underlying key to world change.”. At a small international meeting in Trieste organised by Levi-Montalcini in 1992, the first steps towards a declaration had been taken under the name “The Magna Charta of Duties”.

In her lecture, she reads from Sperry’s article, explains about the work and the arguments brought forward during the meeting and ends by reading the “axioms” making up the declaration. After her appearance in Lindau, work progressed and the declaration became in 1994 “A Declaration of Human Duties”, which was submitted to the United Nations. At the same time she set up an organisation IHCD, the International Council of Human Duties at Trieste, of which she is President. In 1997, this organisation received the status of “non-governmental organization in special consultative status with the Economic and Social Council (ECOSOC) of the United Nations”.

By Anders Bárány.

SUPPORT FOR THE "TINY TOTS SCIENCE CORNER"



H.R.H. Princess Maha Chakri Sirindhorn and Nobel Laureate Theodor Hänsch visited a kindergarten at Lindau during the 2009 Lindau Meeting.



Little scientists thanked their guest of honour for the visit.

Experiments are now taking place on Lake Constance, too. After the successful launch of the initiative "Tiny Tots Science Corner" in Berlin, several institutions in Lindau – the venue of the annual Nobel Laureate Meeting – joined forces three years ago in order to encourage an interest in experimentation among children. The aim is to awaken enthusiasm for an understanding of scientific phenomena, experiments and interrelationships among pre-school children.

Important principles for achieving this are the further training of pre-school teachers, who carry out the work in kindergartens (principle of sustainability), the use of everyday objects in the experiments (principle of cost-effectiveness), and encouraging children to carry out and describe the experiments themselves, so that they experience their own discoveries in a hands-on way (basic didactic principle). The project is being integrated into the curriculum of the federal states. The first series of further training events for pre-school teachers took place in 2007, and since then has taken place on a biannual basis in Lindau.

Strong Partners.

The work of the project is organised on a decentralised and voluntary basis by regional networks. When it was founded, the regional network of Lindau was the first of its kind in Bavaria. The Swabian Chamber of Industry and Commerce, the Lindauer Zeitung, the City of Lindau, the Lindau Public Services, the Sünfzen Association, TANNER AG and the Lindau Adult Education Centre joined forces for the Lindau initiative. The Council for the Lindau Nobel Laureate Meetings is supporting the initiative. The Executive Secretary of the Nobel Laureate Meetings, Andreas Gundelwein, also worked on a voluntary basis and with huge personal commitment to establish the regional network, which has meanwhile drawn the support of many businesses and organisations from the region.

The network partners are organising the further training for pre-school teachers in the Lake Constance area. Basic and further training courses take place on a biannual basis. In addition, the network is involved in

the Germany-wide "Day of Young Researchers" and organises regional "Researcher fairs" for children and their parents. Meanwhile, through its training, the network has reached 70 pre-school teachers in 26 kindergartens who care for around 1000 children in the region.

The project is continuing to grow. Thanks to the sponsorship of ETO Magnetic GmbH, there will soon also be a network in Baden-Württemberg, which will coordinate the work of the "Tiny Tots Science Corner" for the Lake Constance area.

Distinguished Visitors for Little Researchers.

The Physics Nobel Laureate Theodor Hänsch and the Thai princess Maha Chakri Sirindhorn convinced themselves of the fact that Lindau, with its Nobel Laureates, has many clever children as well as intelligent guests. Last year Nobel Laureate Peter Grünberg visited a "House of Young Researches" in Lindau during a meeting, and this year the young researchers could once again look forward to a visit from distinguished guests. The Kindergarten am Hoyersberg is taking part in the "Tiny Tots Science Corner" project. Together with their visitors, the children used water, sugar and food colouring to see how crystals dissolve and colours are mixed. The surface tension of the water was also examined.



Nearly 500 children and their parents participated in the "Researcher Fair" in October 2009.



The fair was organised by the Lindau network of the initiative "Tiny Tots Science Corner".



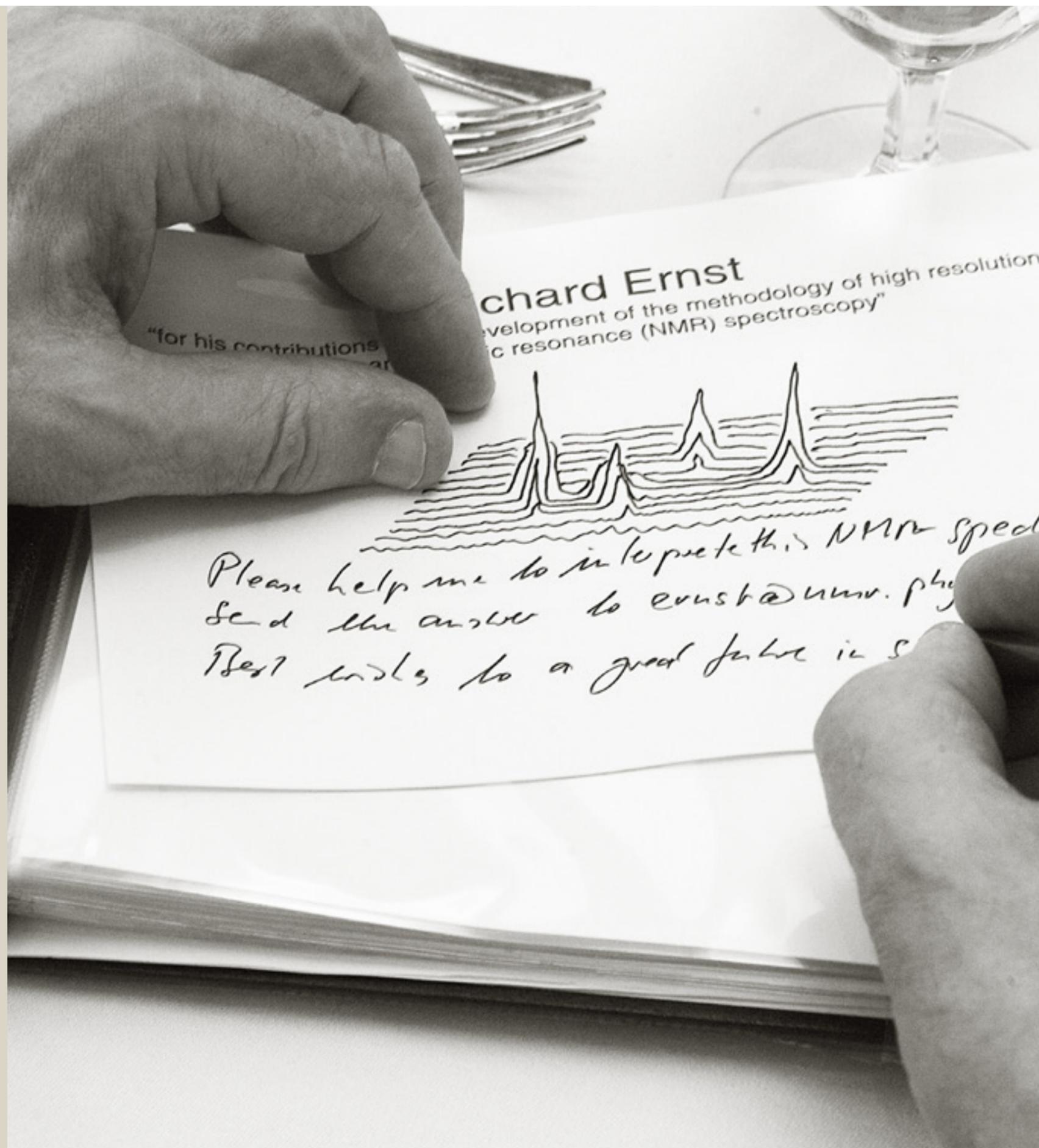
The aim was to awaken enthusiasm for an understanding of scientific phenomena.



The "Tiny Tots Science Corner" reaches 26 kindergartens in the Lindau region and is still expanding.

Organisation

- Council for the Lindau Nobel Laureate Meetings 126
- Foundation Lindau Nobelprizewinnersmeetings at Lake Constance 127
- 229 Nobel Laureates at the Founders' Assembly of the Foundation 128
- Working for the 'Mission Education' 130
- Preliminary Account of the 2009 Lindau Meeting 132
- Upcoming Lindau Meetings of Nobel Laureates 135



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229 Nobel Laureates are members of the Founders´ Assembly of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

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J. Michael Bishop	Ernst Otto Fischer	Louis Ignarro
Sir James Black	Robert W. Fogel	J
Günter Blobel	Jerome Friedman	Brian Josephson
Nicolaas Bloembergen	Milton Friedman	K
Baruch S. Blumberg	Robert F. Furchgott	Eric R. Kandel
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James M. Buchanan	D. Caletan Gajdusek	Wolfgang Ketterle
Linda Buck	Murray Gell-Mann	Har Gobind Khorana
C	Riccardo Giacconi	Lawrence R. Klein
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Steven Chu	Sheldon L. Glashow	Roger D. Kornberg
Aaron Ciechanover	Roy J. Glauber	Masatoshi Koshiha
Ronald H. Coase	Mikhail S. Gorbachev	Edwin Krebs
Stanley Cohen	Joseph L. Goldstein	Herbert Kroemer
Claude Cohen-Tannoudji	Clive Granger	Sir Harold W. Kroto
Leon Cooper	Paul Greengard	Finn Kydland
Elias Corey	David J. Gross	

L	Douglass C. North	Hamilton O. Smith
Willis E. Lamb	Ryoji Noyori	Michael Smith
Robert Laughlin	Christiane Nüsslein-Volhard	Oliver Smithies
Paul C. Lauterbur	Sir Paul M. Nurse	George F. Smoot
Leon M. Lederman	O	Robert M. Solow
David M. Lee	George A. Olah	Jack Steinberger
Tsung-Dao Lee	Douglas Osheroff	Joseph E. Stiglitz
Yuan Tseh Lee	P	John Sulston
Jean-Marie Lehn	Arno Allen Penzias	T
Rita Levi-Montalcini	Edmund S. Phelps	Henry Taube
Edward B. Lewis	William D. Phillips	Joseph Taylor
William N. Lipscomb	John Polanyi	Susumu Tonegawa
Robert E. Lucas Jr.	John Pople	Samuel C. C. Ting
M	Lord George Porter	Charles H. Townes
Alan G. MacDiarmid	Ilja Prigogine	Roger Y. Tsien
Roderick MacKinnon	Edward C. Prescott	Daniel C. Tsui
Sir Peter Mansfield	R	V
Harry M. Markowitz	Norman F. Ramsey	Simon van der Meer
Rudolph A. Marcus	Robert Richardson	Harold E. Varmus
Barry Marshall	Richard J. Roberts	Martinus Veltman
Toshihide Maskawa	Heinrich Rohrer	W
Eric S. Maskin	Sir Joseph Rotblat	Sir John E. Walker
John C. Mather	F. Sherwood Rowland	J. Robin Warren
Daniel L. McFadden	Carlo Rubbia	James D. Watson
Craig C. Mello	S	Thomas H. Weller
Bruce Merrifield	Bert Sakmann	Eric F. Wieschaus
Robert C. Merton	Paul A. Samuelson	Torsten N. Wiesel
Hartmut Michel	Bengt Samuelsson	Frank Wilczek
Sir James A. Mirrlees	Frederick Sanger	Maurice H.F. Wilkens
Rudolf Mößbauer	Andrew V. Schally	Robert Wilson
Mario J. Molina	Thomas C. Schelling	Kurt Wüthrich
Luc Montagnier	Myron S. Scholes	Y
Karl Alexander Müller	Melvin Schwartz	Rosalyn Yalow
Kary B. Mullis	John Robert Schrieffer	Chen Ning Yang
Robert A. Mundell	Richard R. Schrock	Muhammad Yunus
Ferid Murad	Reinhard Selten	Z
Joseph E. Murray	Amartya Sen	Ahmed Zewail
Roger B. Myerson	William F. Sharpe	Rolf Zinkernagel
N	Karl Barry Sharpless	
Yoichiro Nambu	Osamu Shimomura	
John F. Nash jr.	Kai M. Siegbahn	
Erwin Neher	Jens C. Skou	
Marshall Warren Nirenberg	Richard Smalley	

Words of Thanks.

The 'Mission Education' of the Council and Foundation for Nobel Laureate Meetings were successfully developed further in 2009. The 59th Lindau Nobel Laureate Meetings, the début 'Discoveries' exhibition on the Isle of Mainau, and the Mediatheque with lectures from the nearly 60-year history of the meetings – all of these projects are professionally realized by the staff of our Executive Secretariat in Lindau and of the office of the Chairman of the Foundation in St. Gallen, working with great commitment and personal dedication. For this, the members of the Council and of the Board of the Foundation are very grateful. The Executive Secretariat team includes: Andreas Gundelwein (Executive Secretary of the Nobel Laureate Meetings and coordination of the exhibition), Anke Burzler (Mediatheque), Anke Elben (Secretariat), Nadine Gärber and Sabine Harder (Young Researchers' Support), Christian Rapp (Communications, meeting and exhibition) and Susanne Wiczorek (Conference Management). Andreas Böhm and Karin Eijkelhof contribute to the realisation of the 'Mission Education' from St. Gallen.

The 2009 meeting was wonderful. It was the very best of the meetings I have ever attended. I was particularly impressed in the meetings with young enthusiastic students from Southeast Asia.

Osamu Shimomura, 2008 Nobel Laureate Chemistry



Working for the 'Mission Education'

Changeover in the Executive Secretariat for Nobel Laureate Meetings in Lindau.

Beginning January 2010, Wolfgang Huang will become the new Director of the Executive Secretariat for the Nobel Laureate Meetings. He joins us in Lindau from K.I.T. GmbH Association & Conference Management Group & Co. KG in Berlin, where as Head of Conference Logistics he was responsible for the organisation of international scholarly conferences worldwide.

Andreas Gundelwein, to date Executive Secretary of the Council for the Lindau Nobel Laureate Meetings, is ending his work in Lindau and will become Managing Director of the Center for Cluster Development at Freie Universität Berlin. He will continue to co-ordinate the 'Discoveries' exhibition on Mainau Island on behalf of the Council and Foundation. The Council and the Board of Directors of the Foundation thank him for his extraordinary commitment and successful teamwork, wish him all the best for his new challenge, and are pleased that they were able to gain his continued contributions on behalf of 'Discoveries'.

Nikolaus Turner is Managing Director of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

In April 2009, Nikolaus Turner has assumed the newly created position of Managing Director of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance. His new position will focus on the further development of the 'Mission Education', the internationalization of the Lindau Meetings and their participants, and on securing the independence of this internationally recognized forum. Turner has been the Managing Director of the non-profit Kester-Haeusler Foundation in Fürstfeldbruck/Munich since 1992.

As a Member of the Board of Directors, Nikolaus Turner has had close ties with the Foundation since its establishment through 50 Nobel Laureates in the year 2000. In addition to his new position, he will continue to remain active as honorary Treasurer of the Council for the Lindau Nobel Laureate Meetings. Turner will therefore contribute to further enhancing the cooperation between both institutions, which organize and hold the internationally unique encounters between Nobel Laureates and highly talented young scientists who have journeyed to the heart of Europe from all over the world.

Among other engagements as a recognized expert in foundation systems, Turner is a pro bono member of numerous organizations. He is the initiator and a member of the Advisory Board of the Community Foundation for the District of Fürstfeldbruck (Bürgerstiftung für den Landkreis Fürstfeldbruck). He has been a member of the Advisory Council for the Association of Foundations since 1998, where he chairs the Affinity Group for Community Foundations. He received the Federal Cross of Merit from Germany's Federal President for his honorary commitment in April of 2008.

Nobel Laureate Osamu Shimomura (with wife) and Bavarian Minister of State for Sciences, Research and the Arts, Wolfgang Heubisch.

Preliminary Account for the 59th Meeting of Nobel Laureates

(as of October 15th, 2009)

REVENUES		
Donations and funds from the public sector (Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst, Bundesministerium für Bildung und Forschung, Internationale Bodenseekonferenz IBK, The OPEC Fund for International Development (OFID), Stadt Lindau, UNESCO, U.S. Department of Energy), from institutions aiding the advancement of science (Deutsche Forschungsgemeinschaft DFG, Jugend Forscht, Stifterverband für die Deutsche Wissenschaft e. V., Wissenschaftsgemeinschaft Gottfried Wilhelm Leibnitz), from industry (Bayer AG, Boehringer Ingelheim GmbH, Deutsche Bank AG, Deutsche Telekom AG, EnBW Energie Baden-Württemberg, ETO Magnetic KG, Henkel AG & Co.KGaa, Mars, Incorporated, MS Management Service AG, ProLindau Marketing GmbH & Co. KG, RWE AG, Sparkasse Lindau-Memmingen-Mindelheim, Bayerische Lotterieverwaltung/Spielbank Lindau, Südkurier GmbH, Verband der Chemischen Industrie (VCI)) and charitable or non-profit organisations (Deutsche Telekom Stiftung, Deutsche Bank Stiftung, Eduard Rhein Stiftung, Fritz Thyssen Stiftung, Fonds der Chemischen Industrie, Gerda-Henkel-Stiftung, Jacobs Foundation, Klaus Tschira Stiftung gGmbH, Dr. Meyer-Struckmann-Stiftung, Peter-Dornier-Stiftung, Robert Bosch Stiftung GmbH, Stiftung van Meeteren, Wilhelm Sander-Stiftung and the Stiftung Lindauer Nobelpreisträgertreffen am Bodensee with its Mæcenates (Audi AG, Deutsche Bank AG, Ecoscientia Stiftung, EnBW Energie Baden-Württemberg AG, Freistaat Bayern, Mars, Incorporated, Microsoft Corporation, Dr. Ing. h.c. F. Porsche AG, RWE AG, SAP AG, Verband der Bayerischen Metall- u. Elektroindustrie), Principal Patrons (Bertarelli Foundation, Lonza AG, NOVARTIS International AG, Principality of Liechtenstein, Siemens AG, Südwestmetall Baden-Württemberg, Verein der Bayerischen Chemischen Industrie, Volkswagen AG), Patrons (BASF SE, Deutsche Telekom Stiftung, Klaus Tschira Stiftung gGmbH, Robert Bosch GmbH, Verein Deutscher Ingenieure VDI), Principal Donors (Holcim Ltd., Jungbunzlauer AG, LGT Group Foundation, Monika and Wolfgang Schürer, Synthes-Stratec Inc., Tchibo Holding AG (maxingvest ag), Hansjörg Wyss Medical Foundation).		
AMOUNT		862.922,00 EUR

Participant fees for young scientists taken over by benefactors and subsidies or reimbursements of lodging and travel expenses of young researchers: Academy of Finland, Academy of Sciences Malaysia, Academy of Sciences, France, Alexander S. Onassis Public Benefit Foundation, Alexander von Humboldt Foundation, A-Star University, Singapore, Audi AG, Biologie-Olympiade Baden-Württemberg, Carl Zeiss AG, COSCE – Confederación de Sociedades Científicas de España, Danish Agency for Science Technology and Innovation, Department of Energy (DOE), Department of Science and Technology in India (DST), Deutsche Telekom Stiftung, Elite Network of Bavaria, European Molecular Biology Organization (EMBO), European Science Foundation (ESF), Federal Ministry of Education and Research (Germany), Fritz Thyssen Stiftung, Fonds National de la Recherche, Fonds National de la Recherche Scientifique (FNRS), Foundation for Polish Science, Fraunhofer-Gesellschaft, Fulbright Commission, German Academic Exchange Service (DAAD), German Academy of Science and Engineering, Helmholtz Association of German Research Centres, Henkel AG & Co.KGaa, Hochschule Liechtenstein, Human Frontier Science Program (HFSP), Hungarian Academy of Sciences, Industrie-Club e. V., Industriellenvereinigung Wien, Japan Society for the Promotion of Sciences, King Saud University, Klaus Tschira Foundation gGmbH, Konrad-Adenauer-Foundation, Leibniz Association, Lorie Karnath, Mars, Incorporated, Max-Planck-Society, Dr. Meyer-Struckmann-Stiftung, National Council for Scientific and Technological Development (CNPq), National Science and Technology Development Agency, Thailand, National Science Foundation (NSF), Natural Sciences and Engineering Research Council (NSERC), Oak Ridge National Laboratory, The OPEC Fund for International Development (OFID), Royal Netherlands Academy of Arts & Sciences (KNAW), Russian Foundation for Basic Research, RWE AG, Siemens AG, Sino-German Center for Research Promotio, Slovenian Academy of Sciences and Arts, Südwestmetall, Swiss National Science Foundation (SNSF), The Lithuanian Academy of Sciences, The Royal Society of Chemistry (RSC), The Royal Society of New Zealand, UNESCO, U.S. Department of Energy, Vacheron Constantin, VDI – The Association of German Engineers, Verein der Bayerischen Chemischen Industrie, Verband der Chemischen Industrie (VCI).

AMOUNT	559.472,26 EUR
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TOTAL SUM OF REVENUES	AMOUNT	1.422.394,26 EUR
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Any deficit that may arise upon presentation of all costs as of December 31, 2009, will be balanced by an existing letter of indemnity provided by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

EXPENDITURES		
CONFERENCE VENUE		
Technical platform for venues	70.785,94	EUR
Rent conference venues & tent	48.985,28	EUR
SELECTION PROCESS		
Council costs for peer review process of participants	15.760,00	EUR
TRAVEL, LODGING & BOARDING		
General travel expenses (incl. grants for journalists)	29.132,11	EUR
Travel expenses for Nobel Laureates	70.091,46	EUR
Travel expenses for participants	20.970,66	EUR
Travel expenses for programme chairs and Council members	8.019,66	EUR
General boarding costs for academic guests	13.563,66	EUR
Boarding costs for Nobel Laureates	21.158,67	EUR
Boarding costs for participants	112.907,35	EUR
Boarding costs for Council members	1.442,53	EUR
General lodging costs (incl. grants for journalists)	58.007,00	EUR
Lodging costs for Nobel Laureates	32.922,00	EUR
Lodging costs for participants	186.034,63	EUR
Lodging costs for programme chairs and Council members	11.887,29	EUR
Expenses for Nobel Laureates	14.700,33	EUR
PRESS AND MEDIA		
Printing costs (e.g. Participants List)	62.815,90	EUR
External services (EBU, educational films, freelancers, media monitoring, database & computers etc.)	178.810,53	EUR
Translation and interpreting costs	23.655,10	EUR
INTERNET		
Internet (website & live-stream, database, global access, online-mediathèque, former participants)	103.804,66	EUR
GENERAL		
Postage	13.209,99	EUR
Telephone	3.629,98	EUR
Office equipment	13.887,79	EUR
Newspapers, books	354,50	EUR
Overheads for financial transactions	886,11	EUR
Insurances	5.741,03	EUR
Operating costs (rent, electricity, water etc.)	31.023,44	EUR
Accounting costs	9.906,49	EUR
STAFFING, WAGES AND SALARIES INCL. PAYROLL TAXES		
274.599,23 EUR		
Total sum of expenditures (until 15 October 2009)		
		1.438.693,32 EUR
Expected expenditures until 12/2009		
		53.300,00 EUR
TOTAL		
		1.491.993,32 EUR

Additional donations in kind and pro-bono services:

Artificial Image, Audi AG, Axinom GmbH, Big Image GmbH, Business Wire, Deutsche Lufthansa AG, Deutsche Telekom AG, Deutsche Zeppelin Reederei GmbH, EnBW Energie Baden-Württemberg, Fondation du Festival & Académie de Verbier, Gebrüder Weiss GmbH, Hewlett-Packard Development Company, L.P., Land Baden-Württemberg, Lennart-Bernadotte-Stiftung, Lindauer Zeitung, LISTA Office AG, Mainau GmbH, MAN AG, Mischel Computer, Mondi Europe & International, MS Management Service AG, Nobel Foundation, ProLindau Marketing GmbH & Co. KG, PwC Deutsche Revision, Sennheiser electronic GmbH & Co. KG, Stadtwerke Lindau (B) GmbH & Co. KG, Vacheron Constantin, Verlagsgruppe Handelsblatt, Volkswagen Group, Warth, Klein & Leutenecker, Zumtobel Lighting GmbH.



UPCOMING LINDAU MEETINGS

60TH MEETING OF NOBEL LAUREATES

(3rd interdisciplinary meeting with Nobel Laureates from the fields of Physics, Medicine or Physiology, Chemistry) from 27 June–2 July, 2010

61ST MEETING OF NOBEL LAUREATES

(dedicated to Medicine or Physiology) from 26 June–1 July, 2011

4TH MEETING IN ECONOMIC SCIENCES

from 23–27 August, 2011

Kuratorium für
die Tagungen
der Nobelpreisträger
in Lindau
Council for the Lindau
Nobel Laureate Meetings



Stiftung Lindauer
Nobelpreisträgertreffen
am Bodensee
Foundation Lindau
Nobelprizewinners Meetings
at Lake Constance

Council for the Lindau Nobel Laureate Meetings

Foundation Lindau Nobelprizewinners Meetings at Lake Constance

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